

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM ₁₀)	High Volume	RVG_F50666	-	-	On site Calibration
Ambient	Particulate Matter (PM ₁₀)	High Volume	RVG_F50662	-	-	On site Calibration
Ambient	Particulate Matter (PM ₁₀)	High Volume	RVG_F50186	-	-	On site Calibration
Ambient	Particulate Matter (PM ₁₀)	High Volume	RVG_F50188	-	-	On site Calibration
Ambient	Particulate Matter (PM ₁₀)	Digital Balance	RVG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Total Suspended Particulate	High Volume	RVG_F50292	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50189	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50177	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50178	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RVG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RVG_F50252	2-Jul-24	2-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RVG_F50458	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RVG_F50255	2-Jul-24	2-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RVG_F50272	2-Jul-24	2-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RVG_F50251	4-Jul-24	4-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RVG_F50458	5-Jul-24	5-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RVG_F50254	4-Jul-24	4-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RVG_F50532	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	RVG_F50531	28-Aug-24	28-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50545	21-Jan-25	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_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	Pict Tube	BKK_F50073	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Pict Tube	BKK_F50561	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RVG_F50563	26-Jan-24	25-Jan-25	12
Stack	Total Suspended Particulate	Digital Balance	RVG_EN0003	22-Feb-24	22-Feb-25	12
Stack (CEM6)	Oxides of Nitrogen	Analyzer - System calibration, Span	-	-	-	-
Stack (CEM6)	Sulfur Dioxide	Analyzer - System calibration, Span	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RVG_F50213	28-Feb-24	27-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50020	22-Jan-24	21-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50022	25-Jan-24	24-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50018	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Calibrator	RVG_F50496	26-Jan-24	25-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50389	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50437	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50434	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50432	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50439	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50491	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Calibrator	RVG_F50216	23-Aug-24	23-Aug-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50023	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_F50034	29-Nov-23	28-Nov-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_F50097	9-Jan-24	28-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_F50098	9-Jul-24	9-Jul-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50012	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50022	25-Jan-24	24-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50221	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50223	12-Jan-24	11-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50224	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50228	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50226	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50231	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50232	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50356	12-Jan-24	11-Jan-25	12
Illuminance	Illuminance	Lux Meter	RVG_F50471	14-Mar-24	13-Mar-25	12
Illuminance	Illuminance	Lux Meter	RVG_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	RVG_F50550	30-Jul-24	29-Jul-25	12
Rayong Lab	pH at 25 °C	pH Meter	RVG_EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RVG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RVG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RVG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RVG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	BOD	DO meter with Sensor	RVG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RVG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	BOD	Burette	RVG_EN0216	24-Sep-24	24-Sep-25	12
Rayong Lab	Oil & Grease	Electronic Balance	RVG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RVG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RVG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RVG_EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	COD	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Chloride	pH ISE Meter	RVG_EN0152	14-Dec-23	13-Mar-25	18
Rayong Lab	Cyanide	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Formaldehyde	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Phenol	Spectrophotometer	RVG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RVG_EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	Fluoride	pH ISE Meter	RVG_EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RVG_EN0188	11-Mar-24	11-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RVG_EN0152	14-Dec-23	14-Jun-25	18
Water Lab	Calcium	ICP-OES	BKK_EL0037	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	ICP-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	ICP-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	ICP-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	21-Nov-26	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-Jun-25	6-Jun-25	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	13-Sep-24	13-Sep-25	12
Water Lab	Silver	ICP-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	ICP-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	ICP-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	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Iron	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Iron	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Copper	ICP-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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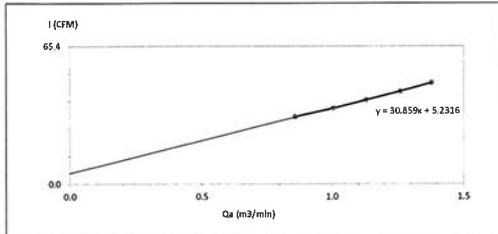
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Nickel	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	CP-MS	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Arsenic	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Arsenic	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	CP-MS	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Selenium	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Selenium	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	CP-MS	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Cadmium	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Cadmium	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	CP-MS	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Zinc	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Zinc	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	CP-MS	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Trivalent Chromium	CP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Trivalent Chromium	Hot Block Chamber (Cooling Room)	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	CP-MS	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 TSS Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่ปูนซีเมนต์ (โรงโม่ปูน) 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 : 6265
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 Juntarapan)
Enviro Field Coordinator Scientist (3)

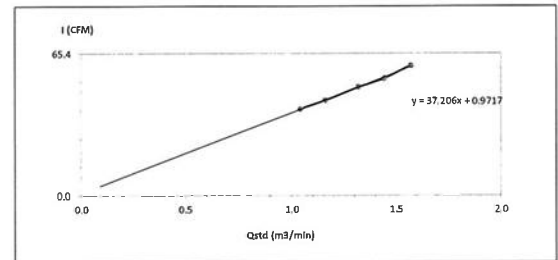
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TSS Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่ปูนซีเมนต์ (โรงโม่ปูน) 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 Juntarapan)
Enviro Field Coordinator Scientist (3)

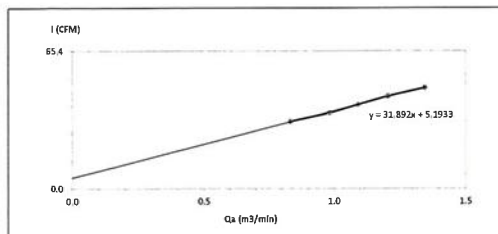
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TSS Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่ปูนซีเมนต์ (โรงโม่ปูน) 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 Juntarapan)
Enviro Field Coordinator Scientist (3)

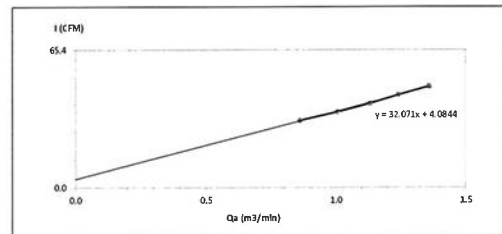
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TSS Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงโม่ปูนซีเมนต์ (โรงโม่ปูน) 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: 32.0719 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 Juntarapan)
Enviro Field Coordinator Scientist (3)

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



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 : 23.8 °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 Operator ☐ 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	M2306197S	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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T
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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 reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the residual 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)	10.0000	99.9999	Nominal value :	50	g
10 g	10.0000	100.0000	Tolerance	0.0004	g
Tolerance	10.0000	100.0001			
0.0001 g	10.0000	100.0001			
Nominal Value : (High Load)			Difference		
100 g	10.0000	100.0001	1	---	
Tolerance	10.0000	100.0000	2	-0.0001	
0.0001 g	10.0000	100.0001	