

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM4-10)	High Volume	RYG F50666	-	-	On site Calibration
Ambient	Particulate Matter (PM4-10)	High Volume	RYG F50662	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RYG F50186	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RYG F50188	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	Digital Balance	RYG EN0001	22-Feb-24	22-Feb-25	12
Ambient	Total Suspended Particulate	High Volume	RYG F50292	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG F50189	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG F50177	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG F50178	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO _x Analyzer	RYG F50252	2-Jul-24	2-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RYG F50459	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RYG F50255	2-Jul-24	2-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RYG F50272	2-Jul-24	2-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG F50251	4-Jan-24	4-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG F50458	5-Jul-24	5-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG F50454	4-Jul-24	4-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG F50332	5-Jul-24	5-Jan-25	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK F50143	20-Aug-24	20-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG F50531	29-Feb-24	29-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG F50545	21-Jul-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG F50608	18-Jul-24	18-Jan-26	18
Stack	Total Suspended Particulate	Console Control Unit	BKK F50468	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Console Control Unit	BKK F50556	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Pilot Tube	BKK F50561	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG F50563	26-Jan-24	25-Jan-25	12
Stack	Total Suspended Particulate	Digital Balance	RYG EN0003	22-Feb-24	22-Feb-25	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Standard gas	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RYG F50213	28-Feb-24	27-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG F50022	25-Jan-24	24-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG F50018	22-Jan-24	21-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG F50019	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG F50496	26-Jan-24	25-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50388	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50431	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50438	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50492	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50493	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50494	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG F50216	22-Oct-24	22-Oct-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50027	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50381	9-Oct-24	9-Oct-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50431	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50434	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50616	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG F50618	12-Jan-24	11-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50218	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50219	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50220	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50226	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50223	12-Jan-24	11-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50224	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50226	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50230	17-Mar-24	17-Mar-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50471	14-Mar-24	13-Mar-25	12
Illuminance	Illuminance	Lux Meter	RYG F50474	14-Mar-24	13-Mar-25	12



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG F50550	30-Jul-24	29-Jul-25	12
Rayong Lab	pH at 25 °C	pH Meter	RYG EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	BOD	DO meter with Sensor	RYG EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG EN0154	1-Nov-24	1-May-26	18
Rayong Lab	BOD	Burette	RYG EN0216	24-Sep-24	24-Sep-25	12
Rayong Lab	Oil & Grease	Electronic Balance	RYG EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RYG EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	COD	Spectrophotometer	RYG EN0132	14-Dec-23	14-Jun-25	18
Rayong Lab	Chloride	pH ISE Meter	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Cyanide	Spectrophotometer	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Formaldehyde	Spectrophotometer	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Phenol	Spectrophotometer	RYG EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RYG EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	Fluoride	pH ISE Meter	RYG EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG EN0189	11-Mar-24	11-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG EN0152	14-Dec-23	14-Jun-25	18
Water Lab	Calcium	CP-OES	BKK EN0037	29-Feb-24	28-Feb-25	12
Water Lab	Calcium	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Calcium	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Magnesium	CP-OES	BKK EL0037	29-Feb-24	28-Feb-25	12
Water Lab	Magnesium	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Magnesium	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Sodium	CP-OES	BKK EL0037	29-Feb-24	28-Feb-25	12
Water Lab	Sodium	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Sodium	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	SAR	CP-OES	BKK EL0037	29-Feb-24	28-Feb-25	12
Water Lab	SAR	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	SAR	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Chlorite	Ion Chromatography	BKK EN0069	12-Jan-24	12-Jan-25	12
Water Lab	Organochlorine Pesticide	GC MSMS	BKK EN0284	13-Sep-24	21-May-26	18
Water Lab	Anionic Surfactant	Spectrophotometer	BKK EN0018	13-Sep-24	13-Sep-25	12
Water Lab	Anionic Surfactant	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK EN0018	13-Sep-24	13-Sep-25	12
Water Lab	Silver	CP-MS	BKK EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Silver	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Silver	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Barium	CP-MS	BKK EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Barium	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Lead	CP-MS	BKK EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Lead	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Iron	CP-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	CP-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
Water Lab	Copper	CP-MS	BKK EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Copper	Hot Block	BKK EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cooling Room)	BKK EN0167	6-Dec-23	6-Jun-25	18



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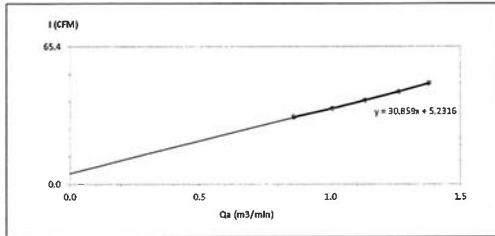
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Arsenic	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Selenium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Selenium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Cadmium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Zinc	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Trivalent Chromium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Mercury	Mercury Analyzer	BKK_EL0128	6-Dec-23	6-Dec-24	12



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่หิน/เหมืองแร่ (โรงโม่หิน) Temperature (°C) : 29
Calibrate Date : 20-Nov-24 High Volume ID : RYG-FS0666
Calibration Sheet No. : C-201124-RYG-FS0666 High Volume Model : TE-5009X
Calibrator ID : RYG-FS0205 High Volume S/N : 6259
Calibrator Model : TE-5028A Calibrator Slope : 0.95561
Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.6	0.860	32	Slope : 30.8592 Intercept : 5.2316 Correlation Coefficient : 0.9994
2	2.2	1.004	36	
3	2.8	1.130	40	
4	3.5	1.261	44	
5	4.2	1.379	48	



Calibrated by
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

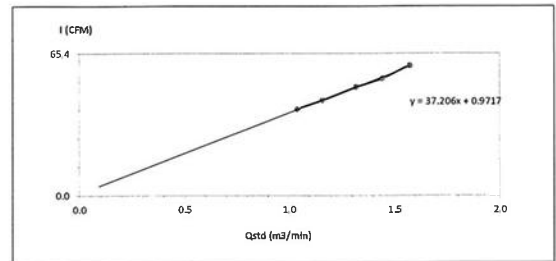
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่หิน/เหมืองแร่ (โรงโม่หิน) Temperature (°C) : 29
Calibrate Date : 20-Nov-24 High Volume ID : RYG-FS0662
Calibration Sheet No. : C-201124-RYG-FS0662 High Volume Model : TE-5009X
Calibrator ID : RYG-FS0205 High Volume S/N : 6259
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	1.0416	40	Slope : 37.2063 Intercept : 0.9717 Correlation Coefficient : 0.9983
2	3.0	1.1603	44	
3	3.9	1.3179	50	
4	4.7	1.4432	54	
5	5.6	1.5720	60	



Calibrated by
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

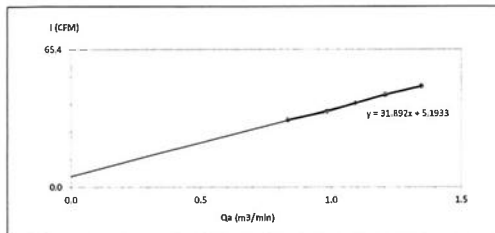
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่หิน/เหมืองแร่ (โรงโม่หิน) Temperature (°C) : 29
Calibrate Date : 20-Nov-24 High Volume ID : RYG-FS0186
Calibration Sheet No. : C-201124-RYG-FS0186 High Volume Model : TE-5009X
Calibrator ID : RYG-FS0205 High Volume S/N : 4794
Calibrator Model : TE-5028A Calibrator Slope : 0.95561
Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.5	0.833	32	Slope : 31.8916 Intercept : 5.1933 Correlation Coefficient : 0.9986
2	2.1	0.982	36	
3	2.6	1.090	40	
4	3.2	1.206	44	
5	4.0	1.346	48	



Calibrated by
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

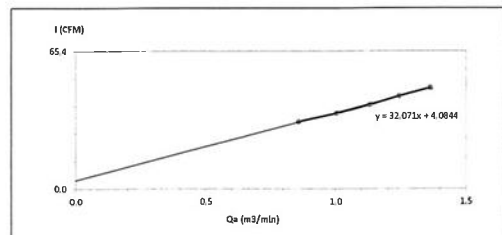
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่หิน/เหมืองแร่ (โรงโม่หิน) Temperature (°C) : 29
Calibrate Date : 20-Nov-24 High Volume ID : RYG-FS0188
Calibration Sheet No. : C-201124-RYG-FS0188 High Volume Model : TE-5009X
Calibrator ID : RYG-FS0205 High Volume S/N : 4796
Calibrator Model : TE-5028A Calibrator Slope : 0.95561
Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.6	0.860	32	Slope : 32.0713 Intercept : 4.0844 Correlation Coefficient : 0.9989
2	2.2	1.004	36	
3	2.8	1.130	40	
4	3.4	1.243	44	
5	4.1	1.363	48	



Calibrated by
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

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



NSC-TS1-TIS 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F
Description : Analytical Balance
Serial Number : 25409664
ID No. : RYG_EN0001
Manufacturer : Sartorius
Certificate No. : 24BCI0068
Issued Date : Friday, February 23, 2024
Reference No. : 229198
Page No. : 1 of 2

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

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

Metrological data :
Capacity : 150 g Readability : 0.0001 g
Ambients Conditions :
Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure : ±
Reasons for calibration
☐ New Installation ☐ Service / Required ☒ Re-calibration/ Maintenance
Equipment Condition : ☒ Good Operate ☐ Fail

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/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)

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P



SARTORIUS

Certificate of Calibration

Model Number : LA130S-F
Description : Analytical Balance
Serial Number : 25409664
ID No. : RYG_EN0001
Manufacturer : Sartorius
Certificate No. : 24BCI0068
Issued Date : Friday, February 23, 2024
Reference No. : 229198
Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express 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 R76).
Nominal Value : (Low Load) 10 g Tolerance 0.0001 g	Nominal value : 50 g Tolerance : 0.0004 g
Nominal Value : (High Load) 100 g Tolerance 0.0001 g	Difference 1 - 2 -0.0001 3 0.0001 4 0.0002 5 0.0000 6 -
Standard Deviation 0.00005 0.00008	

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	0.00020
0.05	0.0500	0.0500	0.0000	0.00021
0.1	0.1000	0.1000	0.0000	0.00021
0.5	0.5000	0.5000	0.0000	0.00021
1	1.0000	1.0000	0.0000	0.00021
2	2.0000	2.0000	0.0000	0.00021
5	5.0000	5.0000	0.0000	0.00021
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00021
100	100.0000	99.9999	-0.0001	0.00024

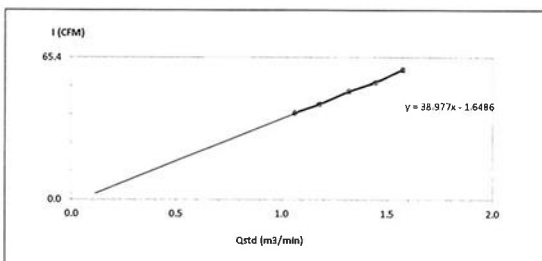
End of Report.

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd.
Calibrate Location : โรงโม่ปูนซีเมนต์
Calibrate Date : 20-Nov-24
Calibration Sheet No. : C-201124-RYG-FS0292
Calibrator ID : RYG-FS0205
Calibrator Model : TE-5028A
Calibrator S/N : 1166
Barometric Pressure (mm Hg) : 755.2
Temperature (°C) : 29
High Volume ID : RYG-FS0292
High Volume Model : TE-5170D
High Volume S/N : 5497
Calibrator Slope : 1.52567
Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.5	1.0623	40	Slope : 38.9766
2	3.1	1.1789	44	Intercept : -1.6486
3	3.9	1.3179	50	Correlation Coefficient : 0.9985
4	4.7	1.4432	54	
5	5.6	1.5720	60	



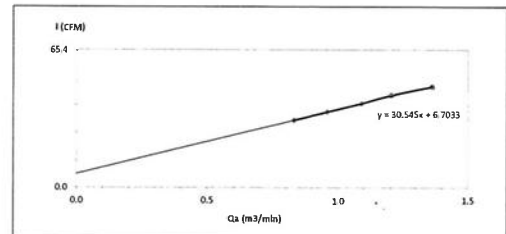
Calibrated by : (Mr.Anurak Tongkhajonsakda)
Field Scientist(2)

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

High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd.
Calibrate Location : โรงโม่ปูนซีเมนต์
Calibrate Date : 20-Nov-24
Calibration Sheet No. : C-201124-RYG-FS0189
Calibrator ID : RYG-FS0205
Calibrator Model : TE-5028A
Calibrator S/N : 1166
Barometric Pressure (mm Hg) : 755.2
Temperature (°C) : 29
High Volume ID : RYG-FS0189
High Volume Model : TE-5009X
High Volume S/N : 4797
Calibrator Slope : 0.95561
Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.5	0.833	32	Slope : 30.5454
2	2.0	0.959	36	Intercept : 6.7033
3	2.6	1.090	40	Correlation Coefficient : 0.9990
4	3.2	1.206	44	
5	4.1	1.363	48	



Calibrated by : (Mr.Anurak Tongkhajonsakda)
Field Scientist(2)

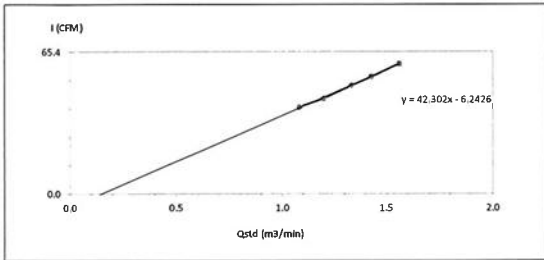
Approved by : (Mr.Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg): 755.2
Calibrate Location: โรงเรือนเพาะเห็ด(โรงปลูกเห็ด) Temperature (°C): 29
Calibrate Date: 20-Nov-24 High Volume ID: RYG_FS0177
Calibration Sheet No.: C-201124-RYG_FS0177 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N: 4803
Calibrator Model: TE-5028A Calibrator Slope: 1.52567
Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0627	40	Slope: 42.3025 Intercept: -6.2426 Correlation Coefficient: 0.9989
2	3.2	1.1972	44	
3	4.0	1.3342	50	
4	4.6	1.4281	54	
5	5.5	1.5582	60	



Calibrated by:
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

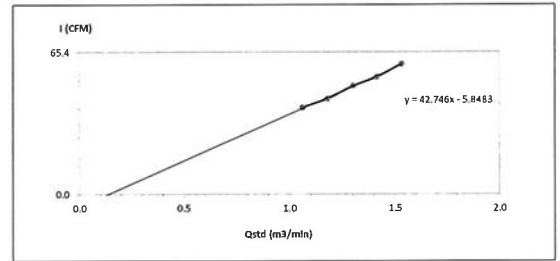
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg): 755.2
Calibrate Location: โรงเรือนเพาะเห็ด Temperature (°C): 29
Calibrate Date: 20-Nov-24 High Volume ID: RYG_FS0178
Calibration Sheet No.: C-201124-RYG_FS0178 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N: 4804
Calibrator Model: TE-5028A Calibrator Slope: 1.52567
Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.5	1.0623	40	Slope: 42.7461 Intercept: -5.8483 Correlation Coefficient: 0.9980
2	3.1	1.1789	44	
3	3.8	1.3013	50	
4	4.5	1.4129	54	
5	5.3	1.5303	60	



Calibrated by:
(Mr. Anurak Tongkhajonsakda)
Field Scientist(2)

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

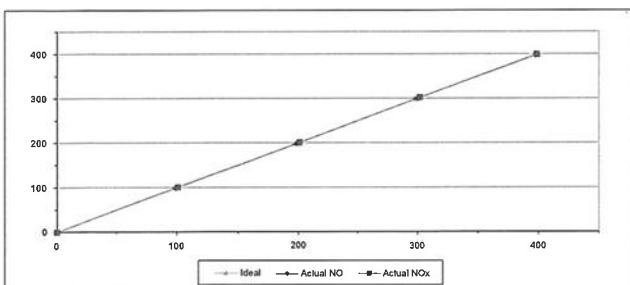
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



MULTIPOINT CALIBRATION REPORT

Calibration Date: 2-Jul-24 Equipment Name: NOx Analyzer
Manufacturer: Teledyne API Model: T200
Serial No.: 2198 Equipment ID: RYG_FS0252
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 Expiry Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	101.00	1.00	1.00
2	200.00	198.00	-2.00	-1.00	201.30	1.30	0.65
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	398.20	-1.80	-0.45	398.60	-1.40	-0.35
AVERAGE (%)				-0.83			0.43



Calibrated By:
(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By:
(Mr. Sarayuth Jittrunont)
Assistant General Manager

ALS Laboratory Group

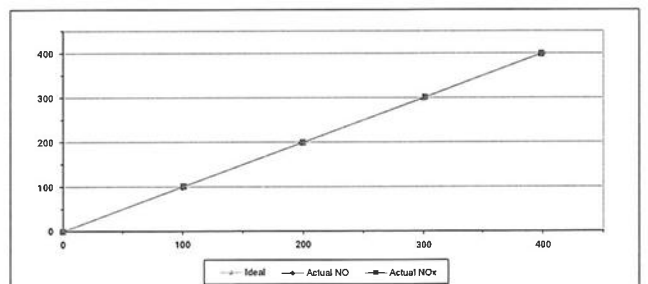
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24 Equipment Name: NOx Analyzer
Manufacturer: HORIBA Model: AFNA-370
Serial No.: NV0ER3YH Equipment ID: RYG_FS0459
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 Expiry Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.20	1.20	1.20
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.40	1.40	0.47
4	400.00	400.30	0.30	0.08	398.80	-1.20	-0.30
AVERAGE (%)				-0.13			0.26



Calibrated By:
(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By:
(Mr. Sarayuth Jittrunont)
Assistant General Manager

ALS Laboratory Group

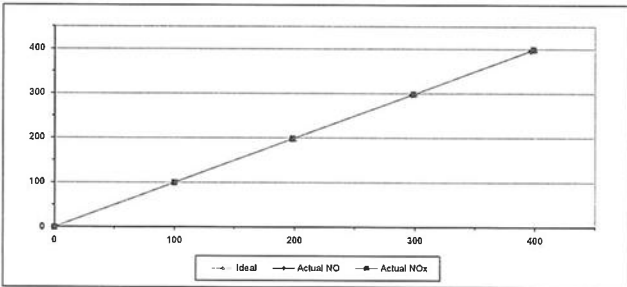
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	2197	Equipment ID	RYG_FS0255
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	100.10	0.10	0.10
2	200.00	198.00	-2.00	-1.00	198.70	-1.30	-0.65
3	300.00	297.30	-2.70	-0.90	298.70	-1.30	-0.43
4	400.00	396.40	-3.60	-0.90	398.80	-1.20	-0.30
AVERAGE (%)				-0.62			-0.24



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

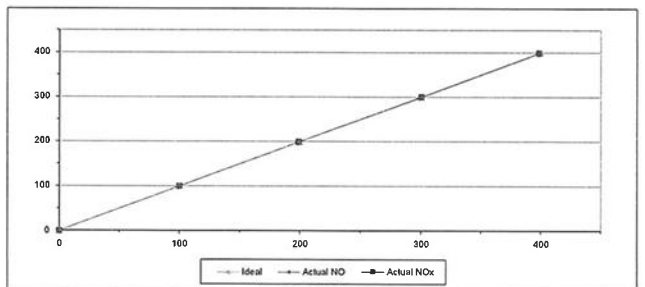
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AV89544	Equipment ID	RYG_FS0272
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.10	0.10	0.10
2	200.00	198.50	-1.50	-0.75	199.20	-0.80	-0.40
3	300.00	298.60	-1.40	-0.47	300.50	0.50	0.17
4	400.00	398.10	-1.90	-0.47	398.70	-1.30	-0.33
AVERAGE (%)				-0.51			-0.07



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

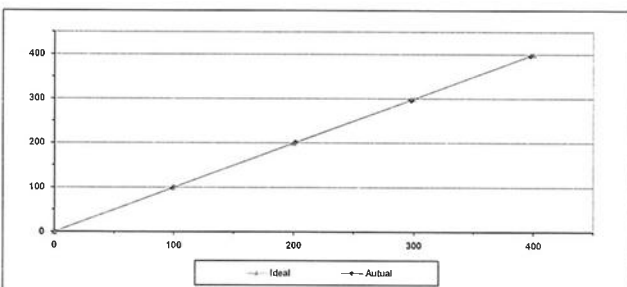
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1773	Equipment ID	RYG_FS0251
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	201.20	1.20	0.60
3	300.00	297.30	-2.70	-0.90
4	400.00	397.60	-2.40	-0.60
AVERAGE (%)				-0.24



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

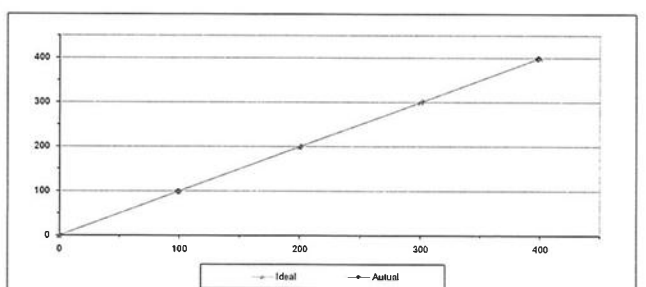
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	PAUY077A	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	201.00	1.00	0.50
3	300.00	302.30	2.30	0.77
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				-0.02



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

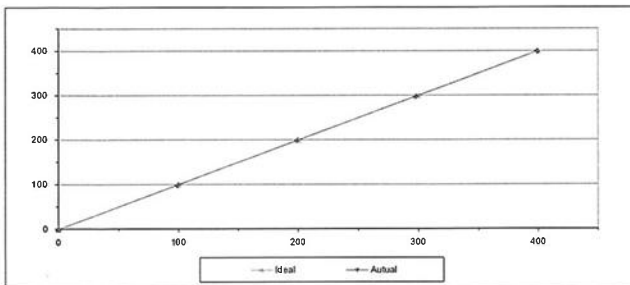
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1772	Equipment ID	RYG_FS0254
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
1	100.00	99.00	-1.00	-1.00
2	200.00	199.60	-0.40	-0.20
3	300.00	297.50	-2.50	-0.83
4	400.00	398.90	-1.10	-0.28
AVERAGE (%)				
-0.45				



Calibrated By

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

Approved By

(Mr. Sarayuth Jittranoit)
Assistant General Manager

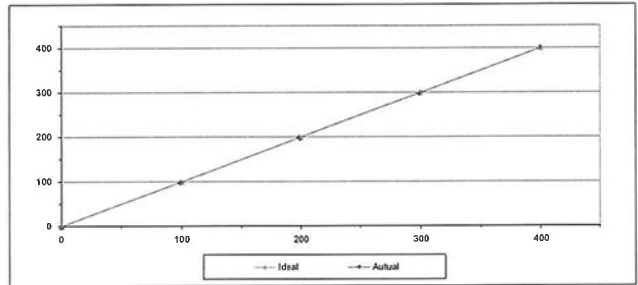
ALS Laboratory Group
FORM NO: F-06-056 REVISION NO: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	8060	Equipment ID	RYG_FS0532
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20
2	200.00	198.60	-1.40	-0.70
3	300.00	298.70	-1.30	-0.43
4	400.00	399.60	-0.40	-0.10
AVERAGE (%)				
-0.47				



Calibrated By

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

Approved By

(Mr. Sarayuth Jittranoit)
Assistant General Manager

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



Jirantee Associates Co., Ltd.
69/24-15, 69/25-36
Pattana 200, 1st, 2nd floors, Bangkok
88/111, 100/111 (Thailand)
Tel: 02-01058212
Mobile: 09-053755433
E-mail: jirantee@jirantee.com
Website: www.jirantee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TS1-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



NSC - TIS1 - TIS 17025
CALIBRATION 0367

Certificate Number

CWS-030-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	Cup anemometer
MANUFACTURER	Novak
MODEL/TYPE	Sensor: WS-02F Data logger: WS-750L
SERIAL NUMBER	Sensor: WSD-44502 Data logger: A4502
ID NUMBER	2008 J50013
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 Aug 2024
MEASUREMENT DATE	20 Aug 2024
ISSUE DATE	20 Aug 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	1010.1 ± 10 hPa

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

CALIBRATION CONDITIONS	Wind tunnel cross-section area ¹	900 cm ²
	Wind direction frontal area ²	100 cm ²
	Diameter of mounting pipe ³	6 mm
	Blockage ratio of test object ⁴	0.111 [-]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (25.2) °C, (41.9) %RH and (1007.9) hPa

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

Calibrated by:
27 Mr. Sarawut Thadavut
23 Nissakorn Jirantee Associate



Approved signature:
Mr. Sarayuth Jittranoit
Calibration Department Manager

REVIEW BY: [Signature]
APPROVED BY: [Signature]
NEXT CAL. DATE: 30/12/26

Remarks:
¹ Actual cross-section area of the wind tunnel
² Projected frontal area of the tested object (include mounting pipe)
³ Diameter of mounting pipe
⁴ Ratio of the area of the object to the area of the wind tunnel

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-030-67

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s 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 pressure differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 3 m/s to 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are ventured in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.989	23.98	24.20	0.9	-0.1	0.31
2.043	24.42	24.20	1.8	0.2	0.31
2.142	23.80	24.20	2.9	-0.1	0.31
4.108	23.82	24.20	3.8	-0.3	0.31
4.97	23.62	24.20	4.9	-0.1	0.31
5.95	23.54	24.20	6.0	0.1	0.31
7.01	23.46	24.20	7.0	0.0	0.31
7.96	23.80	24.20	8.0	0.0	0.31
8.18	23.90	24.20	9.1	0.1	0.31
9.96	23.74	24.20	10.1	0.1	0.31
10.54	24.00	24.20	11.1	0.2	0.31
12.01	23.82	24.20	12.2	0.2	0.31
12.52	24.00	24.20	13.3	0.2	0.31
14.06	23.86	24.20	14.2	0.2	0.31
15.00	24.00	24.20	15.2	0.2	0.31
15.93	23.96	24.20	16.2	0.2	0.31

Remarks:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



MEASUREMENT RESULTS¹

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

Air speed	D ₁ °	D ₂ °	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
45.000	41	-4	0.80	0.80
90.000	87	-3	0.80	0.80
135.000	132	-3	0.80	0.80
180.000	181	1	0.80	0.80
225.000	229	4	0.80	0.80
270.000	275	5	0.80	0.80
315.000	320	5	0.80	0.80
360.000	359	-1	0.80	0.80

Remarks:

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

² Direction of Standard

Direction of Unit Under Calibration

End of Certificate of Calibration

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novasys

Sensor: WS-02F

Data logger: WS-250L

Sensor: WS0-A4562

Data logger: A4562

SNK_F02143

Used item

ALS Laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khut Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AK009915-DIM04 R3.5 UD in an acute reposition of 90° type wind tunnel with 900 cm² flow test section area. The W1-CL-008 based on IEC 61400-12-3, Wind energy generation systems - Part 12-3, 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 the realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA 0536-23.

Uncertainty of Measurement:

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

08 Aug 2024

20 Aug 2024

20 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Hiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹

900

cm²

Wind direction frontal area²

129

cm²

Diameter of mounting pipe³

-

mm

Blockage ratio of test object⁴

0.143

[-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.7) °C, (42.6) %RH and (1007.9) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thachais

Miss Jiraporn Lertkarn

Approved signature

Mr. Panyee Boonchaoon

Calibration Department Manager

Remarks:

¹ Nominal cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio [-]

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

MEASUREMENT RESULTS¹

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

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{ref} (m/s)	Error (m/s)	U (k=2) (m/s)
1.027	24.10	23.90	0.9	-0.1	0.31
2.054	23.72	23.90	1.9	-0.2	0.31
2.992	24.02	23.90	2.9	-0.1	0.31
4.083	24.04	23.90	3.9	-0.7	0.31
4.48	23.70	23.40	5.0	0.0	0.31
6.02	23.60	23.90	6.0	0.0	0.31
7.63	23.70	23.90	7.1	0.1	0.31
7.94	23.58	23.90	8.1	0.1	0.31
8.19	23.70	23.90	9.1	0.3	0.31
9.97	23.50	23.90	10.1	0.1	0.31
10.96	23.78	23.90	11.2	0.2	0.31
12.05	23.50	23.90	12.2	0.2	0.31
12.97	23.60	23.90	13.4	0.5	0.31
14.03	23.56	23.90	14.8	0.3	0.31
15.03	23.80	23.90	15.5	0.3	0.31
16.02	23.70	23.90	16.9	0.3	0.31

Remarks:

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

² Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the Cup anemometer calibration in the wind tunnel of Hiranatee 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

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

MEASUREMENT RESULTS¹

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

Air speed	D ₁ °	D ₂ °	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
0.000	0	0	0	0.80
45.000	43	43	-3	0.80
90.000	87	87	-3	0.80
135.000	133	133	-2	0.80
180.000	180	180	0	0.80
225.000	227	227	2	0.80
270.000	273	273	3	0.80
315.000	318	318	3	0.80

Remarks:

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

² Direction of standard.

³ Direction of Unit Under Calibration.

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novatex
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WS0-AS789
Data logger: AS789
ID NUMBER : RYG_F50531
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model AX4000/5.0504 P3 S-10 in an enclosure of Ethel type wind tunnel with 900 cm² cross sectional area. The WICLOS sensor on IEC 62400-12-1, Wind energy generation system - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used in a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards, and to resolution of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number DA-0036-23.

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

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 28 Aug 2024
ISSUE DATE : 28 Aug 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 : Ethel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION : Wind tunnel cross section area¹ : 900 cm²
Wind direction frontal area² : 120 cm²
Diameter of mounting plate³ : mm
Blockage ratio of test object⁴ : 0.143 [-]

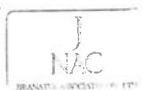
Preconditioning : 24 hours at ambient condition.

Measurement Condition : The average values during measurement are (23.8) °C, (40.0) %RH and (1003.8) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sorawit Thachalad
☐ Miss Jiraporn Lerlornchot
☐ Miss Jiraporn Lerlornchot



Approved signatory

Mr. Panying Booncharoen
Calibration Department Manager

Remarks:

¹ Blockage ratio is the ratio of the area of the wind tunnel.
² Frontal area is the area of the test object including mounting plate.
³ Diameter of mounting plate.
⁴ k = 0.1.

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-163-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novatex
MODEL/TYPE : 110-WS-25DL-D
SERIAL NUMBER : AS789
ID NUMBER : RYG_F50531
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

Calibration procedure:
The temperature calibration was done by in-house calibration method in WP-C1-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number TT-0047-24. Certificate number: LK 0101-23.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 167682-09,
Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DT11000-A MK II, Serial No.: 571407,
Due date: 14 Sep 2024

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

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 28 Aug 2024
ISSUE DATE : 28 Aug 2024

ENVIRONMENTAL CONDITIONS:

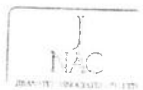
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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 Jiraporn Lerlornchot
☐ Miss Jiraporn Lerlornchot



Approved signatory

Mr. Panying Booncharoen
Calibration Department Manager

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

Continuation of Certificate of Calibration Number CDT-163-67

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: T0210901.
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.049	19.6	-0.4	0.099
80	25.053	24.6	-0.5	0.099
80	30.044	29.7	-0.3	0.099
80	35.027	34.5	-0.5	0.099
80	40.019	39.5	-0.5	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CRT-033-67

MEASUREMENT ITEM

: Relative humidity with data logger

MANUFACTURER

: Navalyra

MODEL/TYPE

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

SERIAL NUMBER

: Sensor: HM160

ID NUMBER

: Data Logger: AS789

CONDITION AS-RECEIVED

: Sensor: T0210901

CUSTOMER

: RVC, J508-31

RECEIVED DATE

: Used item

MEASUREMENT DATE

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

ISSUE DATE

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 0.0 °C

Relative Humidity : 55.0 ± 1.0 %RH

Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as per CL-007 and WA-CL-010 according to comparison method with Standard: Chilled Mirror hygrometer with Temperature sensor and standard humidity generator chamber.

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jirantee Associates Co., Ltd. Certificate number: CRT-001-67

Uncertainty of Measurement:

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

NOTE: This certificate is valid only for the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☐ Mr. Sorawat Thachalad
☐ Mr. Jetraraporn Lertsuaphol
☐ Miss Ruangsri Phoonmit

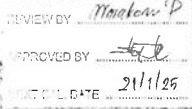
Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

End of Certificate of Calibration



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



Certificate Number

CWS-002-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Cup anemometer

MANUFACTURER

: Navalyra

MODEL/TYPE

: Sensor: WS-027

SERIAL NUMBER

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

ID NUMBER

: Sensor: W50-T0816

CONDITION AS-RECEIVED

: Data logger: AS616

CUSTOMER

: RVC, J508-31

RECEIVED DATE

: Used item

MEASUREMENT DATE

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

ISSUE DATE

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 0.0 °C

Relative Humidity : 55.0 ± 1.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

: Effel type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area : 900 cm²
Wind direction from area : 100 cm²
Diameter of mounting pipe : mm
Blockage ratio of test object : 0.311 %

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: B-55-32 and pitot tube with precision differential pressure meter model: DPM4100 in the flow test section of Effel type wind tunnel with 900 cm² cross test section area. The W-1007, based on IEC 61400-12-1, Wind energy generation system - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a reference 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: TH-0052-21 and NIMT-006-22.

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".

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (23.9) °C, (45.7) %RH and (1008.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☐ Mr. Sorawat Thachalad
☐ Mr. Jetraraporn Lertsuaphol

Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

1. Visible cross-section area of the wind tunnel
2. Projected cross-section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio (%)

Certificate Number

CWS-002-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{ref} (m/s)	Error (m/s)	U (k=2) (m/s)
1.023	23.80	23.90	0.8	-0.2	0.31
2.076	24.00	23.90	1.8	-0.2	0.31
3.021	23.78	23.90	2.8	-0.2	0.31
4.246	23.52	23.90	3.9	-0.2	0.31
5.00	23.60	23.90	4.8	-0.2	0.31
5.99	23.65	23.90	5.8	-0.2	0.31
7.03	23.50	23.90	6.8	-0.2	0.31
8.16	23.63	23.90	7.9	-0.3	0.31
9.08	23.50	23.90	8.9	-0.2	0.31
10.06	23.78	23.90	9.8	-0.3	0.31
11.13	23.50	23.90	10.9	-0.2	0.31
12.11	23.78	23.90	12.0	-0.3	0.31
13.16	23.50	23.90	12.9	-0.3	0.31
14.21	23.66	23.90	14.0	-0.2	0.31
15.18	23.50	23.90	15.0	-0.2	0.31
16.26	23.58	23.90	16.0	-0.3	0.31

Remark:

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

⁶ Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



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

MEASUREMENT RESULTS¹

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

Air speed m/s	D ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	45.000	42	-3	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
	180.000	181	1	1.0
	225.000	229	4	1.0
	270.000	273	3	1.0
	315.000	317	2	1.0
	360.000	359	-1	1.0

Remarks:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novolyte

Sensor: WS-02P

Data logger: 110 WS-25DL-D

Sensor: WS0-A5816

Data logger: A5816

RYG_F50545

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: AA4000TS-

DM04 P-S 10 in on floor type of Effel-

type wind tunnel with 300 cm² cross section

area. The WICL 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 recognition of the national

standards, and to resolution of the international

system of units (SI) through the NIMT (National

Institute of Metrology (Thailand) via Certificate

number: DA-0243-22

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

11 Jul 2023

MEASUREMENT DATE

21 Jul 2023

ISSUE DATE

21 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 0.3 °C

Relative Humidity: 55.0 ± 1.5 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area¹

900 cm²

Wind direction frontal area²

129 cm²

Diameter of mounting pipe³

12 mm

Blockage ratio of test object⁴

0.143 [-]

Preconditioning

24 hours at ambient condition.

Measurement Condition

The average values during measurement are (23.8) °C, (46.9) %RH and (1012.4) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Surawit Thuchulad

Miss Jitraporn Lertsomphol

Approved Signatory:

Mr. Parinya Booncharoen

Mr. Parinya Booncharoen

Calibration Department Manager

Remarks:

¹ Nominal cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio "a"

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-036-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novolyte

Model: 110 WS-25DL-D

Serial No.: A5816

ID No.: RYG_F50545

Customer

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

Address: 104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Suan Luang, Khet Suan Luang, Bangkok

10250 Thailand.

Received date: 11 Jul 2023

Calibration date: 21 Jul 2023

Issue date: 21 Jul 2023

Reference Used During Calibration

2 Standard Temperature Probe Model: STS-100 A500

Serial No.: 667682 09, Due date: 26 Mar 2024

2 Digital Temperature Indicator Model: DTI-1000 A MK

II, Serial No.: 675407-00591 Due date: 22 July 2023

Calibration Condition

Temperature: (23±3) °C

Relative Humidity: (55±15) %

Calibration Procedure

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

Traceability

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

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

Calibrated by

Mr. Surawit Thuchulad

Miss Jitraporn Lertsomphol

Miss Ruanrumpai Phoomm



Approved Signatory:

Mr. Parinya Booncharoen

Mr. Parinya Booncharoen

Calibration Department Manager

Result of Calibration:

☒ Without Adjustment ☐ With Adjustment

Calibration Range:

20-40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: T2320595.

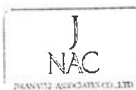
Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.060	19.6	-0.5	0.099
70	25.055	24.6	-0.4	0.14
70	30.050	29.7	-0.4	0.099
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	0.099

UUC = Unit Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No.: RH-0207/2023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novolyne
Model/Type : 110 WS 250L-D
Serial Number : A5816
ID No. : RYG_F50545
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanahon 40, Phatthanahon Rd, Khwaeng Suan Luang, Khel Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 in the humidity generator chamber to determine the errors.

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

Measurement Date : Jul 21, 2023
Issued Date : Jul 21, 2023

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (URI) on display. Model: IMP60, Serial number: T2320595
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (RH)	Standard (RH)	UUC (RH)	Error (RH)	Uncertainty ±(RH)
20	20.05	17.5	-2.6	0.52
50	50.23	46.5	-3.7	0.51
80	80.26	76.5	-4.8	0.51

Performed by:
☐ Mr. Sorawat Thachalas
☒ Miss Jitraporn Lertsomphol
☐ Miss Puangruek Phoommit



Approved Signatory:
Mr. Panya Booncharoen
Calibration Department Manager

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

Jiranatee Associates Co., Ltd.
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS 17025
CALIBRATION 0367
Air speed measurement laboratory
Calibration services department



Certificate Number

CWS-025-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novolyne
MODEL/TYPE : Sensor: WS-021
Data logger: 110 WS 250L-D
SERIAL NUMBER : Sensor: WS-021
Data logger: AS509
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanahon 40, Phatthanahon Rd, Khwaeng Suan Luang, Khel Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Jul 2024
MEASUREMENT DATE : 18 Jul 2024
ISSUE DATE : 18 Jul 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 : Eitel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area : 900 cm²
Wind direction frontal area : 120 cm²
Diameter of mounting pipe : 129 mm
Blockage ratio of test object : 0.133 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.5) °C, (43.3) %RH and (1000.5) hPa

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

Calibrated by:
☒ Mr. Sorawat Thachalas
☒ Miss Jitraporn Lertsomphol



Approved signatory:
Mr. Panya Booncharoen
Calibration Department Manager

Remarks:
* Assessed cross-section area of the wind tunnel
* Potential cross-section area of the tested object include mounting pipe
* Diameter of mounting pipe
* Ratio: 1/3

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

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer (Unit Under Calibration (UUC)) was overheat 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 test section. The calibration was carried out under both wind 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 _{std} (m/s)	Error (m/s)	U (k=2) (m/s)
0.597	24.38	24.45	0.8	-0.2	0.31
2.014	24.20	24.45	1.8	0.2	0.41
2.910	24.80	24.45	2.9	0.1	0.31
4.102	24.88	24.45	3.8	0.3	0.31
4.87	24.80	24.45	5.0	0.0	0.31
5.98	24.50	24.45	6.0	0.0	0.31
7.03	24.70	24.45	7.1	0.1	0.31
7.95	24.38	24.45	8.1	0.1	0.31
9.04	24.70	24.45	9.1	0.1	0.31
9.98	24.36	24.45	10.2	0.2	0.31
10.95	24.80	24.45	11.2	0.2	0.31
12.03	24.40	24.45	12.2	0.2	0.31
12.57	24.70	24.45	13.2	0.2	0.31
14.10	24.50	24.45	14.9	0.2	0.31
15.03	24.70	24.45	15.2	0.2	0.31
15.99	24.58	24.45	16.2	0.2	0.31

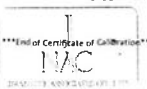
Remark:
¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

Velocity of standard
Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



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



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



Certificate Number

CWS-025-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novolyne
MODEL/TYPE : Sensor: WS-021
Data logger: 110 WS 250L-D
SERIAL NUMBER : Sensor: WS-021
Data logger: AS509
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanahon 40, Phatthanahon Rd, Khwaeng Suan Luang, Khel Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Jul 2024
MEASUREMENT DATE : 18 Jul 2024
ISSUE DATE : 18 Jul 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

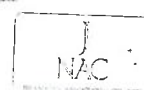
PLACE OF CALIBRATION : Eitel-type wind tunnel of Jiranatee Associates Co., Ltd.

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.4) °C, (43.3) %RH and (1000.5) hPa

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

Calibrated by:
☒ Mr. Sorawat Thachalas
☒ Miss Jitraporn Lertsomphol



Approved signatory:
Mr. Panya Booncharoen
Calibration Department Manager

Remarks:
* Assessed cross-section area of the wind tunnel
* Potential cross-section area of the tested object include mounting pipe
* Diameter of mounting pipe
* Ratio: 1/3

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Certificate Number
CWD-025-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D ₁₅₀ Degree (°)	D ₁₅₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.80
	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	178	-2	0.80
	225.000	225	0	0.80
	270.000	272	2	0.80
	315.000	319	4	0.80

Remarks:

¹ Calibration result is only valid for the tested circumstances and environmental conditions during which calibration took place.

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



J NAC
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NSC TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CDT-120-67

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Nivalyne
MODEL/TYPE : 110-W5-250L-D
SERIAL NUMBER : AS909
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthananakan 40, Phatthananakan Rd.,
Khuang Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

RECEIVED DATE : 08 Jul 2024
MEASUREMENT DATE : 18 Jul 2024
ISSUE DATE : 18 Jul 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 at W-CI-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-0047-24, Certificate number: LR-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe Model: STS-100 A500, Serial No. 667682-09, Due date: 26 Mar 2025
2. Digital Temperature Indicator Model: DTI-1000-A-MK II, Serial No. 671407-00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sorawit Traichalad
☒ Mr. Nattaporn Kertsomphol
☒ Mr. Ruangsakul Phoommit



Approved signatory
Mr. Parinya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-120-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

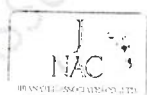
Table 3: This equipment was connected with temperature sensor Model: HANPG S/N: U3641220.
Dimension: Diameter 32 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.047	19.8	-0.2	0.099
80	25.043	24.8	-0.2	0.099
80	30.034	29.8	-0.2	0.099
80	35.028	34.8	-0.2	0.099
80	40.018	39.7	-0.3	0.16

UUC*: Unit 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



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CALIBRATION 0367

Relative humidity and Air Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CRT-022-67

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Nivalyne
MODEL/TYPE : Data Logger: 110-W5-250L-D
Sensor: HM90
SERIAL NUMBER : Data Logger: AS909
Sensor: U3641220
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthananakan 40, Phatthananakan Rd, Khuang Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Jul 2024
MEASUREMENT DATE : 18 Jul 2024
ISSUE DATE : 18 Jul 2024

ENVIRONMENTAL CONDITIONS:

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

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

TABULATION OF RESULTS:

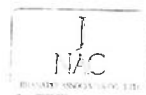
The table on next page give the measured values

Calibration procedure:
The Relative humidity and Air Temperature calibration was done by In-House calibration method at W-CI-005 and W-CI-030 according to comparison method with Nivalyne chilled mirror hygrometer with temperature sensor and standard humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: TT-0012-23 and through Jirananee Associates Co., Ltd. Certificate number: CDT-001-24

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

Calibrated by:
☒ Mr. Sorawit Traichalad
☒ Mr. Nattaporn Kertsomphol
☒ Mr. Ruangsakul Phoommit



Approved signatory
Mr. Parinya Booncharoen
Calibration Department Manager

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Measurement Results

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

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

Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ± (%RH)
29.74	19.49	17.5	-1.9	0.83
29.82	50.54	47.3	-3.3	1.3
29.81	81.68	77.1	-4.6	2.3

UUC: Unit Under Calibration

End of Certificate of Calibration



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration Date :	10-Jul-24	Barometric Pressure (mmHg) :	749.1
Next Cal. Date :	10-Jan-25	Relative Humidity (%) :	46.2
		Temperature (°C) :	33.8
Console Control Meter Data			
Calibration No. :	C-100724-BKK_FS0468	Reference Dry Gas Meter ID :	BKK_FS1122
Dry Gas Meter ID :	BKK_FS0468	Serial No. :	A2003240
Serial No. :	1302005	Correction Factor (V) :	0.9924
Model No. :	XC-572-V	Next Calibration Date :	7-Nov-24
Console Control Meter Data			
Reference Dry Gas Meter Calibration		Console Control Dry Gas Meter	
ΔH (mm.H ₂ O)	Minutes	ΔH (mm.H ₂ O)	Minutes
15	11.90	15	11.90
25	8.90	25	8.90
50	6.90	50	6.90
80	4.94	80	4.94
120	4.10	120	4.10
Average		Average	
0.0001		0.0001	
SD		SD	
0.00003		0.00003	

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

ΔH : Orifice pressure differential that equates to 21.24 in. of air @ 25 °C and 760 mm of mercury. mmH₂O : tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 60 APP A METH. SEC 5.3.8.7

Calibrated by : Saksit Phaisanphaisit
(Mr. Saksit Phaisanphaisit)
RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong
(Mr. Nattapon Jengwareewong)
RYG Field Service Specialist (1)



Stopwatch Calibration Test Report

Calibration Date : 10 Jul 24 Next Cal. Date : 10 Jan 25
Barometric Pressure (mmHg) : 749.1 Temperature (°C) : 33.8
Relative Humidity (%) : 46.2

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_FS0468
Model : XC-572-V
Serial No. : 1302005

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00.04	5:00	3	0.00005
2	5:00.08	5:00	8	0.00013
3	5:00.07	5:00	7	0.00012
4	5:00.08	5:00	8	0.00013
5	5:00.06	5:00	6	0.00010
6	5:00.06	5:00	6	0.00010
7	5:00.06	5:00	6	0.00010
8	5:00.08	5:00	8	0.00013
9	5:00.07	5:00	7	0.00012
10	5:00.07	5:00	7	0.00012
Average			0.00011	
SD			0.00003	

Calibrate by : Saksit Phaisanphaisit
Mr. Saksit Phaisanphaisit
RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong
Mr. Nattapon Jengwareewong
RYG Field Service Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	10 Jul 24	Ambient Temperature (°C)	33.8		
Calibration sheet No. : C-100724-BKK_FS0468		Relative Humidity (%) :	46.2		
Digital Temperature ID : BKK_FS0469		Reference Temperature ID	RYG_FS0881		
Serial No. : 1302005		Serial No. :	201090014018		
Model : XC-572-V		Model :	Digicon-CC-VT-MS		
		Next Calibrate :	13 Nov 24		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	201	1	±3	Pass
Probe	250	251	1	±3	Pass
	300	301	1	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Saksit Phaisanphaisit
(Mr. Saksit Phaisanphaisit)
RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong
(Mr. Nattapon Jengwareewong)
RYG Field Service Specialist (1)

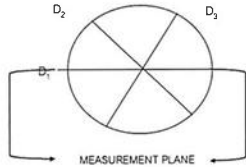


PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 10 Jul 24				Nozzle Set ID. : BKK_FS0474	
Calibration Sheet No. : C-100724-BKK_FS0474				Vernier Caliper ID. : BKK_FS1123	
Nozzle ID #	Nozzle Diameter (cm.)			H - Lo	$(D_1 + D_2 + D_3) / 3$
	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.305	0.300	0.305	0.005	0.303
2	0.455	0.455	0.455	0.000	0.455
3	0.604	0.602	0.601	0.003	0.602
4	0.760	0.765	0.770	0.010	0.765
5	0.935	0.945	0.935	0.010	0.938
6	1.095	1.098	1.092	0.006	1.095
7	1.260	1.260	1.260	0.000	1.260
8	1.605	1.600	1.610	0.010	1.605

Where :

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



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

Approved by : Nattapon Jengwarewong
(Mr. Nattapon Jengwarewong)
RYG Field Services Specialist

FORM NO. : F-08-027 REVISION NO. : 2 ISSUE DATE : 9 Feb 23



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 10-Jul-24
Next Cal. Date : 10-Jan-25

Bathometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 46.2
Temperature (C°) : 33.8

Reference Dry Gas Meter Data
Calibration No. : C-100724-BKK_FS0556
Dry Gas Meter ID : BKK_FS0556
Serial No. : 1606041
Model No. : XC-572-V

Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A203240
Correction Factor (Y) : 0.9824
Next Calibration Date : 7-Nov-24

All (mm Hg)	Minutes	Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter				Dry Gas Meter Correction Factor	Orifice Calibration Factor
		Final	Initial	Total	Ti (°C)	Tf (°C)	Initial	Final	Total		
15	11.75	150.00	0.00	150.00	29.0	30.0	303548.0	303548.0	148.00	0.9875	42.5688
25	9.24	150.00	0.00	150.00	29.0	30.0	303548.0	303548.0	147.00	0.9875	42.5688
30	6.53	150.00	0.00	150.00	29.0	30.0	303548.0	303548.0	146.00	0.9874	43.8741
40	5.19	150.00	0.00	150.00	30.0	31.0	303548.0	303548.0	147.00	0.9874	43.8741
120	4.20	150.00	0.00	150.00	30.0	31.0	304146.0	304146.0	146.00	0.9874	43.8741
Avg										0.9874	42.6442

Y : Ratio of reading of reference to dry gas meter. Tolerance for individual values ± 1.002 from average.

Δ Avg : Orifice pressure differential that equates to 21.24 in. of air @ 25 C and 760 mm of mercury. Tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 80 APP A METH. SEC 5.3.8.7
Calibrated by : Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
RYG Field Services Scientist (4)

Approved by : Nattapon Jengwarewong
(Mr. Nattapon Jengwarewong)
RYG Field Services Specialist

FORM NO. : F-08-027 REVISION NO. : 2 ISSUE DATE : 9 Feb 23



Stopwatch Calibration Test Report

Calibration Date : 10 Jul 24
Barometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 46.2

Next Cal. Date : 10 Jan 25
Temperature (C°) : 33.8

Reference Stopwatch Data
Stopwatch ID No. : RYG_FS0540
Model : F808
Serial No. : E19061
Calibration Date : 4 Jul 24
Certificate No. : E-2407022

Console Control Meter Data
Dry Gas Meter No. : BKK_FS0556
Model : XC-572-V
Serial No. : 1606041

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:03	5:00	3	0.00005
2	5:00:07	5:00	7	0.00012
3	5:00:07	5:00	7	0.00012
4	5:00:08	5:00	8	0.00013
5	5:00:05	5:00	5	0.00008
6	5:00:07	5:00	7	0.00012
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:08	5:00	8	0.00013
10	5:00:07	5:00	7	0.00012
Average			0.00011	
SD			0.00003	

Calibrated by : Saksit Phaisanphisit
Mr. Saksit Phaisanphisit
RYG Field Service Scientist (4)

Approved by : Nattapon Jengwarewong
Mr. Nattapon Jengwarewong
RYG Field Service Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 10 Jul 24		Ambient Temperature (°C)		33.8	
Calibration sheet No. : C-100724-BKK_FS0557		Relative Humidity (%)		46.2	
Digital Temperature ID : BKK_FS0557		Reference Temperature ID		RYG_FS0861	
Serial No. : 1606041		Serial No. :		201000014918	
Model : XC-572-V		Model :		Digicon-CC-VT-MS	
		Next Calibrate :		13 Nov 24	
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	± 3	Pass
	25	24	-1	± 3	Pass
	50	49	-1	± 3	Pass
	100	99	-1	± 3	Pass
	150	149	-1	± 3	Pass
	200	199	-1	± 3	Pass
Probe	250	249	-1	± 3	Pass
	300	299	-1	± 3	Pass
	500	499	-1	± 3	Pass
	100	99	-1	± 3	Pass
	120	119	-1	± 3	Pass
	140	139	-1	± 3	Pass
Oven	100	99	-1	± 3	Pass
	120	119	-1	± 3	Pass
	140	139	-1	± 3	Pass
Filter	100	100	0	± 3	Pass
	120	120	0	± 3	Pass
	140	141	1	± 3	Pass
Exit	0	0	0	± 3	Pass
	10	10	0	± 3	Pass
	20	20	0	± 3	Pass
Meter	0	0	0	± 3	Pass
	25	25	0	± 3	Pass
	50	50	0	± 3	Pass
AUX	0	0	0	± 3	Pass
	25	24	-1	± 3	Pass
	50	49	-1	± 3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของเครื่องมือวัด

Calibrated by : Saksit Phaisanphisit
Mr. Saksit Phaisanphisit
RYG Field Service Scientist (4)

Approved by : Nattapon Jengwarewong
Mr. Nattapon Jengwarewong
RYG Field Service Specialist (1)

FORM NO. : F-08-027 REVISION NO. : 2 ISSUE DATE : 9 Feb 23



PROBE NOZZLE DIAMETER
CALIBRATION DATA SHEET

Calibration Date : 10 Jul 24	Nozzle Set ID : BKK_FS0562
Calibration Sheet No : C-100724-BKK_FS0562	Vernier Caliper ID : BKK_FS1123

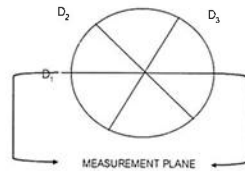
Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.305	0.302	0.302	0.003	0.303
2	0.485	0.475	0.485	0.010	0.482
3	0.620	0.635	0.635	0.015	0.630
4	0.765	0.765	0.765	0.000	0.765
5	0.970	0.980	0.975	0.010	0.975
6	1.085	1.085	1.081	0.004	1.084
7	1.275	1.275	1.275	0.000	1.275
8	1.610	1.610	1.615	0.005	1.612

Where:

D_1, D_2, D_3 = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

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

D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by: Saksit Phaisanphisit

(Mr. Saksit Phaisanphisit)
RYG Field Service Scientist (4)

Approved by: Nattapong Jengwarewong

(Mr. Nattapong Jengwarewong)
RYG Field Service Specialist (1)

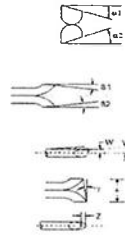
FORM NO.: F 06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 10-Jul-24
Pitot ID BKK_FS0473
Pitot SN -

Due Date 10-Jan-25
Inclinometer ID BKK_FS1131
Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	2.5	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	1.4	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-0.8	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	-0.4	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	0.3	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	$1.05 \leq A/2Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	OK

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

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

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

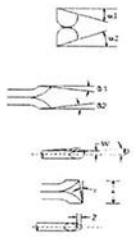
FORM NO.: F 06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 10-Jul-24
Pitot ID BKK_FS0561
Pitot SN -

Due Date 10-Jan-25
Inclinometer ID BKK_FS1131
Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	-2.4	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	-1.2	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-2.0	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	1.3	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	0.3	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.468	$1.05 \leq A/2Dt \leq 1.5$	OK
A	0.91	$2.1Dt \leq A \leq 3Dt$	OK

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

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

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

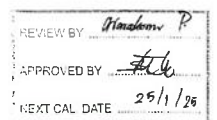


Calibration Certificate



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

Instrument description : Rue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03580098/1121
Instrument serial no. : 62959047/1121
ID no. or control no. : RYG_FS0563
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial no. : -
Customer name : ALS LABORATORY GROUP (THAILAND) CO., LTD.
Customer address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Kiet Suan Luang Bangkok, 10250 Thailand
Total pages of certificate : 2 Pages
Receiving no. : U-240266
Receiving date : 24 Jan 24
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.01, 21.02 %vol, Carbon Monoxide 60.14, 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, 100.6, 600.0 ppm)
Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 \pm 5 $^\circ$ C
Humidity : 55 \pm 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakes, 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 items under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal are void and The results relate only to the items tested/calibrated.
This calibration certificate documents are traceability to national standards, which require measurement according to the International System of Units (SI).

Date of calibration : 26 Jan-24

Kwanthai K.
Mr. Kwanthai Khamduang
Calibration Technician

D. Wuttich
Mrs. Nangluk Wongsetsook
Technical Manager

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

RY-C-05-C Rev.0

Page 1 of 2

Issue Date 26/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Ngamwongwan 47, Yaek 48, Toongsonghong, Lakes, Bangkok 10210 THAILAND Tel: 0-2770-8888 Email: entech@entech.co.th
Fax: 0-105536025591 www.entech.co.th

Standard References (Table 1)

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

Measured room conditions

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

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1.200 ml/min Gas pressure : 1017.1 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.50	2.46	-0.04	0.15
O ₂ (%Vol)	10.04	9.93	-0.11	0.20
O ₂ (%Vol)	21.02	21.09	0.07	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1003	1005	2	12
NO ₂ (ppm)	30.34	30.1	-0.24	8.0
NO ₂ (ppm)	80.96	81.7	0.74	8.0
NO ₂ (ppm)	201.9	200.8	-1.1	12
NO (ppm)	30.01	31	0.99	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO ₂ (ppm)	50.36	52	1.64	6.0
SO ₂ (ppm)	100.8	102	1.2	6.0
SO ₂ (ppm)	600.8	603	2.2	13

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

End of Report

Certificate of Calibration

NSC-TIS-15 17025
CALIBRATION 0426

REVIEW BY: Thawale
APPROVED BY: D. K.
NEXT CAL. DATE: 09/02/2025

Model Number : MSU224S-100-DU
Description : Analytical Balance
Serial Number : 0031709552
ID No. : RYG_EN0003
Manufacturer : Sartorius

Certificate No. : 24BCI0073
Issued Date : Friday, February 23, 2024
Reference No. : 229196
Page No. : 1 of 2

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

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

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

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

Metrological data : Capacity : 220 g Readability : 0.0001 g
Ambients Conditions : Temperature : 23.7 °C ± 5.0 °C
Humidity : 62.0 % 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 Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C1923184S	23-Aug-2024

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

Mr.chonchai inthana(Technical Manager)

SOP FM 33 03 February 2022



Certificate of Calibration

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

Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.		The off-center loading error is yielded by the difference between the result of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (if possible) defined according to OIML R116.	
Nominal Value : (Low Load)	20.0000	200.0001	
20 g	20.0000	200.0000	
Tolerance	0.0001 g	200.0001	
	20.0000	200.0001	
	20.0000	200.0001	
Nominal Value : (High Load)	200.0000	200.0001	
200 g	19.9999	200.0001	
Tolerance	0.0001 g	200.0000	
	20.0000	200.0000	
	20.0000	200.0001	
Standard Deviation	0.00005	0.00003	

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00013
1	1.0000	1.0000	0.0000	0.00013
5	5.0000	5.0000	0.0000	0.00013
10	10.0000	10.0000	0.0000	0.00013
20	20.0000	20.0000	0.0000	0.00013
50	50.0000	50.0000	0.0000	0.00024
100	100.0000	99.9999	-0.0001	0.00018
200	200.0000	199.9999	-0.0001	0.00029

End of Report



Lot No. 24121887-1

ANALYZER CALIBRATION DATA

Client : Gulf T&A Co., Ltd. Location : Udang HRSG 11
Date : 21 Nov 24 Test Operator : Sakitt P.
O₂ ANALYZER : TELEDYNE API 200EH Serial No. : 774
Model : 25

Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.12
Low-Level Gas	8.00	8.10	0.20
Span Gas	16.02	16.12	0.20

NO₂ ANALYZER : TELEDYNE API 200EH Serial No. : 774
Model : 200

Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.07	0.03
Low-Level Gas	82.30	82.49	0.04
Span Gas	164.40	164.50	0.04

SO₂ ANALYZER : TELEDYNE API 100EH Serial No. : 437
Model : 290

Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.01
Low-Level Gas	78.75	78.76	0.01
Span Gas	156.90	156.98	0.02

CO ANALYZER : TELEDYNE API 300EM Serial No. : 451
Model : 500

Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.01
Low-Level Gas	79.48	79.43	0.01
Span Gas	407.40	407.35	0.01

Calibrated by

Sakitt P.

(Mr. Sakitt Phaisanphait)
Environmental Field Scientist (4)



Lot No. 24121667-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Ulae HRSG 11
Date : 21 Nov 24 Test Operator : Sakitt P.O₂ ANALYZER : 16.02 Span (%) : 25
Cylinder Conc. (%) : 16.12

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.05	0.05	0.00	0.02	0.12	0.12
Upscale Gas	16.12	16.12	0.00	16.07	0.20	0.20

NO_x ANALYZER : 164.40 Span (ppm) : 200
Cylinder Conc. (ppm) : 164.50

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.07	0.07	0.00	0.01	0.03	0.03
Upscale Gas	164.50	164.50	0.00	164.42	0.04	0.04

SO₂ ANALYZER : 159.90 Span (ppm) : 200
Cylinder Conc. (ppm) : 159.98

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.04	0.00	0.02	0.01	0.01
Upscale Gas	159.98	159.98	0.00	159.95	0.02	0.02

CO ANALYZER : 407.40 Span (ppm) : 500
Cylinder Conc. (ppm) : 407.35

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.05	-0.05	0.00	-0.01	0.01	0.01
Upscale Gas	407.35	407.35	0.00	407.39	0.01	0.01

Calibrated by

(Mr. Sakitt Phalanphleut)

Environmental Field Scientist (4)

FORM NO. F-06-063 REVISION NO. 4 ISSUE DATE: 18/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 1
Date : 21 Nov 24 Location : Ulae HRSG 11
Start Time : 14:10 Test Operator : Sakitt P.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 14:30
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 437
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:10	14.08	3.83	15.81	0.12	0.32	
14:11	14.08	3.80	15.92	0.10	0.46	
14:12	14.07	3.80	15.17	0.10	0.54	
14:13	14.02	3.82	15.45	0.09	0.48	
14:14	14.02	3.82	15.68	0.08	0.56	
14:15	13.94	3.86	16.69	0.08	0.35	
14:16	14.02	3.83	16.09	0.08	0.38	
14:17	14.03	3.82	16.16	0.10	0.32	
14:18	14.00	3.84	16.33	0.11	0.35	
14:19	14.00	3.81	16.36	0.12	0.42	
14:20	13.93	3.85	16.64	0.14	0.38	
14:21	13.99	3.85	16.95	0.14	0.50	
14:22	14.07	3.81	16.68	0.16	0.55	
14:23	13.96	3.85	16.13	0.16	0.57	
14:24	13.95	3.84	16.54	0.19	0.62	
14:25	13.99	3.84	17.10	0.18	0.69	
14:26	13.94	3.86	17.14	0.18	0.64	
14:27	13.99	3.84	17.02	0.24	0.55	
14:28	14.04	3.81	16.74	0.23	0.45	
14:29	13.95	3.84	16.09	0.25	0.50	
14:30	13.95	3.85	16.28	0.26	0.57	
Average	14.00	3.83	16.40	0.15	0.49	

(Mr. Sakitt Phalanphleut)

Environmental Field Scientist (4)

FORM NO. F-06-030 REVISION NO. 1 ISSUE DATE: 15/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 2
Date : 21 Nov 24 Location : Ulae HRSG 11
Start Time : 14:31 Test Operator : Sakitt P.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 14:51
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 437
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:31	14.05	3.82	16.65	0.29	0.48	
14:32	14.05	3.80	15.99	0.30	0.48	
14:33	14.07	3.79	15.39	0.30	0.51	
14:34	14.10	3.79	15.33	0.30	0.77	
14:35	14.00	3.80	15.32	0.31	0.72	
14:36	13.98	3.84	16.13	0.30	0.67	
14:37	13.94	3.85	16.80	0.32	0.59	
14:38	14.02	3.82	16.31	0.33	0.59	
14:39	13.94	3.85	16.22	0.34	0.60	
14:40	13.95	3.88	16.57	0.34	0.63	
14:41	13.99	3.85	17.08	0.36	0.68	
14:42	14.01	3.83	16.75	0.36	0.62	
14:43	14.01	3.83	16.47	0.37	0.52	
14:44	14.03	3.81	16.23	0.39	0.74	
14:45	14.00	3.81	16.23	0.38	0.66	
14:46	13.94	3.85	16.63	0.39	0.82	
14:47	13.98	3.87	17.15	0.40	0.62	
14:48	13.95	3.85	17.36	0.39	0.68	
14:49	13.97	3.86	17.22	0.40	0.81	
14:50	13.94	3.86	17.60	0.40	0.87	
14:51	13.99	3.85	17.36	0.43	0.88	
Average	13.99	3.83	16.51	0.35	0.67	

(Mr. Sakitt Phalanphleut)

Environmental Field Scientist (4)

FORM NO. F-06-060 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 3
Date : 21 Nov 24 Location : Ulae HRSG 11
Start Time : 14:52 Test Operator : Sakitt P.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 15:12
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 437
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:52	13.93	3.87	17.47	0.43	0.66	
14:53	14.02	3.83	17.06	0.45	0.62	
14:54	14.02	3.81	16.40	0.45	0.83	
14:55	13.95	3.85	16.04	0.45	0.66	
14:56	13.97	3.87	16.61	0.46	0.97	
14:57	13.94	3.86	17.23	0.10	0.30	
14:58	13.94	3.86	17.18	0.13	0.29	
14:59	13.99	3.83	16.99	0.14	0.32	
15:00	13.97	3.82	16.49	0.13	0.19	
15:01	13.98	3.83	16.44	0.14	0.32	
15:02	13.99	3.83	16.53	0.15	0.32	
15:03	14.00	3.84	16.47	0.14	0.31	
15:04	13.99	3.82	16.41	0.16	0.27	
15:05	14.00	3.82	16.94	0.17	0.34	
15:06	13.95	3.84	16.14	0.17	0.25	
15:07	13.96	3.86	16.33	0.17	0.26	
15:08	14.00	3.82	16.55	0.18	0.15	
15:09	13.93	3.85	16.54	0.17	0.14	
15:10	13.98	3.85	16.67	0.20	0.13	
15:11	13.96	3.84	16.96	0.18	0.26	
15:12	13.96	3.84	16.83	0.20	0.31	
Average	13.97	3.84	16.63	0.23	0.39	

(Mr. Sakitt Phalanphleut)

Environmental Field Scientist (4)

FORM NO. F-06-060 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group



Lot No. 24121885-1

ANALYZER CALIBRATION DATA

Client : Gulf T&S Co., Ltd. Location : Uda HRSG 12
Date : 21 Nov 24 Test Operator : Sathaporn T.O₂ ANALYZER : TELEDYNE API 200EH Serial No. : 735
Model :
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.04
Low-Level Gas	8.19	8.20	8.21	0.04
Span Gas	16.07	16.08	16.09	0.04

NO₂ ANALYZER : TELEDYNE API 200EH Serial No. : 735
Model :
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.01
Low-Level Gas	55.91	55.90	55.90	0.00
Span Gas	82.51	82.51	82.48	0.03

SO₂ ANALYZER : TELEDYNE API 100EH Serial No. : 410
Model :
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	50.28	56.27	56.27	0.00
Span Gas	79.76	79.75	79.74	0.01

CO ANALYZER : TELEDYNE API 300EM Serial No. : 425
Model :
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.01
Low-Level Gas	55.20	55.19	55.18	0.01
Span Gas	79.74	79.74	79.72	0.02

Calibrated by

Sathaporn.T

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F 06-002 REVISION NO. 4 ISSUE DATE 18/01/24
ALS Laboratory Group

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Lot No. 24121885-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Uda HRSG 12
Date : 21 Nov 24 Test Operator : Sathaporn T.O₂ ANALYZER : 16.07 Span (%) : 25
Cylinder Conc. (%) :

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.02	0.08	0.02	0.08	0.00
Upscale Gas	16.08	16.10	0.08	16.10	0.08	0.00

NO₂ ANALYZER : 82.51 Span (ppm) : 100
Cylinder Conc. (ppm) :

	NO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.03	0.02	0.03	0.02	0.00
Upscale Gas	82.51	82.45	0.06	82.45	0.06	0.00

SO₂ ANALYZER : 79.76 Span (ppm) : 100
Cylinder Conc. (ppm) :

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.01	0.00	0.01	0.00	0.00
Upscale Gas	79.75	79.72	0.03	79.71	0.04	0.01

CO ANALYZER : 79.74 Span (ppm) : 100
Cylinder Conc. (ppm) :

	GO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.03	0.02	0.03	0.02	0.00
Upscale Gas	79.74	79.70	0.04	79.70	0.04	0.00

Calibrated by

Sathaporn.T

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F 06-003 REVISION NO. 4 ISSUE DATE 18/01/24
ALS Laboratory Group

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EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 1
Date : 21 Nov 24 Location : Uda HRSG 12
Start Time : 14:25 Test Operator : Sathaporn T.
Finish Time : 14:45
SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 410
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 735
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NOx (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:25	13.86	4.00	14.62	0.02	1.10	
14:26	13.90	3.92	15.28	0.02	1.20	
14:27	13.88	3.88	15.39	0.04	1.11	
14:28	13.87	3.92	15.70	0.02	1.01	
14:29	13.94	3.89	15.52	0.00	0.97	
14:30	13.96	3.89	14.73	0.03	0.83	
14:31	13.86	3.96	15.06	0.00	0.93	
14:32	13.89	3.93	15.78	0.00	0.95	
14:33	13.94	3.89	15.19	0.00	0.86	
14:34	13.94	3.90	14.81	0.00	0.92	
14:35	13.94	3.94	14.74	0.01	0.89	
14:36	13.95	3.90	14.79	0.00	0.95	
14:37	13.95	3.91	15.02	0.01	0.88	
14:38	13.96	3.91	14.99	0.02	0.81	
14:39	13.91	3.93	14.69	0.02	0.87	
14:40	13.91	3.94	14.54	0.02	0.75	
14:41	13.85	3.96	15.37	0.03	0.75	
14:42	13.89	3.94	16.54	0.02	0.64	
14:43	13.95	3.89	16.25	0.00	0.67	
14:44	13.95	3.87	15.67	0.02	0.70	
14:45	13.94	3.93	15.20	0.06	0.67	
Average	13.92	3.92	15.25	0.02	0.88	

Sathaporn.T

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

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EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 2
Date : 21 Nov 24 Location : Uda HRSG 12
Start Time : 14:46 Test Operator : Sathaporn T.
Finish Time : 15:00
SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 410
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 735
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NOx (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:46	13.92	3.92	15.07	0.00	0.69	
14:47	13.87	3.87	15.02	0.01	0.68	
14:48	13.87	3.84	15.04	0.01	0.53	
14:49	13.87	3.84	15.01	0.01	0.58	
14:50	13.87	3.85	14.97	0.02	0.55	
14:51	13.87	3.86	14.88	0.03	0.54	
14:52	13.85	3.85	15.05	0.03	0.53	
14:53	13.83	3.87	15.17	0.00	0.43	
14:54	13.79	3.88	15.69	0.03	0.48	
14:55	13.81	3.90	15.77	0.01	0.55	
14:56	13.84	3.86	15.32	0.01	0.53	
14:57	13.85	3.82	15.00	0.04	0.49	
14:58	13.85	3.82	15.04	0.00	0.56	
14:59	13.79	3.95	15.43	0.05	0.61	
15:00	13.75	3.89	16.07	0.01	0.64	
15:01	13.80	3.85	15.87	0.02	0.75	
15:02	13.79	3.88	15.34	0.03	0.61	
15:03	13.76	3.89	15.55	0.01	0.67	
15:04	13.78	3.84	15.53	0.03	0.78	
15:05	13.80	3.88	14.91	0.02	0.65	
15:06	13.80	3.86	14.35	0.02	0.59	
Average	13.83	3.87	15.24	0.02	0.60	

Sathaporn.T

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

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ALS Laboratory Group

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EMISSION TEST RESULT

Client	Gulf T54 Co., Ltd.	Run #	3
Date	21 Nov 24	Location	1404 HR50 12
Start Time	15:07	Test Operator	Sethaporn T.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	15:27
NO ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:07	13.81	3.85	14.11	0.02	0.55	
15:08	13.80	3.85	14.28	0.01	0.53	
15:09	13.78	3.82	14.95	0.03	0.53	
15:10	13.80	3.85	15.42	0.03	0.46	
15:11	13.84	3.83	15.30	0.02	0.49	
15:12	13.87	3.80	15.00	0.07	0.52	
15:13	13.89	3.81	14.82	0.06	0.52	
15:14	13.92	3.79	14.71	0.03	0.46	
15:15	13.94	3.78	14.70	0.03	0.49	
15:16	13.92	3.75	14.77	0.01	0.54	
15:17	13.96	3.81	14.61	0.01	0.61	
15:18	13.96	3.80	14.43	0.01	0.68	
15:19	13.96	3.77	14.64	0.04	0.49	
15:20	13.96	3.78	15.43	0.01	0.60	
15:21	13.99	3.74	15.67	0.02	0.55	
15:22	13.97	3.75	15.69	0.00	0.52	
15:23	14.09	3.62	15.59	0.00	0.48	
15:24	14.20	3.85	15.41	0.06	0.46	
15:25	14.25	3.83	14.81	0.02	0.49	
15:26	13.94	3.80	14.70	0.01	0.52	
15:27	13.92	3.81	14.77	0.01	0.52	
Average	13.94	3.79	14.94	0.02	0.52	

Sethaporn.T

(Mr. Sethaporn Thakaw)

Environmental Field Scientist (3)



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE
(THAILAND) LTD
Part Number: E04N199E3HA0002
Cylinder Number: GN0027210
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: CO,NO,NOX,SO₂,BALN

Reference Number: 180-402340013-1
Cylinder Volume: 247.2 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Feb 11, 2022

Expiration Date: Feb 11, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/4-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are in mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.36 PPM	G1	+/- 1.6% NIST Traceable	02/04/2022, 02/11/22
CARBON MONOXIDE	80.00 PPM	79.46 PPM	G1	+/- 0.6% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	82.36 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/22
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/22
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	CC733108	98.81 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Oct 06, 2026
NTRM	200610-04	CC708944	98.81 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Oct 06, 2026
NTRM	12420884139	CC523707	4.087 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 26, 2023

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Feb 03, 2022
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 10, 2022
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 27, 2022
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 20, 2022

Triad Data Available Upon Request

Net Weight: 48.5 Kg

Net Weight: 8.1 Kg



FORM NO. F 06-060 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group

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Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A021C
Cylinder Number: CC709609
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12021
Gas Code: CO,NO,NOX,SO₂,BALN

Reference Number: 160-402020199-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Feb 22, 2021

Expiration Date: Feb 22, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/4-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.96 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.84 PPM	G1	+/- 0.1% NIST Traceable	02/15/2021
NITRIC OXIDE	55.00 PPM	54.69 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14080753	CC434455	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12385	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-04	CC707963	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
GMS	124206849	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL002190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Feb 04, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

Net Weight: 28.8 Kg
Net Weight: 4.8 Kg



Approved for Release

Page 1 of 160-402020199-1



Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Chatham, NJ 08072-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E3HA0026
Cylinder Number: ND62877
Laboratory: 124 - Riverston (SAP) - NJ
PGVP Number: B52018
Gas Code: CO,NO,NOX,SO₂,BALN

Reference Number: 82-401257890-1
Cylinder Volume: 247.2 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Aug 07, 2018

Expiration Date: Aug 07, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/4-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
NITRIC OXIDE	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
SULFUR DIOXIDE	160.0 PPM	158.9 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
CARBON MONOXIDE	400.0 PPM	407.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	17060241	EB007557	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	May 11, 2019
PRM	12388	5604110	29.89 PPM NITROGEN DIOXIDE/AIR	+/- 1.6%	Jun 02, 2017
GMS	7042010104	CC52841	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	11010414	KAL004782	96.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	15080538	CC45307	491.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 08, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 CO	FTIR	Jul 18, 2018
Nicolet 6700 APW1100391 NO	FTIR	Jul 12, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 03, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 02, 2018

Triad Data Available Upon Request

Net weight: 8107 grams
Gross weight: 47090 grams

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol EPA-600/4-12/031. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

Page 1 of 1 82-401257890-1

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E04N199E3HA0002 Reference Number: 160-402138465-1
Cylinder Number: ND11222 Cylinder Volume: 247.2 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12021 Valve Outlet: 590
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jul 15, 2021
Expiration Date: Jul 15, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable
CARBON MONOXIDE	80.00 PPM	78.74 PPM	G1	+/- 0.6% NIST Traceable
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable
SULFUR DIOXIDE	80.00 PPM	78.78 PPM	G1	+/- 1.0% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	11010130	KAL004538	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%
NTRM	200610-50	CC733428	68.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%
GMS	124226889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%
NTRM	19010224	KAL000638	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.5%

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret ISO FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicoret ISO FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicoret ISO FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicoret ISO FTIR AUP2010245 SO2	FTIR	Jul 06, 2021

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.0 Kg
Net Weight: 7.8 Kg



Michael J. Kuhl
Approved for Release

Page 1 of 160-402138465-1

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E02N182E3HA0000 Reference Number: 82-401018725-1
Cylinder Number: ND60018 Cylinder Volume: 248.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2214 PSIG
PGVP Number: BS2017 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Oct 23, 2017
Expiration Date: Oct 23, 2025

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	8.000 %	8.000 %	G1	+/- 0.4% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	09080208	CC262337	9.961 % OXYGEN/NITROGEN	+/- 0.3%

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA 510-G2-TVMU041	Paramagnetic	Sep 28, 2017

Triad Data Available Upon Request

NOTES:
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 2000.02

D. Miller
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Page 1 of 82-401018725-1

CERTIFICATE OF ANALYSIS Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001 Reference Number: 160-402340010-1
Cylinder Number: GN0027197 Cylinder Volume: 249.8 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12022 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Feb 02, 2022
Expiration Date: Feb 02, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	16.00 %	16.02 %	G1	+/- 0.4% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	08010230	K003228	23.20 % OXYGEN/NITROGEN	+/- 0.4%

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 8 - N1-W5-951 - O2	PARAMAGNETIC	Jan 27, 2022

Triad Data Available Upon Request

NOTES: Gross Weight: 48.5 Kg
Net Weight: 8.2 Kg



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Page 1 of 160-402340010-1

CERTIFICATE OF ANALYSIS Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001 Reference Number: 160-402830555-1
Cylinder Number: GN0029535 Cylinder Volume: 250.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12023 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Sep 05, 2023
Expiration Date: Sep 05, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results apply only to the items listed. The report shall not be reproduced in full without approval of the issuer. Do not use this cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	16.00 %	16.07 %	G1	+/- 0.4% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	08010230	K003228	23.2 % OXYGEN/NITROGEN	+/- 0.4%

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 8 - N1-W5-951 - O2	PARAMAGNETIC	Aug 11, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 50.0 Kg
Net Weight: 8.4 Kg



Robert A. Miller
Approved for Release

Page 1 of 1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02N182E3HA0000 Reference Number: 160-401948144-1
Cylinder Number: GN0025086 Cylinder Volume: 248.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12020 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Nov 11, 2020

Expiration Date: Nov 11, 2028

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a solar analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are in mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.186 %	G1	+/- 0.3% NIST Traceable	11/11/20
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010602	1038055	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 10, 2022

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-651 - 02	PARAMAGNETIC	Oct 28, 2020

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.1 Kg
Net Weight: 8.2 Kg



Approved for Release

Page 1 of 16h4n44

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292 MTC No. EEL, BP. 83/0267

CALIBRATION CERTIFICATE

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

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator
Temperature : (23 ± 3) °C
Manufacturer : Rion
Relative Humidity : (50 ± 15) %
Model : NC-74
Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 134178121 (ID:RYG_FS0213)
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037,
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484,
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214,
4. Digital Multimeter Agilent 34401A S/N MY44005560,
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001,
6. Audio Analyzer Keithley 2015-P S/N4106495,
7. Condenser Microphone B&K 4180 S/N 2839871.

Calibration Procedure: C1-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 19 Feb. 2024
Date of Calibration : 28 Feb. 2024

The results relate only to the items tested and based on values assumed.
Advertising the Report/Certificate and publication of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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Office: 101 Phumyothin Road, Bangkok, Thailand
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SITHIPORN ASSOCIATES CO., LTD.

CALIBRATION LABORATORY

451/4511 Sathorn Road, Bangpoo, Bangkok, 10700 Thailand
Tel: +66 2433 6351 Email: calibration@sithiporn.com

SITHIPORN ASSOCIATES



Cert. No.: ACL24094
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Pre-amplifier NH-24
Serial No.: 01222723 / 143841 / 22770
ID No.: RYG_FS0022

Condition As Found : GOOD

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

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

Received Date : 19 JANUARY 2024
Calibration Date : 25-26 JANUARY 2024
Date of Issue : 29 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292 MTC No. EEL, BP. 83/0267

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

Note: 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Calibrated by : (Mr. Weerachai Deechaiyao)
Approved by : (Mr. Prayut Klueyae)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb. 2024
Date of Issue : 29 Feb. 2024

End of Certificate

Ref: 2011267021900719001

2 / 2

The results relate only to the items tested and based on values assumed.
Advertising the Report/Certificate and publication of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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E-mail: tistr@tistr.go.th

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CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunmu, Bangkok, Bangkok 10700 Thailand
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Cert. No. : ACL24094
Job No. : VC67AC0058
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	EI-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petch

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Cert. No. : ACL24094
Job No. : VC67AC0058
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	12.0
C - weight	18.4
Flat	24.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.7	±5.0

T. Petch

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Cert. No. : ACL24094
Job No. : VC67AC0058
Pages : 3 of 8

Summary of Measurement Result :

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

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Cert. No. : ACL24094
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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	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch

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Cert. No. : ACL24094
Job No. : VC67AC0058
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.1	0.1	± 1.1

T. Petchur

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Cert. No. : ACL24094
Job No. : VC67AC0058
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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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lpeak (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	132.9	-0.1	±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		
89.8	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

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Cert. No. : ACL24073
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122579 / 172172 / 74022
ID No.: RYG_FS0018

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 30) %

Received Date : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisitpaian

Approved by :

T. Petchur
(Thanakul Petchurai)

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Cert. No. : ACL24073
Job No. : VC67AC0054
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. Petch...

Cert. No. : ACL24073
Job No. : VC67AC0054
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	14.2
C - weight	19.2
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	0.2	0.2	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	3.3	3.4	3.4	±5.0

T. Petch...

Cert. No. : ACL24073
Job No. : VC67AC0054
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. : ACL24073
Job No. : VC67AC0054
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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch...

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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	34.0	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

7. Peter

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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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	± 3.0
One	136.4	136.4	0.0	± 3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	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

7. Peter

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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	0.0	± 1.5

12. High level stability

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

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

End of Calibration Certificate

7. Peter

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Cert. No. : ACL24074
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122607 / 145554 / 34373
ID No.: RYG_FS0019

Condition As Found : GOOD

Customer : A.I.S. 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 : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : *7. Peter*
(Thanakul Petchurai)

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Job No. : VC67AC0054
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-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

Signature

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Cert. No. : ACL24074
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Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.0

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	22.7

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	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.4	-1.4	-1.3	±5.0

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Cert. No. : ACL24074
Job No. : VC67AC0054
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

Signature

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Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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

Signature

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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	104.1	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	25.0	0.0	± 1.1

T. Petchur

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Cert. No. : ACL24074
Job No. : VC67AC0054
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 Weighing	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	0.0	±1.5

12. High level stability

Frequency Weighing	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. : ACC24008
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG_TS0496

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pitsuppaissan

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

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

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

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

T. Petchurui

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

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

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

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

End of Calibration Certificate

T. Petchurui

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Cert. No. : ACL24007
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173609 / 172170 / 74021
ID No.: RYG_FS0388

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KJIT 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 : 05-06 JANUARY 2024
Date of Issue : 09 JANUARY 2024

Calibrated by : Nalinorn Pisutpaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

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Cert. No. : ACL24007
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL_BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchurui

Summary of Measurement Result 1.

Parameter	Uncertainty	Maximum-permitted
	(dB)	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. Petchu.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A-weight	13.4
C-weight	19.9
Flat	25.3

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	0.1	0.1	0.1	± 1.0
8000	0.8	0.9	0.9	± 5.0

T. Petchu.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

T. Petchu.

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Cert. No. : ACL24007
Job No. : VC67AC0044
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 171/0167

CALIBRATION CERTIFICATE

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

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

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

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296518 (ID: RYG_FS0431)

Microphone : Type UC-52 No.66239

Preamplifier : Type N11-24 No.34375

Standards used :

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

Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

REVIEW BY *Kinghorn P.*
APPROVED BY *[Signature]*
EFFECTIVE DATE 21/2/25

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

1/9

The results, data and/or to the data is provided in full or as attached.

Advising the Report/Certificate and validity of the results is not in full or as attached unless written permission is obtained from the provider of TISTR.

FM/LMTC 002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 171/0167

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

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

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

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

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb. 2024

2/9

The results, data and/or to the data is provided in full or as attached.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 171-0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.3	113.9	-0.1	1.0	0.20	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 125.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.2	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	14.4	0.10	N/A
C-Weight	19.9	0.10	N/A
Flat	25.3	0.10	N/A

Date of Calibration : 22-28 Feb. 2024

3 / 9

The results relate only to the items tested/calibrated as stated above.
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Request No. 21-67/0232

MTC No. EEL, BP, 171-0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	-0.1	0.2	0.1	1.5	0.45	0.6
1 000	0.0	0.0	0.0	1.0	0.45	0.6
8 000	-1.7	-1.7	-1.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 171-0167

5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 171-0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 171/0167

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	43.9	-0.1	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.8	-0.2	1.1	0.30	0.3

8. Level linearity including the level range control

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

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 171/0167

8. Level linearity including the level range control

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

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

9. Tone burst response

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

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 171/0167

10. Peak C sound level

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

11. Overload indication

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

12. High-level stability

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

Calibrated by :
(Mr. Pannasit Phasingat)

Approved by :
(Mr. Prawate Klaiyap)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref : 2011267012400347001

End of Certificate

9/9

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SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirdhorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND.
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Cert. No. : ACL23321
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00597168 / 179117 / 87524
ID No. : RYG_FS0438

Condition As Found : GOOD

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

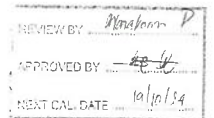
Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 11 OCTOBER 2023
Calibration Date : 19-20 OCTOBER 2023
Date of Issue : 24 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Peichurai)



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-TS12-03-04-020661

Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	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).

Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 3 of 8

Summary of Measurement Result :

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

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

QI-TS12-04-04-020664

QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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	17.8
Flat	23.2

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	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.0	2.1	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±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	-0.1	±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

QI-TS12-04-04-020664

QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.6	-0.8	±3.0

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

QI-TS12-04-04-020664

7. Retu



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 176/0167

CALIBRATION CERTIFICATE

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

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-42
Serial No. : 00900071 (ID RYG_FS0492)
Microphone : UC-52 No.18464
Preamplifier : N11-24 No.01733
Standards used :

Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa



1. Band Pass Filter Wavelec 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889671.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Jan. 2024

Date of Calibration : 23 Feb.2024-1 Mar.2024

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The results relate only to the items tested/calibrated and are not intended to be used for any other purpose without written permission from the provider of this R.

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Continuation of Calibration Certificate

Cert. No. : ACL23321
Job No. : VC67AC0011
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QI-TS12-04-04-020664

7. Retu



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 176/0167

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

Calibration Procedure :

This instrument was calibrated by using calibration procedures in CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.94	113.7	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	12.4	0.10	N/A
C-Weight	18.1	0.10	N/A
Flat	23.9	0.10	N/A

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.2	0.2	1.5	0.45	0.6
1 000	-0.1	-0.1	-0.1	1.0	0.45	0.6
8 000	0.3	0.3	0.2	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.8	-0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 23 Feb 2024-1 Mar 2024

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Request No. 21-67/0232

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8. Level linearity including the level range control

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

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

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
SEL	200	120.0	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.8	-0.2	+1.5; -5.0	0.20	0.3

Date of Calibration : 23 Feb 2024-1 Mar 2024

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Request No. 21-67/0232

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle	(dB)	(±dB)	(±dB)	(±dB)
135.0	135.0	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawakiat Jamsamran)

(Mr. Praphayak Kiatyap)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb 2024-1 Mar 2024

Date of Issue : 1 Mar. 2024

Ref: 2011267012400347006

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP. 177/0167

CALIBRATION CERTIFICATE

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

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

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

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900072 (ID-RYG_FS0493)

Microphone : UC-52 No.188465

Preamplifier : NH-24 No.01734

Standards used :

- Band Pass Filter Wavetek 752A S/N 99010494.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Huke 8520A S/N 4985007.
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Date of Receipt : 24 Jan. 2024

Date of Calibration : 23 Feb 2024-1 Mar 2024

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11. Digital Multimeter Agilent 34401A S/N MY44005560.
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The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

Date of Calibration : 23 Feb 2024-1 Mar 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.3	0.4	0.4	1.5	0.45	0.6
1 000	-0.2	-0.2	-0.2	1.0	0.45	0.6
8 000	-0.4	-0.5	-0.5	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 23 Feb 2024-1 Mar 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (±dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.91	114.0	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
17.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	11.3	0.10	N/A
C-Weight	17.0	0.10	N/A
Flat	23.4	0.10	N/A

Date of Calibration : 23 Feb 2024-1 Mar 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 23 Feb 2024-1 Mar 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.1	0.1	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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MTC No. EEL, BP, 177/0167

8. Level linearity including the level range control

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

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

9. Tone burst response

Time Weighting	Toneburst Duration, 1b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	109.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
	200	120.0	0.0	±1.0	0.20	0.3
SEL	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	135.5	0.0	1.5	0.20

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawikiat Jamsunran)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb.2024-1 Mar.2024

Date of Issue : 1 Mar. 2024

Ref : 2011267012400347007

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

CALIBRATION CERTIFICATE

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

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., A-Mung, Samutprakarn 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900073 (ID:RYG_FS0494)

Microphone : UC-52 No.18466

Preamplifier : NI-24 No.01735

Standards used :

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

Date of Receipt : 24 Jan, 2024

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.91	114.1	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	12.9	0.10	N/A
C-Weight	18.5	0.10	N/A
Flat	24.2	0.10	N/A

Date of Calibration : 23 Feb.2024-1 Mar.2024

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

Calibration Procedure :

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

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

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

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

3. Acoustical signal test of frequency weightings

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

4. Electrical signal test of frequency weightings

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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TMBL/MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP. 178/0167

5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 23 Feb 2024-1 Mar 2024

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FM/BL/MTC 002 Rev 4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP. 178/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3

Date of Calibration : 23 Feb 2024-1 Mar 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP. 178/0167

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 23 Feb 2024-1 Mar 2024

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Request No. 21-67/0232

MTC No. EEL, BP. 178/0167

8. Level linearity including the level range control

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

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

9. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	109.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
	0.25	120.0	0.0	±1.0	0.20	0.3
SEL	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 23 Feb 2024-1 Mar 2024

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Request No. 21-67/0232

MTC No. EFL, BP, 178/0167

10. Peak C sound level

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

11. Overload indication

Measured value (dB)		Deviated value	Acceptance limit class 2	Uncertainty	Maximum-permitted uncertainty of measurement
Positive one-half cycle	Negative one-half cycle	(dB)	(±dB)	(±dB)	(±dB)
135.5	135.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

T. Petchur
(Mr. Tawikiat Jansamran)

Approved by :

Mr. Prayut Klaiyap
(Mr. Prayut Klaiyap)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb.2024-1 Mar.2024

Date of Issue : 1 Mar. 2024

Ref : 2011267012400347008

End of Certificate

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PMEL/MTC 002 Rev.4

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Cert. No. : ACC24055
Job No. : VC68AC0015
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-42KA1	34560495	AA-3001-24	05-FEB-25
Audio Analyzer	AVR-3360A	V74B6069	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).

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Cert. No. : ACC24055
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178124
ID No. : RYG_FS0216

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 : 18 OCTOBER 2024
Calibration Date : 22 OCTOBER 2024
Date of Issue : 24 OCTOBER 2024

Calibrated by : Nuthakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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Cert. No. : ACC24055
Job No. : VC68AC0015
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	94.19	0.19	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1001.3	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
1.82	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

T. Petchur

Cert. No. : ACL24076

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734221 / 157777 / 22653
ID No.: RYG_FS0027

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 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 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
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Cert. No. : ACL24076
Job No. : VC67AC0054
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

Cert. No. : ACL24076
Job No. : VC67AC0054
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Cert. No. : ACL24076
Job No. : VC67AC0054
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A-weight	12.6
C-weight	18.9
Flat	24.7

3. Acoustical signal tests of frequency weightings

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

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

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Cert. No. : ACL24076
Job No. : VC67AC0054
Pages : 6 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	-0.1	0.0	-0.1	±1.5
250	-0.1	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	0.0	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	94.0	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	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 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	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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Cert. No. : ACL24076
Job No. : VC67AC0054
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, 1. peak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	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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Cert. No. : ACL24076
Job No. : VC67AC0054
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch

Cert. No. : ACL24304
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RJON
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00873057 / 171591 / 73333
ID No. : RYG_FS0381

Condition As Found : GOOD

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

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

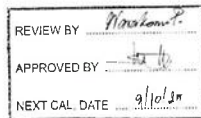
Received Date : 23 SEPTEMBER 2024
Calibration Date : 09 OCTOBER 2024
Date of Issue : 09 OCTOBER 2024

Calibrated by : Natlakorn 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. : ACL24304
Job No. : VC67AC0164
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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Cert. No. : ACL24304
Job No. : VC67AC0164
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

Cert. No. : ACL24304
Job No. : VC67AC0164
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)
16.7

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

Frequency Weighting	Weighting (dB)
A - weight	13.4
C - weight	19.3
Flat	25.0

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.1	1.2	1.2	± 5.0

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 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	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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

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10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.9	-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	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No.21-67/0232

MTC No. EEL, BP, 174/0167

CALIBRATION CERTIFICATE

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

Address : 104 Phatthanasak 40, Phatthanasak Rd., Kluang Phatthanasak, Khet Suan Luang, Bangkok 10250,

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

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NI-42

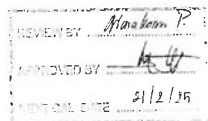
Serial No. : 00296517 (ID: RYG_FS0434)

Microphone : Type UC-52 No.135220

Preamplifier : Type NI-24 No.87527

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494,
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871,
3. Decade Attenuator Ando AL-205 S/N 00461602,
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042665,
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037,
6. Digital Multimeter Fluke 8520A S/N 4985007,
7. Phonophone Rion NC-72 S/N 00402446,
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.



Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

The results relate only to the items tested/calibrated or value assessed.

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Request No.21-67/0232

MTC No. EEL, BP, 174/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.3	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.5 dB.

2. Self-generated noise

2.1 Normal test

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

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	14.1	0.10	N/A
C-Weight	19.6	0.10	N/A
Flat	24.9	0.10	N/A

Date of Calibration : 22-28 Feb. 2024

The results relate only to the items tested/calibrated or value assessed.

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Request No.21-67/0232

MTC No. EEL, BP, 174/0167

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

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

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

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

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb. 2024

The results relate only to the items tested/calibrated or value assessed.

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	±DIV/0!	±DIV/0!	±DIV/0!	1.5	±DIV/0!	0.6
1 000	±DIV/0!	±DIV/0!	±DIV/0!	1.0	±DIV/0!	0.6
8 000	±DIV/0!	±DIV/0!	±DIV/0!	5.0	±DIV/0!	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP, 174-0167

5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL BP, 174-0167

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL BP, 174-0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL BP, 174-0167

8. Level linearity including the level range control

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

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

9. Tone burst response

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

Date of Calibration : 22-28 Feb. 2024

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FMILMTC.002 Rev.4

Cert. No. : ACL24013
Job No. : VC67AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	20.3
Flat	25.8

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	1.5	1.6	1.6	±5.0

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Cert. No. : ACL24013
Job No. : VC67AC0044
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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Cert. No. : ACL24013
Job No. : VC67AC0044
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	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	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.2	0.2	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.3	0.3	± 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	135.8	-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	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

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Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency	SLM Display	SLM Display	Deviated	Acceptance
Weighting	at initial	at final	Value	Limits
	(dB)	(dB)	(dB)	(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. : ACL24034
Pages : 1 of 8

Calibration Certificate

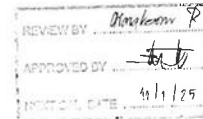
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623393 / 198640 / 26421
ID No. : RYG_FS0618

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 : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024



Calibrated by : Nuthakorn Pisutpaisan

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

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

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Cert. No. : ACL24034
Job No. : VC67AC0052
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-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

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

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Cert. No. : ACL24034
Job No. : VC67AC0052
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

Cert. No. : ACL24034
Job No. : VC67AC0052
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.4
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	0.1	0.1	0.1	± 1.0
8000	-0.3	-0.2	-0.2	± 5.0

7. P. 10

Cert. No. : ACL24034
Job No. : VC67AC0052
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

7. P. 10

Cert. No. : ACL24034
Job No. : VC67AC0052
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	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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Cert. No. : ACL24034
Job No. : VC67AC0052
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	5	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	5	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	5	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	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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

7. P. 10

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok, 10700 Thailand
Tel: 166 7433 8391 Email: calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24034
Job No. : VC67AC0052
Pages : 8 of 8



JIRANAT LEE ASSOCIATES CO., LTD.

Jiranan Associates Co., Ltd.
67/1-15, 67/25-36
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Mobile: +66-81-094533
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Web site: www.jiranan.com

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

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-054-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006713
ID NUMBER : RYG_F50218
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 : 12 Feb 2024
MEASUREMENT DATE : 15 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 WI-CL-001
according to comparison method with standard
digital temperature indicator and standard
temperature probe. The temperature scale use
was based on ITS-90.

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

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS500, Serial No: 667682-09,
Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI-1000 A MK II, Serial No: 671407-
00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sorewit Thachalas
☐ Miss Jittaporn Lertsomphol
☐ Miss Ruangrumpai Phoommitt



Approved signatory: Mr. Panyia Booncharoen
Calibration Department Manager

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



Continuation of Certificate of Calibration Number CDT-054-67

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: 22035270.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.064	20.1	0.0	0.099
80	25.053	25.1	0.0	0.099
80	30.043	30.1	0.1	0.099
80	35.033	35.1	0.1	0.099
80	40.018	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276 2 S/N: 22035462.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.064	20.1	0.0	0.099
110	25.053	25.1	0.1	0.16
110	30.043	30.2	0.2	0.099
110	35.033	35.2	0.2	0.099
110	40.018	40.2	0.2	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015499.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.3	0.2	0.099
75	25.053	25.2	0.1	0.099
75	30.043	30.0	0.0	0.099
75	35.033	35.0	0.0	0.099
75	40.018	39.8	-0.2	0.099

UUC*: Units Under Calibration
Remark: T1 is 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



JIRANAT LEE ASSOCIATES CO., LTD.

Jiranan Associates Co., Ltd.
67/1-15, 67/25-36
Pattana 77/1, 11, Wadthani, Bangkok
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Tel: +66-81-094532
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-055-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006714
ID NUMBER : RYG_F50219
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 : 12 Feb 2024
MEASUREMENT DATE : 15 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

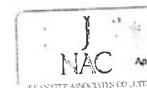
Calibration procedure:
The temperature calibration was done by
In-House calibration method as WI-CL-001
according to comparison method with standard
digital temperature indicator and standard
temperature probe. The temperature scale use
was based on ITS-90.

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

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS500, Serial No: 667682-09,
Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI-1000 A MK II, Serial No: 671407-
00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sorewit Thachalas
☐ Miss Jittaporn Lertsomphol
☐ Miss Ruangrumpai Phoommitt



Approved signatory: Mr. Panyia Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP9201.2 S/N: 22035263.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.063	20.4	0.3	0.099
80	25.054	25.4	0.3	0.099
80	30.040	30.4	0.4	0.099
80	35.026	35.4	0.4	0.099
80	40.018	40.4	0.4	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276 2 S/N: 17023217.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.064	20.3	0.2	0.099
110	25.054	25.3	0.2	0.099
110	30.040	30.3	0.3	0.099
110	35.027	35.3	0.3	0.099
110	40.018	40.3	0.3	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015491.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.5	0.4	0.099
75	25.054	25.4	0.3	0.099
75	30.041	30.4	0.4	0.099
75	35.026	35.3	0.3	0.099
75	40.018	40.2	0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-055-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006715
ID NUMBER : RYG_F50220
CONDITION AS-RECEIVED : Used Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khel Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 11 Jan 2024
MEASUREMENT DATE : 11 Jan 2024
ISSUE DATE : 17 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 temperature calibration was done by In-house calibration method as WA-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: EA-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.: 671407-00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jiraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP9201.2 S/N: 17022563.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.0	0.0	0.099
80	25.042	25.0	0.0	0.099
80	30.040	30.0	0.0	0.099
80	35.034	35.0	0.0	0.099
80	40.026	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276 2 S/N: 20019632.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.050	20.0	0.0	0.099
110	25.042	25.0	0.0	0.099
110	30.040	30.1	0.1	0.099
110	35.034	35.1	0.1	0.099
110	40.026	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015507.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.050	20.2	0.2	0.099
75	25.042	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.034	35.0	0.0	0.099
75	40.026	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-057-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006726
ID NUMBER : RYG_F50226
CONDITION AS-RECEIVED : Used Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khel Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 12 Feb 2024
MEASUREMENT DATE : 16 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 WA-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: EA-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.: 671407-00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jiraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

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

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: 15015841.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.054	20.0	-0.1	0.099
80	25.055	25.0	-0.1	0.099
80	30.041	30.0	0.0	0.099
80	35.032	35.0	0.0	0.099
80	40.018	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276 2 S/N: 20008282.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.0	0.1	0.099
110	25.055	25.1	0.0	0.099
110	30.041	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.018	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015494.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.054	20.2	0.1	0.099
75	25.054	25.0	-0.1	0.099
75	30.041	29.9	-0.1	0.099
75	35.032	34.8	-0.2	0.099
75	40.018	39.7	-0.3	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-017-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006738
ID NUMBER : RYG_F50223
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 11 Jan 2024
MEASUREMENT DATE : 12 Jan 2024
ISSUE DATE : 17 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

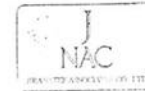
Calibration procedure:
The temperature calibration was done by In-House calibration method as (VIM-CL-001) according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

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

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS500, Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI-1000A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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

Calibrated by:
☐ Mr. Sorawit Thachaiad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangsri Phummit



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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: 18009588.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	20.1	0.0	0.099
80	25.045	25.1	0.1	0.099
80	30.040	30.1	0.1	0.099
80	35.039	35.1	0.1	0.099
80	40.030	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276 2 S/N: 20019638.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.1	0.1	0.14
110	25.045	25.7	0.7	0.099
110	30.040	30.3	0.3	0.099
110	35.039	35.3	0.3	0.099
110	40.030	40.3	0.3	0.099

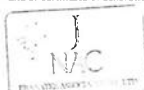
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015496.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.053	20.2	0.1	0.099
75	25.045	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.039	34.9	-0.1	0.099
75	40.030	39.8	-0.2	0.099

UUC*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.14, based on standard uncertainty multiplied by a coverage factor k=2 14 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-056-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006720
ID NUMBER : RYG_F50224
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 : 12 Feb 2024
MEASUREMENT DATE : 16 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 (VIM-CL-001) according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

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

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS500, Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI-1000A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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

Calibrated by:
☐ Mr. Sorawit Thachaiad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangsri Phummit



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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: 15035854.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.054	19.7	-0.4	0.099
80	25.054	24.7	-0.4	0.099
80	30.041	29.7	-0.3	0.099
80	35.032	34.7	-0.3	0.099
80	40.020	39.6	-0.4	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20008279.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.1	0.0	0.099
110	25.055	25.3	0.0	0.099
110	30.041	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.020	40.2	0.2	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015498.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.054	20.3	0.2	0.099
75	25.054	25.2	0.1	0.099
75	30.041	30.1	0.1	0.099
75	35.032	35.0	0.0	0.099
75	40.019	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



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

Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-012-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15020734
ID NUMBER : RYG_F50230
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 : 05 Jan 2024
MEASUREMENT DATE : 08 Jan 2024
ISSUE DATE : 09 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 temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90

Traceability:
The measurement results are traceable to the International System of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: 17-0038-23, Certificate number: EA-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe Model: STS-100 A500, Serial No. 667682 V5, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000 A MK II, Serial No. 071407-00591 Due date: 14 Sep 2024

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

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



Approved signatory:
Mr. Parinya Boonchareon
Calibration Department Manager

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

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: 17015112.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.059	20.0	-0.1	0.099
80	25.050	24.9	-0.1	0.16
80	30.044	29.9	-0.1	0.099
80	35.037	34.9	-0.1	0.099
80	40.034	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15028482.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.1	0.0	0.099
110	25.050	25.1	0.0	0.099
110	30.044	30.1	0.1	0.099
110	35.037	35.1	0.1	0.099
110	40.034	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15033222.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.1	0.0	0.099
75	25.050	24.9	-0.2	0.099
75	30.044	29.8	-0.2	0.099
75	35.038	34.7	-0.3	0.099
75	40.034	39.6	-0.4	0.099

UUC*: Unit 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



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

Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-085-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15030244
ID NUMBER : RYG_F50236
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

RECEIVED DATE : 15 May 2024
MEASUREMENT DATE : 17 May 2024
ISSUE DATE : 21 May 2024

ENVIRONMENTAL CONDITIONS:

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

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

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

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

Traceability:
The measurement results are traceable to the International System of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: 17-0047-24, Certificate number: EA-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe Model: STS-100 A500, Serial No. 667682 V5, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000 A MK II, Serial No. 071407-00591 Due date: 14 Sep 2024

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

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



Approved signatory:
Mr. Parinya Boonchareon
Calibration Department Manager

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

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: 20030506.
Dimension: Diameter 9.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.058	20.1	0.0	0.099
80	25.047	25.1	0.1	0.099
80	30.042	30.1	0.1	0.099
80	35.035	35.1	0.1	0.099
80	40.025	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17009694.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.058	20.0	-0.1	0.099
110	25.047	25.0	0.0	0.099
110	30.042	30.0	0.0	0.099
110	35.035	35.0	0.0	0.099
110	40.025	40.0	0.0	0.16

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15053223.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.1	0.0	0.099
75	25.047	25.0	0.0	0.099
75	30.043	29.8	-0.2	0.099
75	35.035	34.7	-0.3	0.099
75	40.024	39.6	-0.4	0.099

UUC*: Unit 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



Certificate of Calibration

Certificate No.: 24PH145

Page: 1 of 2

Equipment: Lux Meter

Manufacturer: Tenmars

Model: TM-201L

Serial No.: 199702490

ID No.: RYG_FS0471

Condition As-Received: Used Item

Received Date: 12 March 2024

Calibration Date: 14 March 2024

Reference: 2403-0392WSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

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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-PH01 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	120RC003	DL-0064-22	20 Jul 2025
2) Luminous intensity standard lamp	OL FEL-U	F-1543	TP-1030-23	08 Jun 2024

2. This result of calibration was made on request at the point specified by customer.

3. Test Equipment: Programmable Voltage/Current Source (Model: OL83A, S/N: 16221394)

4. Test Equipment: Illuminance Meter (Model: S1002, S/N: 080129)

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

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

- National Institute of Metrology Thailand (NIMT)

- National Institute of Metrology (Thailand): NSQ-ONSC Accredited No. Calibration 0144

Calibrated by: Nivat Nitas
Issue Date: 18 March 2024

Approved Signatory:
[] Phalinoo Prabpaijal
[] Wanlop Lorpkeom
[] Nuntawat Khanchai

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Certificate of Calibration

Certificate No.: 24PH145

Page: 1 of 2

Equipment: Lux Meter

Manufacturer: TENMARS

Model: TM-201L

Serial No.: 200300974

ID No.: RYG_FS0474

Condition As-Received: Used Item

Received Date: 12 March 2024

Calibration Date: 14 March 2024

Reference: 2403-0392WSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

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.

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-PH01 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	120RC003	DL-0064-22	20 Jul 2025
2) Luminous intensity standard lamp	OL FEL-U	F-1543	TP-1030-23	06 Jun 2024

2. This result of calibration was made on request at the point specified by customer.

3. Test Equipment: Programmable Voltage/Current Source (Model: OL83A, S/N: 16221394)

4. Test Equipment: Illuminance Meter (Model: S1002, S/N: 080129)

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

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

- National Institute of Metrology Thailand (NIMT)

- National Institute of Metrology (Thailand): NSQ-ONSC Accredited No. Calibration 0144

Calibrated by: Nivat Nitas
Issue Date: 18 March 2024

Approved Signatory:
[] Phalinoo Prabpaijal
[] Wanlop Lorpkeom
[] Nuntawat Khanchai



Cert. No.: 24PH146
Page: 2 of 2

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

Function : Illuminance Measurement

Range : 200 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
0	0,0	0,0	-
20	20,1	0,1	0,26
50	50,1	0,1	0,65
100	100,1	0,1	1,3
150	150,1	0,1	2,0
190	190,1	0,1	2,5

Function : Illuminance Measurement

Range : 2000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
200	200	0	2,6
500	500	0	6,5
1000	1000	0	13
1500	1500	0	20
1900	1900	0	25

Function : Illuminance Measurement

Range : 20000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
2000	1990	-10	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH890
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : C219171496
ID No. : RYG_FS0550
Condition As-Received: Used Item
Received Date : 26 July 2024
Calibration Date : 30 July 2024
Reference : 2407-0932DSC-2
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd, Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand

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

Calibrated by : Warakorn Lemgagrakul
Approved by : Sathip
Approved Signatory

() Unnopphol Harachai
() Ponpan Paipim
(✓) Sathip Meangmai
Issue Date : 30 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 24CH890
Page: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument

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

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

2. Certified Reference Materials

The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	970551	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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

Calibration Results

Function : mV Measurement

Performing standard curve by Document Process Calibrator at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: C219171496	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.00	0.58	2.00

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 3293237	4.008	4.01	177	0.0071	2.00
	6.986	6.99	2	0.011	2.00
	9.997	10.00	-173	0.0092	2.00

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

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



Certificate of Calibration

Cert. No.: 24LM121
Page.: 1 of 2

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seve2Go S2
Serial No. : C129171496
ID No. : RYG_FS0550
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd, Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand

Location : TPA On Site Calibration Laboratory

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

Calibrated by : Warakorn Lemgagrakul
Approved by : Kunchit
Approved Signatory

() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promrat
Issue Date : 01 August 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2407-0932DSC-4
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 241317 TPA 21 Mar 2025

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certificate is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N: 3184175

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.004	25.3	0.296	0.16	2.00
30.0	100	30.001	30.4	0.399	0.16	2.00
40.0	100	40.004	40.4	0.396	0.16	2.00
50.0	100	50.004	50.4	0.396	0.16	2.00

UUC* : Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 15, SUANLUANG, BANGKOK 10250
TEL: 0-2517-3000-24 FAX: 0-2716-9481



Certificate of Calibration

Certificate No.: 23E3924
Page: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 08 December 2023
Calibration Date: 14 December 2023
Reference: 2312-0151DSC
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 10) %
616/10 Moo 5, T. Maenam Khu, A. Phakdaeng,
Rayong 21140, Thailand
Procedure used: Calibration were conducted using calibration procedure No. CP-E17 according to EURAMET c9 15

Condition of this result of calibration

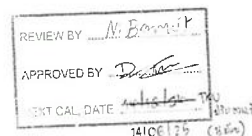
1. Reference standards instruments:

Instrument Model Serial No. Certificate No. Due Date
1) Multi-Product Calibrator 5502A 245502 EE-004-1-23 26 Apr 2024

2. This result of calibration was made on requested at the point specified by customer

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

4. This Certificate is traceable to the International System of Unit maintained through:-
- National Institute of Metrology Thailand (NIMT)



Calibrated by: Naphachon Prasomsakul
Issue Date: 15 December 2023

Approved Signatory: [Signature]
[] Phaisano Prapaisai
[x] Nantawat Khomchit
[] Pongsagom Boonyasarn

0331106



Cert. No.: 23E3924
Page: 2 of 2

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

Function: DC voltage measurement Range: 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (± µV)
-200.0000	-199.9	0.1	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	100.0	0.0	63
150.0000	150.0	0.0	65
200.0000	199.9	-0.1	68

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

UUC* = Unit Under Calibration.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 15, SUANLUANG, BANGKOK 10250
TEL: 0-2517-3000-24 FAX: 0-2716-9481



Certificate of Calibration

Cert. No.: 23CH1574
Page: 1 of 3

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 08 December 2023
Calibration Date: 15 December 2023
Reference: 2312-0151DSC-3
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5, T. Maenam Khu, A. Phakdaeng,
Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH6 by comparison with standard thermometer

Calibrated by: Warakorn Lemgagrakul

Approved by: [Signature]
Approved Signatory

[] Sathip Meangma
[] Warakorn Lemgagrakul
[x] Ponpan Palpm

Issue Date: 19 December 2023

The Uncertainties are for a confidence probability of approximately 95 %

For more detailed information, please refer to the certificate of calibration and the report of the calibration.
Approved by: Head of Calibration Services 3: Equipment Calibration and Testing Services

01193422

0061696



Cert.No.: 23CH1574
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :-

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

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

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASO National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value		Standard Voltage Input		Actual Reading	Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	pH			
pH Meter	4.000	177.48	177.3	4.000	0.058	2.00	
S/N: B834291445	7.000	0.00	-0.1	7.000	0.058	2.00	
	10.000	-177.46	-177.5	10.000	0.058	2.00	



Cert.No.: 23CH1574
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode	4.008	4.013	184.1	0.0045	2.00
S/N: 3225368	6.986	6.996	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0088	2.11

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLabSEExpert Pro-ISM

- Serial No. : 3225368

Dimension of probe;

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.003	24.3	-0.703	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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a 1193852

a 1193851

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8351-6, e-mail: service.thailand@sartorius.com



MSC-TSP-TIS 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY: *Tran-Vall*
APPROVED BY: *D. [Signature]*
NEXT CAL. DATE: 02/02/2025

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 24BCI0059
Issued Date : Friday, February 23, 2024
Reference No. : 229198
Page No. : 1 of 2

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

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

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Thursday, February 22, 2024
Calibration Procedure No. : This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2018

Metrological data :
Capacity : 220 g Readability : 0.0001 g
Ambients Conditions :
Temperature : 24.2 °C \pm 5.0 °C
Humidity : 57.0 % RH \pm 10.0 % RH
Pressure : \pm
Reasons for calibration
☐ New Installation ☐ Service / Required ☒ Re-calibration/ Maintenance ☐ Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref:Lab 14

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

Traceability:

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

This certificate relate and apply this equipment only.

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

Mr.chonchai.inthana(Technical Manager)



Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8351-6 Fax: +66 2543 6357, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 24BCI0059
Issued Date : Friday, February 23, 2024
Reference No. : 229198
Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.					
Nominal Value : (Low Load)	20.0000	199.9999			
20 g	20.0000	200.0000			
Tolerance	20.0001	200.0000			
0.0001 g	20.0000	199.9999			
	20.0001	200.0000			
Nominal Value : (High Load)	19.9999	200.0000			
200 g	20.0000	200.0000			
Tolerance	20.0000	199.9999			
0.0001 g	19.9999	200.0001			
	19.9999	200.0000			
Standard Deviation	0.00007	0.00006			

Eccentricity (Off-center loading error)		
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 DIN/EN 876).		
Nominal value :	100 g	
Tolerance	0.0004 g	
		Difference
		1 -
		2 -0.0001
		3 -0.0001
		4 0.0000
		5 -0.0001
		6 -

Linearity

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

Tolerance 0.0002 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00018
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.



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

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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a 1172155



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-2000-29 FAX: 0-2719-9484



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

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5 T. Maenam Khu. A. Pluakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 25 July 2023
Calibrated Date : 27 July 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Preecha Hiahib
Approved by :
() Pornthippa Tameyakul
() Malee Bulkrua
(✓) Suwit Imjai
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713DSC-2
Procedure Used :-

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

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	221285	TPA	21 Oct 2023

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

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

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

Result of Calibration :- (✓) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N : 1228475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC* : Unit Under Calibration

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

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a 1159515



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-2000-29 FAX: 0-2719-9484



Cert. No.: 24TM1683
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818.0084
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng,
Rayong 21140, Thailand
Location : BOD Room
Received Order : 01 November 2024
Calibration Date : 01 November 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Krisda Malee
Approved by :
() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promrat
Issue Date : 07 November 2024

REVIEW BY	
APPROVED BY	
NEXT CAL DATE	01/05/26

The Uncertainties are for a confidence probability of approximately 95%

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

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

Procedure Used :-

Calibration was conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY44073381 24LM73 TPA 18 May 2025

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

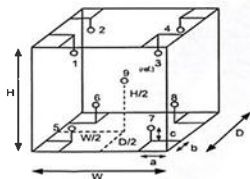
3. This certification is traceable to the International System of Unit.

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

Result of Calibration : (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

Dimension of Chamber :
a = 10 cm D = 0.60 m
b = 10 cm W = 1.0 m
c = 10 cm H = 1.2 m
Capacity = 0.72 m³

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

Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	23-01RTD-07
8	1RTD-2/8
9 (ref.)	23-01RTD-09



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

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

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.026	0.26	0.53	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.071	19.915	20.273	20.179	19.977	19.782	20.056	20.026	20.033	0.30

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

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

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

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

UUC* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SDI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL.0-2717-3000-29 FAX 0-2719-0484



Certificate of Calibration

Cert.No.: 24CG3711
Page.: 1 of 2

Equipment : Burette
Capacity : 50 mL
Serial No. : *
ID. No. : RYG_EN0216
Manufacturer : Witag
Made in : Germany
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakaeng
Rayong 21140, Thailand

Ambient Temperature : (20 ± 2.5) °C
Relative Humidity : (50 ± 10) %
Barometric Pressure : 756 mmHg
Calibration Procedure : ASTM E 542 - 01

Calibrated by : Sa-nguankarn Wongsu

Approved by :
Approved Signatory

(✓) Srisuda Khamliha
() Porpan Palpim
() Unnopphol Harachai

Issue Date : 24 September 2024

REVIEW BY
APPROVED BY
NEXT CAL DATE 24/09/25



Equipment : Burette
Received Date : 19 September 2024
Condition As-Received : Used Item
Calibration Date : 24 September 2024
Reference : 2409-0756DSC-3

Cert.No.: 24CG3711
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	XP205	B134206712	140RC007	24MM316	TPA	15 July 2025
2) Data Logger	HL-20D	20683159	140EC012	23H2174	TPA	10 Oct 2024
3) Thermometer	-	1594592	140EC010	241175	TPA	20 Feb 2025

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
10	10.0259	0.0082	2.00
20	20.0214	0.0085	2.00
30	30.0006	0.0089	2.00
40	40.0003	0.0094	2.00
50	49.9988	0.011	2.00

Remark mL = cm³

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

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The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Procedure Used :-

Cert. No.: 24TM635
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

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

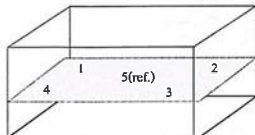
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (°) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental	AC Voltage Supply
	(°C)	(Volt)
Beginning of Calibration	25	222
Finished of Calibration	25	223



Front

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



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

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

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.426	84.424	84.489	84.507	84.477	0.18

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	2

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

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

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

UUC* : Unit Under Calibration

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

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

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Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhohi, 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. T241120

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)
Manufacturer : MODULAR
Model : IREVC0HCOO
Serial No. : C00351459
Customer Code : RYG_EN0184
ID No. : T1939A5
Customer : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140

Customer Location : Laboratory

Date of Receipt : 5 June 2024

Calibrated By : Sujjar Nakkred (Site Calibration Manager)

Approved By : Preecha Phisassutthikul (Temperature Calibration Manager)

Date of Issue : 12 JUN 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.



Metrology

SCI ECO Services Company Limited

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



Certificate No. T241120

Page 2 of 4

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 11 June 2024
Environment : Temperature : 23.1-24.1 °C
Line Voltage : 222.3-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine 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-120 (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	T240713	19 April 2025
TC	TYPE T	TN171-TN180	T240713	19 April 2025
DATA LOGGER	34970A	T149	T240713	19 April 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 : 3 Hour 30 Minute At 3 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☒ Not Available

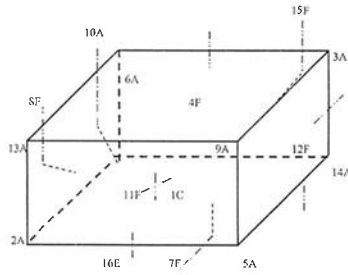
5. Adjustment :

() without adjustment

(X) after adjustment

Approved By

Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C = TN161	11F = TN171
2A = TN162	12F = TN172
3A = TN163	13A = TN173
4F = TN164	14A = TN174
5A = TN165	15F = TN175
6A = TN166	16E = TN176
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	

Approved By:

FM-L15 118 / 8-08-60

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
J	2.73	2.70	2.77	2.78	2.99	2.35	3.09	3.21	3.08	2.90
	TN171	TN172	TN173	TN174	TN175	TN176				
	3.39	3.01	2.93	2.81	3.42	3.42				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min, Max	Average					
3.0	2.9 , 4.4	3.7	2.97	1.32	1.13	2.02	2.00

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on t standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By:

Approved By:

FM-L15 118 / 8-08-60

FM-L15 118 / 8-08-60



Certificate of Calibration

Certificate No.: C06230441

Page 2 of 3

Equipment: SPECTROPHOTOMETER
Model: DR6000
Serial No. (or ID.): 1627845 (RYG_END037)
Manufacturer: HACH
Condition: In Condition

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

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

Environment Condition: Temperature 23.9 °C ± 0.2
Humidity 65.3 %RH ± 1.4

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

Calibration By: Mr.Nattapat Rungueang
Calibration Date: 18 September 2023
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Sarna Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584
The standard for Photometric Certificate No. 9114984 and 111583
The standard for Stray light Certificate No. 111586 and 111585
The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapat Rungueang)
Person in charge

(Mr. Nitinun Srihawan)
Authorized signatory

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

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

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

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CAL-FM-C06-15/ 12 Sep 2022

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.3	0.31	0.13
536.66	536.6	0.06	0.13
637.98	638.3	-0.32	0.13
748.46	748.7	-0.22	0.13
807.03	807.4	-0.37	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.269	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2518	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9468	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2578	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

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CAL-FM-C06-15/ 12 Sep 2022

Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	0.737	-0.0015	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2864	0.290	-0.0036	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)	
260.82 +/- 0.11 nm	260.8	1.3	1.886	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	268.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4566	0.2780		
Absorbance (A)	0.413	0.300		

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

The End of Certificate

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CAL-FM-C06-15: 12 Sep 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005362

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR8000

หมายเลขเครื่อง: 1627845

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

เพิ่มปริมาตรน้ำ: *656.1nm=656.1nm

*486.0nm=485.5nm

Mr.Nattapat Rungrusang
Service Engineer

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CAL-FM-R31-03: 20 Jul 2022

Certificate of Calibration

Certificate No.: C29240011

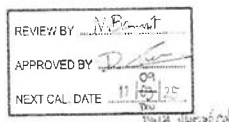
Page: 2 of 4

Represent to Certificate of Calibration No. C29240007

Equipment:	Block Digestion Unit	Certificate No.:	C29240011
Model:	KT-20s	Issued Date:	22 March 2024
Serial No. (or ID.):	5720210009/5770200073	Job No.:	WO-00020429
Manufacturer:	Gerhardt	Page:	1 of 4
Condition:	In Condition	Digestion Block:	20 holes.

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

Environment Condition: Temperature: 25 °C ± 0.7 °C
Humidity: 54 %RH ± 4.1 %RH
Voltage: 225 VAC ± 1.7 VAC



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

Calibration By: Mr. Thanathorn Phunok
Calibration Date: 11 March 2024
The Method used: In house method, base on by comparison with standard
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)
Certificate No.: TC22/0060

(Mr. Thanathorn Phunok)

Person in charge

(Mr. Udon Srichana)

Authorized signatory

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

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

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

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CAL-FM-C29-07: 20 Jul 2022

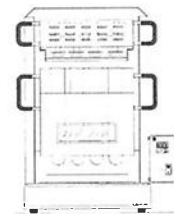
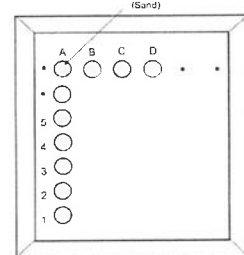


Fig. 1: Front view



Location of standard

Fig. 2 : Digestion block

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the Digestion block.

Measured Temperature: The average reading of working standard at any points or location

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CAL-FM-C29-07: 20 Jul 2022

Calibration Results:
Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	360	360	401.5	21.5	1.5
A2				401.2	21.2	1.5
A3				399.1	19.1	1.5
A4				397.8	17.8	1.5
A5				395.1	15.1	1.5
B1				396.6	16.6	1.5
B2				396.1	16.1	1.5
B3				392.9	12.9	1.5
B4				391.6	11.6	1.5
B5				390.7	10.7	1.5
C1				395.3	15.3	1.5
C2				395.6	15.6	1.5
C3				392.8	12.8	1.5
C4				391.7	11.7	1.5
C5				390.3	10.3	1.5
D1				397.6	17.6	1.5
D2				396.6	16.6	1.5
D3				395.0	15.0	1.5
D4				394.2	14.2	1.5
D5				393.6	13.6	1.5

Calibration Results:
Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	365	365	382.5	17.5	1.5
A2				382.4	17.4	1.5
A3				382.1	17.1	1.5
A4				378.7	14.7	1.5
A5				378.3	13.3	1.5
B1				380.1	15.1	1.5
B2				380.1	15.1	1.5
B3				378.5	13.5	1.5
B4				378.3	13.3	1.5
B5				379.1	14.1	1.5
C1				380.1	15.1	1.5
C2				380.1	15.1	1.5
C3				378.9	13.9	1.5
C4				378.2	13.2	1.5
C5				377.3	12.3	1.5
D1				380.5	15.5	1.5
D2				380.6	15.6	1.5
D3				378.1	13.1	1.5
D4				378.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00020429

ชนิดเครื่อง: Block Digestion Unit รุ่น: KT-20s
หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
11 Mar 2024	รายการตรวจเช็ค	11 Mar 2024		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>

BKK_EL0037

Agilent
CrossLab
From Insight to Outcome

Agilent CrossLab Start Up Services
Agilent 5100 5110 ICP-OES
Preventive Maintenance

REVIEW BY	Thitima B.
APPROVED BY	Sau L. N.
NEXT CAL DATE	11/01/2025

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

ข้อเสนอแนะ

Mr. Thanathorn Phonook
Service Engineer

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 HPLC applications, the instrument should be returned to its standard sample introduction system.

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <http://www.agilent.com/en-us/agilentresource/>. 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

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	
649010A / M41610005	
Instrument System Site and Location	
ALS Laboratory Group (Thailand) Co., LTD	

List System Component	Product Numbers	List the Serial Numbers of each Component
1	649010A	M41610005
2	649010A	M415440764
3	649010A	M415440764
4		
5		
6		
7		
8		
9		

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	<u>Flow Spray</u> One Neb Conical Other
Spray Chamber	Cyclonic Single Pass <u>Cyclonic Double Pass</u> Other
Torch	Radial Dual View Other
Torch Type	One Piece Semi Disposable Fully Disposable Other
Injector Diameter	2.4mm <u>3.8mm</u> 1.4mm 0.8mm Other
Injector Material	<u>Quartz</u> 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 is necessary
- ☐ Clean X and Z axis slide shafts
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial

SPS 4 Auto sampler

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

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

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

Record Post-PM instrument performance

- ☒ Run Instrument Performance test
- ☒ Record results in Instrument Performance Test Results Table - Post PM
- ☒ For systems using ICP Expert version 7.2 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 SBR	1511.1	3446.3	1530.0	3421.8
Mn 257.510 nm SBR	2356.1	17553.6	2349.3	17959.3
Al 396.152 nm SBR	2.1	15.0	5.4	10.3
K 766.491 nm SBR	3.3	66.0	5.4	92.2

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

Instrument Test Results Table

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

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

ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Main Voltage	219.31 V	VAC	215.13 V	VAC
Main Current	0.016 A	A	0.113 A	A
Instrument Temperature	11.5 °C	°C	23.2 °C	°C
RF Air Flow (sensor speed)	19.0 Hz	Hz	23.0 Hz	Hz
Plasma Exhaust Temperature	No measurement		50.1 °C	°C
Water Flow Oscillator	No measurement		12.0 L/min	L/min
Water Flow Detector	1.14 L/min	L/min	1.09 L/min	L/min
Water Inlet Temperature	22.5 °C	°C	23.6 °C	°C
Polychromator Temperature	35.0 °C	°C	35.0 °C	°C
QCD Temperature	-46.1 °C	°C	-45.0 °C	°C
Thermal Stabilizer	31.5 °C	°C	34.4 °C	°C
Argon Supply Pressure	614.34 kPa	kPa	551.70 kPa	kPa
Purge Gas Supply Pressure*1	610.4 kPa	kPa	534.30 kPa	kPa
Optics Gas Supply Pressure*1	— kPa	kPa	— kPa	kPa
Nebulizer Flow	No measurement		0.70 L/min	L/min
Nebulizer Back Pressure	No measurement		7.6 kPa	kPa
Plasma Gas Flow	No measurement		11.8 L/min	L/min
Auxiliary Gas Flow	No measurement		1.0 L/min	L/min
RF Power	No measurement		1466.5 W	W
RF Supply Current	No measurement		15.6 A	A
RF Supply Voltage	No measurement		14.6 kV	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	5799-0017	Agilent Water Remineralizer	1
Purge Gas Filter	G8010-60136	All	1
Air Inlet Filter	G9000-68202	All	1
High Capacity Air Filter	G8010-60189	Optional	1
Rotor seal for 6.7 port valve for AVSv7	G8494-60002	G8494A/G8495	1
Rotor seal for 4 port valve for AVS4	G8494-60002	G8494A	1
Rinse solution to rinse station 2 5mm x 1m	G8410-80125	SPS 4	1
Bomb connector 2.5mm ID, 5mm OD	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			
Xerox drive belt	S410047500	SPS 3	1
Xerox drive belt	S410047400	SPS 3	1
Peristaltic pump tubing, PVC Solvaflex 3 bagged	3710049300	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

Nukorn Luchangyong

Service Engineer Signature

Nukorn L.

Total number of pages in this document:

16

Date Service Completed

Feb 24, 2023

Customer Name

Customer Signature

Revision A.01 Issued 21 January 2022
Document Number: 68011-62075
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Page 2 of 6



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhroi, 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 Nakhnaked (Site Calibration Manager)

Date of Issue : 26 SEP 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L12 109/30-05-57



Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK

Date of Calibration : 22 September 2023

Environment : Temperature : 21.8-23.1 °C

Line Voltage : 221.6-226.3 V

Relative Humidity : 55-65 %RH

Condition of this results of calibration :

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.

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	1151	T230014	17 January 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION U24.1)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 20 Minute At 95 °C

Fresh Air Dumper ☐ Open ☐ Min ☐ Medium ☐ Max☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

Approved By: 

Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

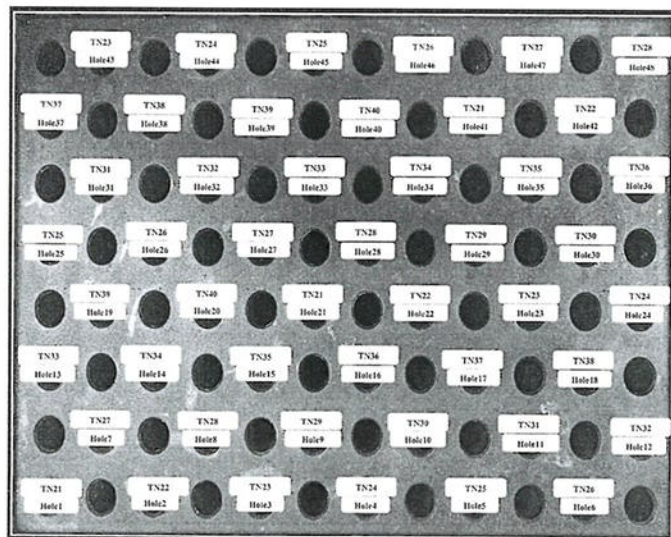
Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By: 

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	95.12
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.59	94.42	94.52	94.24	94.63	94.67
	Min	95.21	94.06	94.13	93.88	94.28	94.27
	Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.95	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	95.47
	Min	94.24	94.53	94.44	93.98	93.92	95.56
	Average	94.43	94.72	94.60	94.14	94.08	95.71
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	92.45	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	95.09	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

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
105	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	104.41	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	104.29
	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	104.30	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.

FM-L13 108/30-05-57

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 which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.

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.

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-TISI-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

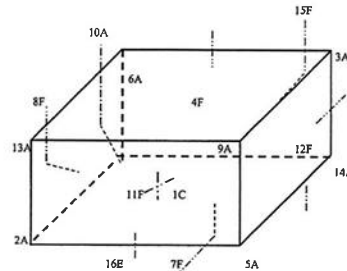
Approved By.

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
4F = 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 <i>k</i>
	Min , Max	Average					
3.0	2.8 , 4.1	3.5	3.36	1.10	2.00	1.90	2.09

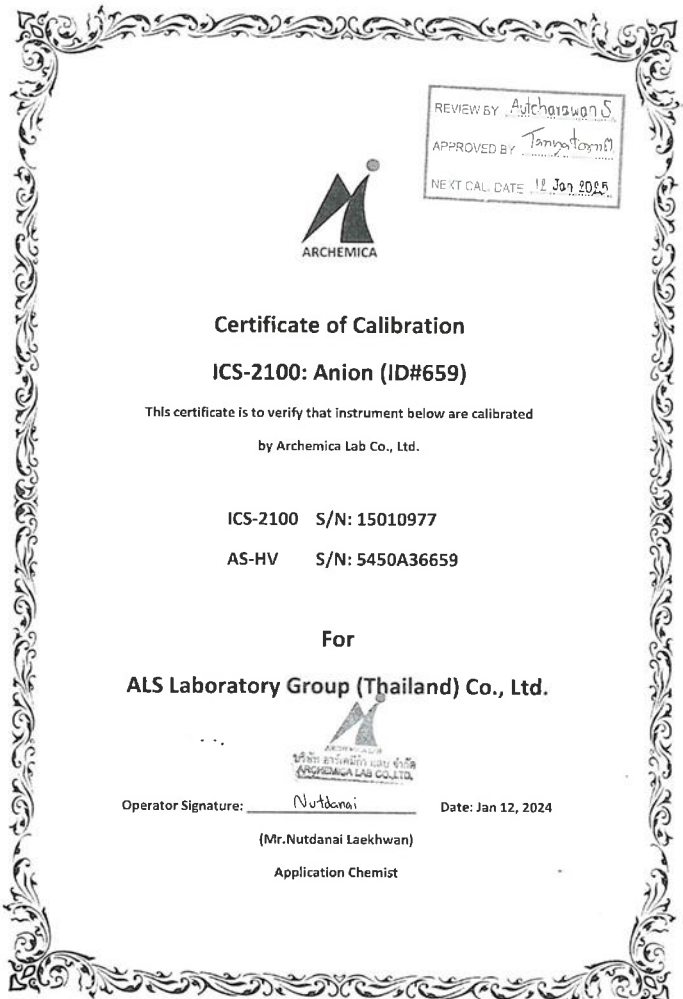
The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By.

FM-L15 118/18-08-66



Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pattharakam 40, Pattharakam Rd., Kwang Suan Luang, Khet Suan Luang, Bangkok 10250

Date: November 21, 2024 2:12:44 PM
EQP Name: AgilentRecommended, AgilentRecommended

EQP Revision: GC.02.55, GCMS.02.56
Overall Qualification Status: Pass

REVIEW BY: *Suchada T.*
APPROVED BY: *Nant Sank*
NEXT CAL DATE: *21-May-21*

CDS Logon Verification - GC

Logon: asbkk.env03

Overall CDS Logon Verification Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front MMI

Setpoint Status: Pass

Inlet Pressure: 25.0 psi Actual 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended: <= 1.2 psi

Date: November 21, 2024 2:12:44 PM

System ID: GM-10

Page 1 / 15

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Temperature: 230.0 228.2 °C

Accuracy: -1.8 °C

Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)

<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Temperature: 100.0 100.7 °C

Accuracy: 0.7 °C

Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)

<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

NOTE: This test's 2 comment(s) and 0 deviation(s) are available in the Attachments section.

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Temperature: 100.0 100.7333 °C

Stability: 0.1 °C

Agilent Recommended: <= 0.5 °C

Date: November 21, 2024 2:12:44 PM

System ID: GM-10

Page 2 / 15

Overall GC Oven Temperature Stability Test Status

Pass

NOTE: This test's 1 comment(s) and 0 deviation(s) are available in the Attachments section.

Tune EI

Tested Combination1 Front MMI / External TQ

Name: 7000D

Setpoint Status: Pass

Filament: 1

Setpoint Status: Pass

Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1 Front MMI / External TQ

Name: 7693A

Source: EI - Extractor

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1 Front MMI / External TQ

Name: 7693A

Source: EI - Extractor

Date: November 21, 2024 2:12:44 PM

System ID: GM-10

Page 3 / 15

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Minimum RSD: 4.58 %

Agilent Recommended: <= 12.00 %

Status: Pass

Instrument Detection Limit: 1.54238 fg

Agilent Recommended: <= 4.03800

Status: Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1 Front MMI / External TQ

Name: Injection Tower

Source: EI - Extractor

Setpoint Status: Pass

Injection Volume on Column: 0.5 uL

Area Mass 1

Abundance's

RSD: 2.23 %

Agilent Recommended: <= 5.00 %

Status: Pass

Overall Mass Ratio Precision Test Status

Pass

Date: November 21, 2024 2:12:44 PM

System ID: GM-10

Page 4 / 15

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System	
System ID	GM-10
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging
Tested Combination1	
Injection Technique	Injection Tower
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7893A
Model Number	G4513A
Serial Number	CN18180003
Firmware Revision	A.11.02
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

Sampler 2	
Manufacturer	Agilent Technologies
Type	Trey
Name	7893A
Model Number	G4514A
Serial Number	CN18170137
Firmware Revision	A.11.03
Vial Heater	Not Installed
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN18153080
Firmware Revision	B.02.05
Oven Type	Standard
Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	TQ
Name	7000D
Model Number	G7000D
Serial Number	US1828U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Liquid Injection Scouting Run Standard	OFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of Filaments	2

Electronic Signature

Purpose

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

Details	
Full Name of Signor:	Supasek Nimsongtham
Logged On User Name:	supasek.nimsongtham@agilent.com
Signature Creation Date:	November 21, 2024
Reason for Signature:	Executed protocol and published this original version of document

ACE Self Qualification Status

The installed version of ACE used to deliver this service passed qualification; the results conform with expected values. The self qualification summary report is available in the session folder location SDS\CleanStore\AceSelfQualification.

Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assume compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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User Name: suparak.nimsongtham
Report Generated by Hostname: SCG115HMC
System ID: GM-10
Print Date: November 21, 2024 2:12:48 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 11:58:17 AM	Audit	Session Created	Session	Host Name: SCG115HMC, Drive Serial Number: C2031776
November 21, 2024 11:58:17 AM	Start	Configuration	Session	None
November 21, 2024 11:58:17 AM	Audit	Entitlement	Licensing	User is Field Engineer and does not require an unlock code
November 21, 2024 12:01:59 PM	Audit	Exported	Session	EOP details for primary technique [GC] - File path: [ProtocolPacks\GC\Config\ion02.55\GC-12.55.eop], EOP File Name: [GC-12.55.eop], EOP Name: [AgilentRecommended] Photo Revision: [GC-12.55] EOP results for primary technique [GC] - File path: [ProtocolPacks\GC\Config\ion02.55\GC-12.55.eop], EOP File Name: [GC-12.55.eop], EOP Name: [AgilentRecommended]
November 21, 2024 12:02:54 PM	End	Configuration	Session	None
November 21, 2024 12:02:12 PM	Start	Qualification	Session	QC
November 21, 2024 12:02:12 PM	Start	Execution	CDS Logon Verification - GC - 7890 - Qualitative test	None
November 21, 2024 12:03:09 PM	End	Execution	CDS Logon Verification - GC - 7890 - Qualitative test	Run Count: 1

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suparak.nimsongtham
Report Generated by Hostname: SCG115HMC
System ID: GM-10
Print Date: November 21, 2024 2:12:49 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:03:11 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	None
November 21, 2024 12:03:20 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	Run Count: 1
November 21, 2024 12:03:23 PM	Start	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
November 21, 2024 12:03:28 PM	End	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
November 21, 2024 12:03:30 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
November 21, 2024 12:05:02 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
November 21, 2024 12:05:03 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
November 21, 2024 12:05:07 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
November 21, 2024 12:06:20 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suparak.nimsongtham
Report Generated by Hostname: SCG115HMC
System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:06:23 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
November 21, 2024 12:06:26 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
November 21, 2024 12:07:10 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
November 21, 2024 12:07:14 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
November 21, 2024 12:07:16 PM	Start	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Flamm 1 (Qualitative - No setpoints associated)	None
November 21, 2024 12:07:28 PM	End	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Flamm 1 (Qualitative - No setpoints associated)	Run Count: 1
November 21, 2024 12:07:28 PM	Start	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Flamm 2 (Qualitative - No setpoints associated)	None
November 21, 2024 12:07:39 PM	End	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Flamm 2 (Qualitative - No setpoints associated)	Run Count: 1
November 21, 2024 12:07:41 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TO - Source - EI - Extractor Part of GCMS System Preparation	None

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suparak.nimsongtham
Report Generated by Hostname: SCG115HMC
System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:06:53 PM	Audit	Data	Scouting Run - Injection Tower, Front MM, TO - Source - EI - Extractor Part of GCMS System Preparation	Data File Path: C:\GM-10\002024\SC001.D
November 21, 2024 12:09:33 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection/Scouting Correction Mode: Advanced/Initial Slope Sensitivity: 10000 Peak Width: 0.01 Initial Area Reject: 0.001 Height Reject: 50 Integration: 0.4] 0 Integration: 0.4
November 21, 2024 12:09:30 PM	End	Execution	Scouting Run - Injection Tower, Front MM, TO - Source - EI - Extractor Part of GCMS System Preparation	Run Count: 1
November 21, 2024 12:09:53 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TO - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	None
November 21, 2024 12:10:46 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TO - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: C:\GM-10\002024\SC001.D
November 21, 2024 12:18:46 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TO - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: C:\GM-10\002024\SC002.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: supasak.nimsvongtham
Report Generated by Hostname: SCG1115HNC
System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:16:46 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:46 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:47 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:47 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:47 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:47 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: supasak.nimsvongtham
Report Generated by Hostname: SCG1115HNC
System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:16:47 PM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:16:15 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection, Baseline Correction Mode: Advanced, Initial Slope Sensitivity: 10, Initial Peak Width: 0.01, Initial Area Reject: 0, Initial Height Reject: 50, Integration: Off at 0, Integration: On at 4]
November 21, 2024 12:22:43 PM	End	Execution	Instrument Detection Limit - Injection Tower, Front MMH, TQ - Source: EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Run Count: 1
November 21, 2024 12:22:52 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	None
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: supasak.nimsvongtham
Report Generated by Hostname: SCG1115HNC
System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Data file Path: C:\Q16-10\00204\001.D
November 21, 2024 12:33:20 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection, Baseline Correction Mode: Advanced, Initial Slope Sensitivity: 10, Initial Peak Width: 0.01, Initial Area Reject: 0, Initial Height Reject: 5000, Integration: Off at 0, Integration: On at 4]
November 21, 2024 12:36:42 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMH, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Run Count: 1
November 21, 2024 12:37:11 PM	End	Qualification	Session	OQ
November 21, 2024 12:37:11 PM	Start	Reporting	Session	None
November 21, 2024 11:11:52 PM	Audit	Reporting	Session	Report Generated: Certificate
November 21, 2024 1:37:20 PM	Audit	Reporting	Session	Report Generated: Report

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Ramad Road
Siam 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-1600
Manufacturer Shimadzu
Serial No. A11454906533 CD
ID No. BKK_EN0016
Date of receipt 13 September 2024
Date of calibration 13 September 2024
Date of issue 13 SEP 2024


REVIEW BY *Jude K*
APPROVED BY *Smith P*
NEXT CAL DATE *19/9/2025*

Customer name ALS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Phattanakon 40, Phattanakon Road, Phattanakon, 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
Silyl Light is traceable to certificate No. 106377
The above certificate are traceable to SI unit through Siam Scientific Ltd
(UKAS accredited calibration laboratory NO. 0659)
Calibrated by Mr. Wanchana Janloy



Approved by

Mr. Sonthi 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 custody of the results are prohibited and who shall not be reproduced
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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6375496-7 Fax : 02-6375496-7
www.barascientific.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
572.88	572.97	-0.02	0.18
878.41	878.17	-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
	0.2788	0.2781	-0.0005	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6199	0.6194	-0.0005	0.0075



*CNR = Customer not request

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FM-UV-708-02 Rev.01 (23/01/63)



Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6375496-7 Fax : 02-6375496-7
www.barascientific.com

Certificate of Calibration

Certificate No. **BSCC-UV-374/24**
Number of Page(s) **3 of 3**

Calibration Results:

3.Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5761	0.5765	0.0004	0.0042
	0.7119	0.7105	-0.0014	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5610	0.5613	0.0003	0.0042
	0.7001	0.6984	-0.0017	0.0042
485.0	0.0000	0.0000	0.0000	0.0042
	0.5235	0.5232	-0.0003	0.0042
	0.6614	0.6598	-0.0016	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5249	0.5245	-0.0004	0.0042
	0.6975	0.6956	-0.0019	0.0042
580.0	0.0000	0.0000	0.0000	0.0042
	0.5590	0.5586	-0.0004	0.0042
	0.7725	0.7708	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	1.1125	1.1114	-0.0011	0.0042
	0.6600	0.6590	-0.0010	0.0042
635.0	0.5666	0.5666	0.0000	0.0042
	0.7620	0.7604	-0.0016	0.0042
	1.0982	1.0971	-0.0011	0.0042

*CNR = Customer not request

4.Stray Light*

Standard cut-off wavelength (nm)	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.85±0.11nm	199.58	0.9520	2.0217

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A
*Stray Light not NSC-ONSC Accredited.


The measurement uncertainty is base 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 except in full, without written approval of the Bara Scientific Co., Ltd.

FM-UV-708-02 Rev.01 (23/01/63)

BKK_EL0026



Agilent Technologies (Thailand) Limited
968 U Chu Liang Bldg. 2/F Unit A/D
Siam Rama 4 Road, Siam, Bangkok
Bangkok 10500 Thailand
Tel: +662 637 6300
Fax: +662 632 4334
Email: ccc.sm@agilent.com
Website: www.agilent.com/thai

Customer Contact:

ALS Laboratory Group (Thailand) Co. Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Phrasong Phatthanakan Khet Suan
TAX ID : 0105540004859
Chanatagarn.lmchom@alsglobal.com
27603088

Invoice To:

ALS Laboratory Group (Thailand) Co. Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Phrasong Phatthanakan Khet Suan

Delivery Site:

ALS Laboratory Group (Thailand) Co. Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Phrasong Phatthanakan Khet Suan

Location:

Room
Bldg
Lab
Dept

SERVICE REPORT

Customer Purchase Order Number: 70371013

Service Request:

Service Order: 6905338201

Customer Number: 70371013

Service Request Date:

Service Confirmation: 6905338201

REVIEW BY: *Syaporn M.*

APPROVED BY: *Syaporn M.*

NEXT CAL. DATE: 13/06/2025

Direct Inquiries to:

Contact Name: *Syaporn M.*

Contact E-mail: ccc.sm@agilent.com

Contact Telephone: +662 637 6363

Contact Fax: +662 632 4334

Customer Contact Center:

ccc.sm@agilent.com

+662 637 6363

+662 632 4334

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	DEAAC11098	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1311B	1260 Quaternary Pump	DEAB704380	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G3281A	Agilent 7700x ICP-MS	JP12691612	ICP MS 7700 (HPLC)	SYS-IM-7700-E

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EOI	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:

Service Confirmation Number: 9905338201
Service Confirmation Date: 12.12.2023



REVIEW BY	Chanade S.
APPROVED BY	Savitree K.
NEXT CAL. DATE	6/12/24

Service Information:

Problem Description: WU-OQ-IM/HPLC-7700-6001143313		
Service Provided: Perform OQ Hardware control test: CSD logon, Autosample, ISIS, Auto tune, BG and Stability. After done the instrument BKK_EL0026 calibrated pass all.		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 9.0	Travel Hours: 1.0	
Customer Field Service Representative Name: Panthep Kurasathain	Customer Field Service Representative Signature: 	Date: 12 Dec 2023
Customer Name: Supakwan Mak	Customer Signature: 	Date: 12 Dec 2023
Additional Comments:		

Performance Verification Certificate for Mercury Analyzer

PRODUCT ID Quicktrace M-8000 , Teledyne Leeman Labs
Equipment ID BKK_EL0128 Mercury Analyzer
 S/N: US22133002
 BKK_EL0129 Autosampler
 S/N: 052222A560
Customer Name AIS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Pattana 40, Pattana Rd. Suan Luang, Suan Luang
 Bangkok 10250 Thailand

Date of Qualified December 6, 2023
Next Due date December 6, 2024

This certifies for products which was performed in acceptable criteria specifications

Autosampler & Sample Introduction	PASSED
Analyzer	PASSED
Gas Liquid Separator & Dryer	PASSED
CVAFS Detector	PASSED
Electronics/Mechanical	PASSED
Data station/PC	PASSED
Analytical test	PASSED

Provided by

Scientist Instrument Co., Ltd.
113 Soi Ekachai 44, Ekachai Road
Khlong Bang Phran, Bangchon
Bangkok 10150 Thailand

Certified by

Thunraphol Sakdayos
Service Engineer

ภาคผนวก จ

สำเนาหนังสือใบอนุญาตขึ้นทะเบียน
ห้องปฏิบัติการวิเคราะห์เอกชน

ที่ อก ๐๓๑๐(๑)/ ๑ ๖ ๑ ๖ ๘



กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒ ๐ พฤศจิกายน ๒๕๖๖

เรื่อง ค่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง ค่าขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารเคมีของห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๔ สิงหาคม ๒๕๖๖

- สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น
๓. ขอบข่ายสารเคมีที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๑๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุหนังสือ
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๒๐๔ สกานที่เลขที่ ๑๐๔ ขอพัฒนาการ ๔๐
ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด
ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

- ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ ๑๘๑ ราย ตามสิ่งที่ส่งมาด้วย ๒
ค. ขอบข่ายสารเคมีที่ได้รับขึ้นทะเบียนไว้วิเคราะห์ในน้ำเสีย น้ำใต้ดิน อากาศเสีย สิ่งปฏิกูล
หรือวัสดุที่ไม่ใช่แล้ว และดิน ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๘ หากประสงค์จะต่ออายุหนังสือ
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อ
กรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นสุดของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ทั้งทางเว็บไซต์กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายศิริระ จันทน์)

นักวิทยาศาสตร์เชี่ยวชาญ วิชาการความปลอดภัย
ผู้อำนวยการกองวิจัยและเฝ้าระวังมลพิษโรงงาน
ปฎิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเฝ้าระวังมลพิษโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๕๓๐ ๖๓๓๖ ต่อ ๒๑๐๓-๕

โทรสาร ๐ ๒๕๓๐ ๖๓๓๖ ต่อ ๒๑๑๕๔

ไปรษณีย์อิเล็กทรอนิกส์ saraband@dlw.mail.go.th



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



สิ่งที่ส่งมาด้วย ๒

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ๖-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑ ๖ ๑ ๖ ๘ ลงวันที่ ๒ ๐ พฤศจิกายน ๒๕๖๖

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๘๘๑ ราย

- ๑) นายกาญจน์ศักดิ์ กิตติคุณวิทย์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๑
- ๒) นายภัทรพล สว่างใจธรรม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๒
- ๓) นายธนารักษ์ เพ็ญกิจชัย ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๓
- ๔) นายศิริโชค พงษ์ประสม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๔
- ๕) นายณัฐวิทย์ ตั้งแพง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๕
- ๖) นางสาวจินดา ใจจุลธรรม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๖
- ๗) นางสาวสาวตรี น้อยเจริญม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๗
- ๘) นางสาวเพ็ญกาญจน์ อิมขม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๘
- ๙) นางสาวนันทพร สายแสง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๐๙
- ๑๐) นางสาวนิพนธ์ ฐนบูรณ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๐
- ๑๑) นางสาวศรีมาตา เติมจรัส ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๑
- ๑๒) นางสาวอัญญา มงคลจิรัฐิ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๒
- ๑๓) นางสาวศิริลักษณ์ บุญนาค ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๓
- ๑๔) นายณพพงศ์ จันทน์จันุ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๔
- ๑๕) นายบรรณวิทย์ โภมาลัย ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๕
- ๑๖) นายธนากร จิตยา ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๖
- ๑๗) นางสาวเกศรินทร์ แก้วมัน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๗
- ๑๘) นางสาวสุวิมล ชัยเรืองวุฒิ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๘
- ๑๙) นางสาวสุชาดา ธรรมถาวร ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๑๙
- ๒๐) นางสาวเบญจมา ชัยเดชอนกุล ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๐
- ๒๑) นางสาวศศิธร พูลสวัสดิ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๑
- ๒๒) นางสาวเสาวลักษณ์ ภูมิกำแหง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๒
- ๒๓) นายอภิสิทธิ์ สิงหา ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๓
- ๒๔) นายศักดิ์สิทธิ์ โพธิ์พิสุทธิ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๔
- ๒๕) ว่าที่ร้อยตรีหญิง พรรณีมา ช่างเจริญ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๕
- ๒๖) นางจิตติ คำภูแก้ว ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๖
- ๒๗) นางสาวอรรณพ รักอง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๗
- ๒๘) นางสาวพรรัตน์ เข้มภรณ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๘
- ๒๙) นายจุลเดช วาจิวัน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๒๙
- ๓๐) นางสาวศุภาวิรัตน์ รุ่งคำ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๐
- ๓๑) นายพนมย์ ศรีปัดเนตร ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๑
- ๓๒) นายสุทิน อุ่นมิม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๒
- ๓๓) ว่าที่ร้อยตรี เติมเกียรติ อมรศรีเสริม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๓
- ๓๔) นางสาววริยา สร้างนา ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๔
- ๓๕) นายอนุพงศ์ รัตนศรีประเสริฐ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๕

๑๖) นางสาวจุฑารัตน์...

- ๒ -

- ๓๖) นางสาวจุฑารัตน์ โอนสันเพียร ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๖
- ๓๗) นางสาวจุฑารัตน์ พิมพ์ลิขิตยา ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๗
- ๓๘) นางสาวปรารถนาทิพย์ กิ่งไพศาลศักดิ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๘
- ๓๙) นางสาวเดือนใจ ทางกลาง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๓๙
- ๔๐) นางสาวจิราพร ศิริเวช ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๐
- ๔๑) นายวรารักษ์ ภูวกิจ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๑
- ๔๒) นายพนง วิริยะสกิจ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๒
- ๔๓) นายธนิ เจนชม ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๓
- ๔๔) นายณิศกร ชำเพชร ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๔
- ๔๕) นายภูวิช พรหมสะอาด ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๕
- ๔๖) นายธนเดช โกศาพิพัฒน์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๖
- ๔๗) นายชฎาธิ์ วงษ์จันทร์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๗
- ๔๘) นายอภิสิทธิ์ ศรีเสน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๘
- ๔๙) นายเจตน์พร คงศักดิ์ไทย ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๔๙
- ๕๐) นายจรัส บุญยั้ง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๐
- ๕๑) นายธนณัติ เอนก ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๑
- ๕๒) นายอภิวัฒน์ พนมพู ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๒
- ๕๓) นางสาวสุภาวีย์ มาก ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๓
- ๕๔) นางสาวทิพร ขวาลสมบูรณ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๔
- ๕๕) นางสาวธิดา บุญเพ็ง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๕
- ๕๖) นางสาวภาณุมาศ นามวัฒน์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๖
- ๕๗) นางสาวอุไรรัตน์ หังสร้างแป้น ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๗
- ๕๘) นายธีรวัฒน์ ปวงสุข ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๘
- ๕๙) นายอิทธิพล ยะโส ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๕๙
- ๖๐) นายประจักษ์ วรรณช้อย ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๐
- ๖๑) นายชยธร พงษ์พิทย์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๑
- ๖๒) นางสาวกนกวรรณ จันทร์บาท ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๒
- ๖๓) นายสิทธิโชค ธงเงิน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๓
- ๖๔) นายศศิธารณ ใจบุญ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๔
- ๖๕) นางสาวพรรณธิดา พุ่มคง ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๕
- ๖๖) นายณภัทร ศรีวิริยะ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๖
- ๖๗) นายสุวิชา ทองอ่อน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๗
- ๖๘) นายวิญญู บุญตะเนย ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๘
- ๖๙) นายสมบูรณ์ บุตรจันทร์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๖๙
- ๗๐) นายวิรัตน์ ไชยชนะ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๗๐
- ๗๑) นายณณพจน์ เหมขุน ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๗๑
- ๗๒) นายจิรภูมิ ขวาลอ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๗๒
- ๗๓) นายธรรมาภรณ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๗๓
- ๗๔) นายธรรมาภรณ์ ทะเบียนเลขที่ ๖-๒๐๔-๖-๐๐๗๔

๗๕) นายประเสริฐ...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
19	Copper	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
20	Cyanide	Distillation, Colorimetric Method ⁽⁴⁾
21	2,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
22	4,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
23	2,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
24	4,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
25	2,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
26	4,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
27	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
28	Endosulfan Sulfate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
29	Endosulfan I	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
30	Endosulfan II	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
31	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
32	Endrin Aldehyde	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
33	Formaldehyde	Distillation, Colorimetric Method ⁽³⁾
34	Free Chlorine	1) DPD Ferrous Titrimetric Method ⁽⁴⁾ 2) DPD Colorimetric Method ⁽⁴⁾
35	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
36	Heptachlor Epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
37	Hexavalent Chromium	Colorimetric Method ⁽⁴⁾
38	3-Hydroxycarbofuran	High-Performance Liquid Chromatographic Method ⁽⁴⁾
39	Lead	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾

40 Manganese...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
40	Manganese	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
41	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
42	Methiocarb	High-Performance Liquid Chromatographic Method ⁽⁴⁾
43	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
44	Methomyl	High-Performance Liquid Chromatographic Method ⁽⁴⁾
45	Nickel	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
46	Oil & Grease	1) Liquid-Liquid, Partition-Gravimetric Method ⁽⁴⁾ 2) Soxhlet Extraction Method ⁽⁴⁾
47	Oxamyl	High-Performance Liquid Chromatographic Method ⁽⁴⁾
48	Propoxur	High-Performance Liquid Chromatographic Method ⁽⁴⁾
49	pH	Electrometric Method ⁽⁴⁾
50	Phenols	1) Distillation, Chloroform Extraction Method ⁽⁴⁾ 2) Distillation, Direct Photometric Method ⁽⁴⁾
51	Selenium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
52	Sulfide	Iodometric Method ⁽⁴⁾
53	Temperature	Laboratory and Field Methods ⁽⁴⁾
54	Total Dissolved Solids	Dried at 180 °C ⁽⁴⁾
55	Total Kjeldahl Nitrogen	Semi-Micro Kjeldahl Method ⁽⁴⁾
56	Total Phosphorous	Digestion, Colorimetric Method ⁽⁴⁾
57	Total Suspended Solids	Dried from 103-105 °C ⁽⁴⁾
58	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
59	Trivalent Chromium	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ⁽⁴⁾
60	Zinc	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽⁴⁾

น้ำดื่ม...

น้ำดื่ม จำนวน 126 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
3	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
4	Anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
5	Antimony	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
7	Atrazine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
8	Barium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
9	Benz(a)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
11	Benzo(b)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
12	Benzo(k)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
13	Benzoic Acid	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
14	Benzo(a)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
15	Benzo(g,h,i)perylene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
17	Bis(2-chloroethyl)ether	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾

18 Bis(2-ethylhexyl)phthalate...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
18	Bis(2-ethylhexyl)phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
21	Butanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
22	Butyl benzyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
24	Carbazole	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
25	Carbon disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
27	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
28	p-Chloroaniline	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
32	2-Chlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
33	Chromium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ⁽⁴⁾
35	Chromium (VI)	Colorimetric Method ⁽⁴⁾

36 Chrysene...

ลำดับที่	สารเคมี	วิธีการตรวจ
36	Chrysene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
37	Cyanide	Distillation, Colorimetric Method ⁽⁴⁾
38	2,4-D	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
39	DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
40	DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
41	DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
42	Dibenz(a,h)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
43	Di-n-Butyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
47	3,3-Dichlorobenzidine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
53	2,4-Dichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾

56 1,3-Dichloropropene...

ลำดับที่	สารเคมี	วิธีการตรวจ
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
57	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
58	Diethyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
59	2,4-Dimethylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
60	2,4-Dinitrophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
61	2,4-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
62	2,6-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
63	Di-n-octyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
64	Endosulfan	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
65	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
67	Fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
68	Fluorene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
69	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
70	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
71	Hexachlorobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
73	n-Hexane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
74	α-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
75	β-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾

76 γ-HCH...

ลำดับที่	สารเคมี	วิธีการตรวจ
76	γ-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
77	Hexachlorocyclopentadiene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
78	Hexachloroethane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
79	Indeno(1,2,3-cd)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
80	Isophorone	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
81	Lead	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
82	Manganese	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
83	Mercury	1) Digestion, Cold Vapor Atomic Absorption Spectrometric Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
84	Methanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
86	Methyl bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
87	Methylene chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
89	2-Methylnaphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
90	Methyl tert-butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
91	Naphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
92	Nickel	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾

94 N-Nitrosodiphenylamine...

ลำดับที่	สารเคมี	วิธีการตรวจ
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
95	N-Nitrosodi-n-Propylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
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 ⁽⁴⁾
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
98	pH	Electrometric Method ⁽⁴⁾
99	Phenanthrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
100	Phenol	1) Distillation, Chloroform Extraction Method ⁽⁴⁾ 2) Distillation, Direct Photometric Method ⁽⁴⁾ 3) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
101	Pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
102	Selenium	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
103	Silver	1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾
104	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
105	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
106	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
107	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
108	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾
109	TPH (C ₈ -C ₁₆)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(4,23)

110 TPH (C₈-C₁₆)...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
110	TPH (C ₈ -C ₁₆)	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method ^{9,22}
111	TPH (C ₁₆ -C ₃₃)	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method ^{9,22}
112	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
113	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
114	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
115	Trichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
116	2,4,5-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ⁴¹
117	2,4,6-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ⁴¹
118	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
119	Vanadium	1) Digestion, Inductively Coupled Plasma Method ⁴² 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
120	Vinyl acetate	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
121	Vinyl chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
122	m-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
123	o-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
124	p-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
125	Xylene (Total)	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ⁴¹
126	Zinc	1) Digestion, Inductively Coupled Plasma Method ⁴² 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹

ภาคผนวก...

ภาคผนวก (ต่อเนื่องจาก) จำนวน 28 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Antimony	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
2	Arsenic	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
3	Beryllium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
4	Cadmium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
5	Carbon Monoxide	1) Instrumental Analyzer Method ⁴³ 2) Sampling Bag Non-Dispersive Infrared Method ⁴³
6	Chlorine	1) Absorption Sampling, Ion Chromatographic Method ⁴³ 2) Isokinetic Sampling, Ion Chromatographic Method ⁴³
7	Chromium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
8	Cobalt	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
9	Copper	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
10	Cresol	Adsorption Sampling, Gas Chromatographic Method ⁴³
11	Dioxins	Isokinetic Sampling ⁴³
12	Hydrogen Chloride	1) Absorption Sampling, Ion Chromatographic Method ⁴³ 2) Isokinetic Sampling, Ion Chromatographic Method ⁴³
13	Hydrogen Fluoride	1) Absorption Sampling, Ion Chromatographic Method ⁴³ 2) Isokinetic Sampling, Ion Chromatographic Method ⁴³
14	Hydrogen Sulfide	Absorption Sampling, Iodometric Method ⁴³

15 Lead...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
15	Lead	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
16	Manganese	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
17	Mercury	1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁴³ 2) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ⁴³
18	Nickel	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
19	Opacity	Ringelmann's Method ⁴³
20	Oxides of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method ⁴³ 2) Absorption Sampling, Alkaline Permanganate/Colorimetric Method ⁴³ 3) Instrumental Analyzer Method ⁴³
21	Selenium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
22	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Method ⁴³ 2) Instrumental Analyzer Method ⁴³
23	Sulfuric Acid	Isokinetic Sampling, Barium-Thorin Titrimetric Method ⁴³
24	Tellurium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
25	Tin	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
26	Total Suspended Particulate	1) Isokinetic Sampling, Gravimetric Method ⁴³ 2) Paired Train, Isokinetic Sampling, Gravimetric Method ⁴³

27 Vanadium...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
27	Vanadium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method ⁴³ 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁴¹
28	Xylene	Absorption Sampling, Gas Chromatographic Method ⁴³

สิ่งปลูกสรหรือวัตถุที่ไม่ใช่ตัว จำนวน 35 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^{1,9,24} 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^{10,26} 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^{11,26}
2	Antimony	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^{1,6,14} 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{1,6,17} 3) Digestion, Inductively Coupled Plasma Method ^{7,16} 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{7,17}
3	Arsenic	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^{1,6,14} 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{1,6,17} 3) Digestion, Inductively Coupled Plasma Method ^{7,16} 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{7,17}
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^{1,6,14} 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{1,6,17} 3) Digestion, Inductively Coupled Plasma Method ^{7,16} 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^{7,17}

5 Beryllium...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
6	Cadmium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
7	Chlordane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
8	Chromium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
9	Chromium (III)	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method ^(1.6.16.19) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method ^(1.6.17.19) 3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7.8.16.19) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7.8.17.19)

10 Chromium (VI)...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
10	Chromium (VI)	1) Waste Extraction, Colorimetric Method ^(8.19) 2) Alkaline Digestion, Colorimetric Method ^(8.19)
11	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
12	Copper	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
13	2,4-D	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
14	DDD	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
15	DDE	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
16	DDT	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24)

2) Soxhlet...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
17	Dieldrin	2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24) 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
18	Endrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
19	Heptachlor	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
20	Lead	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
21	Lindane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)

22 Mercury...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
22	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^(1.6.20) 2) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^(1.6.30) 3) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽²⁰⁾ 4) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ⁽²⁰⁾ 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ⁽²¹⁾
23	Methoxychlor	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
24	Mirex	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)
25	Molybdenum	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.16) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
26	Nickel	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.17) 3) Digestion, Inductively Coupled Plasma Method ^(7.14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.17)
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 ^(1.9.24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10.24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11.24)

- 2-Chlorobiphenyl...

ลำดับที่	สารเคมี	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',3,4,5,5-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',5,6-Nonachlorobiphenyl Pentachlorophenol	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1,2,24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24) Electrometric Method ^(23,24)
29	pH	
30	Selenium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,6,14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,6,17) 3) Digestion, Inductively Coupled Plasma Method ^(7,14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)

31 Silver...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
31	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,6,14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,6,17) 3) Digestion, Inductively Coupled Plasma Method ^(7,14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
32	Thallium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,6,14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,6,17) 3) Digestion, Inductively Coupled Plasma Method ^(7,14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
33	Toxaphene	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1,2,24) 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
34	Vanadium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,6,14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,6,17) 3) Digestion, Inductively Coupled Plasma Method ^(7,14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
35	Zinc	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,6,14) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,6,17) 3) Digestion, Inductively Coupled Plasma Method ^(7,14) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)

ดิน...

ฉบับ จำนวน 125 รายการ

ลำดับที่	สารเคมี	วิธีวิเคราะห์
1	Acenaphthene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
2	Acetone	1) Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25) 2) Equilibrium Headspace, Gas Chromatographic/Mass Spectrometric Method ⁽¹³⁾
3	Aldrin	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
4	Anthracene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
5	Antimony	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
7	Atrazine	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
8	Barium	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
9	Benz(a)anthracene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
10	Benzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)

11 Benzo(b)fluoranthene

ลำดับที่	สารเคมี	วิธีวิเคราะห์
11	Benzo(b)fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
12	Benzo(k)fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
13	Benzoic acid	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
14	Benzo(a)pyrene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
15	Benzo(g,h,i)perylene	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
17	Bis(2-chloroethyl)ether	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
18	Bis(2-ethylhexyl)phthalate	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
20	Bromoform	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
21	Butanol	Equilibrium Headspace, Gas Chromatographic/Mass Spectrometric Method ^(13,25)
22	Butyl Benzyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(10,24) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)

23 Cadmium...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method ^(7,18) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
24	Carbazole	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
27	Chlordane	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
28	p-Chloroaniline	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
32	2-Chlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
33	Chromium	1) Digestion, Inductively Coupled Plasma Method ^(7,18) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7,8,16,19) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7,8,17,19)
35	Chromium (VI)	Alkaline Digestion, Colorimetric Method ^(8,19)

36 Chrysene...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
36	Chrysene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
37	Cyanide	Extraction, Distillation, Colorimetric Method ^(27,28,29)
38	2,4-D	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
39	DDD	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
40	DDE	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
41	DDT	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
42	Dibenz(a,h)anthracene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
43	Di-n-Butyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
47	3,3-Dichlorobenzidine	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)

49 1,2-Dichloroethane...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
53	2,4-Dichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
57	Dieldrin	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
58	Diethyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
59	2,4-Dimethylphenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
60	2,4-Dinitrophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
61	2,4-Dinitrotoluene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
62	2,6-Dinitrotoluene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)

63 Di-n-Octyl Phthalate...

ลำดับที่	สารเคมี	วิธีวิเคราะห์
63	Di-n-Octyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
64	Endosulfan	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
65	Endrin	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
67	Fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
68	Fluorene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
69	Heptachlor	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
70	Heptachlor epoxide	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
71	Hexachlorobenzene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
73	n-Hexane	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25) 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)

73 n-Hexane...

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
74	α -HCH	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
75	β -HCH	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
76	γ -HCH	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
77	Hexachlorocyclopentadiene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
78	Hexachloroethane	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
79	Indeno(1,2,3-cd)pyrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
80	Isophorone	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
81	Lead	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
82	Manganese	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
83	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽²⁰⁾ 2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry ⁽²¹⁾ 3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ⁽²⁰⁾

84 Methanol...

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
84	Methanol	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25) 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
85	Methoxychlor	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
88	2-methylphenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
89	2-Methylnaphthalene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
91	Naphthalene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
92	Nickel	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
93	Nitrobenzene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
94	N-Nitrosodiphenylamine	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
95	N-Nitrosodi-n-propylamine	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)

96 Polychlorinated biphenyls (PCBs)

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
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 ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
97	Pentachlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
98	Phenanthrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)

99 Phenol...

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
99	Phenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
100	Pyrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
101	Selenium	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
102	Silver	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,17)
103	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
106	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
107	Toxaphene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(10,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(11,26)
108	TPH (C ₅ -C ₆)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
109	TPH (C ₅ -C ₁₆)	1) Automate Extraction, Gas Chromatographic Method ^(11,22) 2) Solvent Extraction, Gas Chromatographic Method ^(12,23) 3) Ultrasonic Extraction, Gas Chromatographic Method ^(22,23)
110	TPH (C ₅ -C ₃₅)	1) Automate Extraction, Gas Chromatographic Method ^(11,22) 2) Solvent Extraction, Gas Chromatographic Method ^(12,23) 3) Ultrasonic Extraction, Gas Chromatographic Method ^(22,23)
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(15,25)

115 2,4,5-Trichlorophenol...

ลำดับที่	สารเคมี	วิธีการวิเคราะห์
115	2,4,5-Trichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(16,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
116	2,4,6-Trichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(16,26) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(11,24)
117	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
118	Vanadium	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)
119	Vinyl Acetate	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
120	Vinyl Chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
121	m-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
122	o-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
123	p-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
124	Xylene (Total)	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(15,25)
125	Zinc	1) Digestion, Inductively Coupled Plasma Method ^(7,14) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,17)

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20. United States...



ที่ อภ ๐๓๐๑/๑๙๑๑๑๑

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๒ เขตทุ่งครุ กรุงเทพฯ ๑๐๑๐๐

๒๕ เมษายน ๒๕๖๗

เรื่อง เสนอเปลี่ยนแปลงโครงสร้างห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอสแอลเอส แอสโซซิเอตส์ กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารเคมีของห้องปฏิบัติการวิเคราะห์ของ บริษัท เอสแอลเอส แอสโซซิเอตส์ กรุ๊ป (ประเทศไทย) จำกัด

ตามคำขอที่อ้างถึง บริษัท เอสแอลเอส แอสโซซิเอตส์ กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการวิเคราะห์ของ บริษัท เอสแอลเอส แอสโซซิเอตส์ กรุ๊ป (ประเทศไทย) จำกัด ขอเปลี่ยนแปลงโครงสร้างและชนิดสารเคมีของห้องปฏิบัติการวิเคราะห์ของ บริษัท เอสแอลเอส แอสโซซิเอตส์ กรุ๊ป (ประเทศไทย) จำกัด

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้อยู่ในโครงสร้างที่เปลี่ยนแปลงโครงสร้างวิเคราะห์ จำนวน ๓ ราย

- | | |
|--|-----------------------------|
| ๑) นางสาวพรวิภา คุ้มคง | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๒) นายกำชัย สุทธิยะ | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๓) นางสาวศุภรดา ปิ่นสุภา | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๒. ให้เพิ่มเจ้าหน้าที่ห้องปฏิบัติการวิเคราะห์เภสัชภัณฑ์ จำนวน ๑๒ ราย | |
| ๑) นางสาวณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๒) นางสาวณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๓) นางสาวณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๔) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๕) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๖) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๗) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๘) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๙) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๑๐) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๑๑) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |
| ๑๒) นายณิศา กลิ่นเขียว | ทะเบียนเลขที่ ๖-๒๐๑๕-๑-๐๐๒๕ |

อนึ่ง หนังสือฉบับนี้

อนึ่ง หนังสือฉบับนี้จะส่งมอบพร้อมหนังสือต่ออายุรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
ในวันที่ ๒ กันยายน ๒๕๖๕

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ



กรมวิจัยและพัฒนาผลิตภัณฑ์โรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบผลิตภัณฑ์และทะเบียนห้องปฏิบัติการ
โทร ๐ ๒๕๓๐ ๖๓๑๒ ต่อ ๒๐๐๑-๕
โทรสาร ๐ ๒๕๓๐ ๖๓๑๕ ต่อ ๒๑๕๕
ไปรษณีย์อิเล็กทรอนิกส์ sarabangediv@mail.go.th



ที่ อก ๐๓๑๐(๑)/ ๑๒ ๓ ๖ ๕

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๒ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๑๘ สิงหาคม ๒๕๖๕

เรื่อง ยกเลิกบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขออนุญาตสิทธิ์ของห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๒ ธันวาคม ๒๕๖๓

ตามคำขอที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการ
วิเคราะห์เอกชน เลขทะเบียน ๖-๒๐๔ สดแทนที่เลขที่ ๑๐๔ ขอพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ
เขตสวนหลวง กรุงเทพมหานคร ขยายเลิกบุคลากร ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้ออกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์
จำนวน ๘ ราย ได้แก่

๑) นายประพนธ์ วรรณสุขชัย	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๐๖๐
๒) นายจิรณัฐ ขาวละออ	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๐๓๒
๓) นายพิรพัฒน์ คำคำ	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๐๘
๔) นางสาวอรรษา ศักดิ์ทอง	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๔๔
๕) นายกิตติพงศ์ แซ่ลี	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๔๔
๖) นายจิรเมธ ประเสริฐศิริพงษ์	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๖๐
๗) นายภัทรพงษ์ มณฑาทอง	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๖๗
๘) นางสาวจารุวรรณ กระจำพันธุ์	ทะเบียนเลขที่ ๖-๒๐๔-๑-๐๑๘๑

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายธีรศักดิ์ อัครางกูร ณ อุตสาหกรรม)
รองอธิบดี ปฏิบัติราชการแทน
อธิบดีกรมโรงงานอุตสาหกรรม

กรมวิจัยและพัฒนาผลิตภัณฑ์โรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบผลิตภัณฑ์และทะเบียนห้องปฏิบัติการ
โทร ๐ ๒๕๓๐ ๖๓๑๕ ต่อ ๒๑๐๑-๕
โทรสาร ๐ ๒๕๓๐ ๖๓๑๕ ต่อ ๒๑๕๕
ไปรษณีย์อิเล็กทรอนิกส์ sarabangediv@mail.go.th



"อุตสาหกรรมก้าวหน้า ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



"อุตสาหกรรมก้าวหน้า ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



ที่ อก ๐๓๑๐/ ๑๒ ๓ ๖ ๕

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๒ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๑๘ สิงหาคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขออนุญาตสิทธิ์ของห้องปฏิบัติการวิเคราะห์
เอกชน ลงวันที่ ๒๓ พฤษภาคม ๒๕๖๓

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือต่ออายุรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด จำนวน ๓ แผ่น

ตามคำขอที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุ
หนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๓๐๓ สดแทนที่เลขที่ ๖๑๖/๑๐ หมู่ที่ ๕
ตำบลแม่ไม้ อำเภอลำปาง จังหวัดลำปาง ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้ออกให้ เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย)
จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมห้องปฏิบัติการวิเคราะห์เอกชน

๑) นายเดช งามชน	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๑
๒) นายวิชาวัฒน์ นริวัธ	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๒
๓) นายสุพรรณ สลามาพิง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๓

ข. เจ้าหน้าที่ห้องปฏิบัติการวิเคราะห์เอกชน

๑) นายณัฐพงษ์ เพ็ชรชวนา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๔
๒) นางสาวกัญญารัตน์ รักดี	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๕
๓) นางสาวสุภาวรัตน์ ศิริทองงาม	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๖
๔) นางสาวจิตติสุภา ประทีปสุข	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๗
๕) นายสุรเชษฐ์ คุยอภัย	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๘
๖) นายณัฐวัฒน์ อ่อนพรมพร	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๐๙
๗) นายจิตรกร สีระชา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๐
๘) นายสิริพงษ์ สุวรรณรัตน์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๑
๙) นายสิทธิพันธ์ เสนาชีวะ	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๒
๑๐) นายอนุวัฒน์ เฒ่า	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๓
๑๑) นายสุรวิทย์ นพพงษ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๔
๑๒) นายณัฐพล สิงห์วีวงศ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๕
๑๓) นายอานนท์ บุญจีน	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๖
๑๔) นายณัฐพงศ์ วงศ์อัครา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๗
๑๕) นายอานนท์ โพธิ์พระทอง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๘

๑๖) นายณัฐพล...

๑๖) นายณัฐพล อัครางกูร	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๑๙
๑๗) นายสุกัญญา พิเศษพันธ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๐
๑๘) นายสันติ คันทิ	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๑
๑๙) นายวิญญู นิพัทธ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๒
๒๐) นายสุกัญญา สุกอัครา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๓
๒๑) นายเอกชัย ถิ่นทอง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๔
๒๒) นายพงษ์เทพ สิทธิละ	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๕
๒๓) นายนิพนธ์ กนกนิก	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๖
๒๔) นางสาวนันทิยา บุญจันทร์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๗
๒๕) นายสิทธิชัย อันพิมาย	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๘
๒๖) นางสาวพนาสิน หลอดทอง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๒๙
๒๗) นางสาวพนาสิน สิตา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๐
๒๘) นางสาวอริยา กุลศิริวงศ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๑
๒๙) นายพิทยา ทองแดง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๒
๓๐) นางสาวชลธิชา สุนท	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๓
๓๑) ว่าที่ร้อยตรี ธนชัย มั่งคั่ง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๔
๓๒) นายวรวิทย์ หันหา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๕
๓๓) นายศักดิ์รินทร์ จรัสกาย	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๖
๓๔) นายสุรศักดิ์ สาขิน	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๗
๓๕) นายสุภากร ลาแก้ว	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๘
๓๖) นายสุวิทย์ อดิพนธ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๓๙
๓๗) นายสุวิทย์ หันหา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๐
๓๘) นางสาววนิดา เจริญบุตรกุล	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๑
๓๙) นายธนสิทธิ์ วงศ์ไชย	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๒
๔๐) นายชัยยุทธ เลิศนันทกุลชัย	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๓
๔๑) นายสุวิทย์ เพ็ชรแสง	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๔
๔๒) นายณัฐพล มณีพันธ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๕
๔๓) นายวิวัฒน์ อธิจินดา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๖
๔๔) นายสุวิทย์ วงศ์สุริยา	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๗
๔๕) นายสุวิทย์ อดิพนธ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๘
๔๖) นางสาวกิตติยา สันติวิทยารักษ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๔๙
๔๗) นางสาวสิริรัตน์ ศิริมงคล	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๐
๔๘) นายพิพัฒน์ นิกิต์เศรษฐ์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๑
๔๙) นายสุวิทย์ เรืองสม	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๒
๕๐) นายปรเมศ สัตยาคณ	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๓
๕๑) นายณัฐพล ธรรมะโร	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๔
๕๒) นางสาวสุกัญญา โสจันทร์	ทะเบียนเลขที่ ๖-๓๐๓-๑-๐๐๕๕

๕๓) นายพชร...

๕๒) นายพรกร เจริญชัย
๕๓) นายท้าวกร เชื้อมาก
๕๔) นายอนุรักษ์ ทองขจรศักดิ์
๕๕) นายอภิชาติ วิลาศ
๕๖) นายจรัสศรี ศรีรักษา
๕๗) นายประสาธน์ นิ่มเพ็ญ
๕๘) นายภาณุวัฒน์ วัชร
๕๙) นายสันธิ์ ชัยชนะ
๖๐) นายสินกร กุณฑา
๖๑) นายสินกร กุณฑา

ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๕
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๕
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๖
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๗
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๘
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๕๙
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๖๐
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๖๑
ทะเบียนเลขที่ ๖-๓๒๓-๖-๐๐๖๒

๓. ขอบข่ายข้อมูลสารมลพิษที่ได้รับขึ้นทะเบียนในวิเคราะห์น้ำเสีย น้ำใต้ดิน อากาศเสีย ตามสิ่งที่ส่งมาด้วย

หนังสือฉบับนี้จะมีผลใช้บังคับตั้งแต่วันที่ ๒๕ มิถุนายน ๒๕๖๓ หากประสงค์จะต่ออายุหนังสือ รับขึ้นทะเบียนต้องปฏิบัติตามวิธีการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อกรมโรงงาน อุตสาหกรรมภายใน ๖๐ วัน ก่อนวันสิ้นสุดของหนังสือรับขึ้นทะเบียนเพื่อปฏิบัติตามวิธีการวิเคราะห์เอกชน จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายพรศ กสินกรอง)
รองอธิบดีกรมโรงงานอุตสาหกรรม
สำนักงานกรมโรงงานอุตสาหกรรม

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
โทร. ๐ ๒๓๑๓ ๖๐๕๖-๕๖ ๕๐๐๑-๖
โทรสาร ๐๒๓๑๓ ๖๐๕๖-๕๐๐๑-๖
e-mail: oem@oem.go.th



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



เอกสารแนบท้ายหนังสือเปลี่ยนแปลงสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลแอล แอบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ๖-๓๒๓
ที่ ออก ๐๓๒๐/ ๗ ๕๓ ๘ ลงวันที่ ๐๔ สิงหาคม ๒๕๖๓

ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๒๔ รายการ
น้ำเสีย จำนวน 14 รายการ

ลำดับ ที่	สารมลพิษ	วิธีวิเคราะห์
1	Biochemical Oxygen Demand	1) 5-Day BOD Test, Membrane Electrode Method ⁽²⁾ 2) 5-Day BOD Test, Azide Modification Method ⁽²⁾
2	Chemical Oxygen Demand	1) Open Reflux, Titrimetric Method ⁽²⁾ 2) Closed Reflux, Colorimetric Method ⁽²⁾ 3) Closed Reflux, Titrimetric Method ⁽²⁾
3	Color	ADAI Weighted-Ordinate Spectrophotometric Method ⁽²⁾
4	Cyanide	Distillation, Colorimetric Method ⁽²⁾
5	Formaldehyde	Distillation, Colorimetric Method ⁽²⁾
6	Free Chlorine	DPD Ferrous Titrimetric Method ⁽²⁾
7	Oil and Grease	Liquid-Liquid, Partition Gravimetric Method ⁽²⁾
8	pH	Electrometric Method ⁽²⁾
9	Phenols	1) Distillation, Chloroform Extraction Method ⁽²⁾ 2) Distillation, Direct Photometric Method ⁽²⁾
10	Sulfide	ZnS Precipitation, Iodometric Method ⁽²⁾
11	Temperature	Field Method ⁽²⁾
12	Total Dissolved Solids	Dried at 180 °C ⁽²⁾
13	Total Kjeldahl Nitrogen	Semi Macro Kjeldahl Method ⁽²⁾
14	Total Suspended Solids	Dried at 103-105 °C ⁽²⁾

น้ำใต้ดิน จำนวน 3 รายการ

ลำดับ ที่	สารมลพิษ	วิธีวิเคราะห์
1	Cyanide	Distillation, Colorimetric Method ⁽²⁾
2	pH	Electrometric Method ⁽²⁾
3	Phenols	Distillation, Direct Photometric Method ⁽²⁾

อากาศเสีย...

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อากาศเสีย (ปล่อยระบาย) จำนวน 7 รายการ

ลำดับ ที่	สารมลพิษ	วิธีวิเคราะห์
1	Carbon Monoxide	1) Sampling Bag, Non-Dispersive Infrared Method ⁽⁵⁾ 2) Instrumental Analyzer Method ⁽⁹⁾
2	Hydrogen Sulfide	Absorption Sampling, Iodometric Method ⁽⁵⁾
3	Opacity	Ringelmann's Method ^(3,4)
4	Oxide of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method ⁽⁶⁾ 2) Instrumental Analyzer Method ⁽¹⁰⁾
5	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Acid Method ⁽⁵⁾ 2) Instrumental Analyzer Method ⁽¹¹⁾
6	Sulfuric Acid	Isokinetic Sampling, Barium - Titrimetric Method ⁽⁶⁾
7	Total Suspended Particulate	Isokinetic Sampling, Gravimetric Method ⁽⁷⁾

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๑๔ ตุลาคม ๒๕๖๗

เรื่อง แก้ไขรายชื่อเจ้าหน้าที่ห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบริทอรี่ กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง หนังสือ บริษัท เอแอลเอส แลบริทอรี่ กรุ๊ป (ประเทศไทย) จำกัด เลขที่ Env 2024/005
ลงวันที่ ๓๐ สิงหาคม ๒๕๖๗

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบริทอรี่ กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการ
วิเคราะห์เอกชน เลขทะเบียน ว-๓๒๓ สถานที่ตั้งเลขที่ ๖๑๖/๑๐ หมู่ที่ ๕ ตำบลแม่ป่าแก้ว อำเภอปลวกแดง
จังหวัดระยอง ขอแก้ไขชื่อเจ้าหน้าที่ห้องปฏิบัติการวิเคราะห์เอกชน เนื่องจากมีความคลาดเคลื่อน ความละเอียด
แจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรม ได้รับทราบและดำเนินการแก้ไขรายชื่อเจ้าหน้าที่ห้องปฏิบัติการ
วิเคราะห์เอกชน จำนวน ๕ ราย ตามที่แจ้งเรียบร้อยแล้ว เป็นดังนี้

ลำดับที่ ๒๗ นางพจนา สิตา

ลำดับที่ ๒๘ นางสาวอนิศา กุลสุริวงศ์

ลำดับที่ ๓๐ นางชลธิชา สุปงกช

ลำดับที่ ๓๖ นายสุทธิศักดิ์ โชคปิณันท์

ลำดับที่ ๔๒ นายกันตพล มณีสันพันธ์

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

ผอ.

(นายพรยศ กลิ่นกรอง)
อธิบดี ปฏิบัติราชการ
อธิบดีกรมโรงงานอุตสาหกรรม

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
โทร. ๐ ๓๓๐๓ ๖๐๕๙ ต่อ ๕๐๐๓-๖
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"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"





บริษัท เอแอลเอส แลборาทอรี กรุ๊ป (ประเทศไทย) จำกัด (สำนักงานใหญ่)

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แขวงพัฒนาการ เขตสวนหลวง กรุงเทพฯ 10250

ติดต่อเรา

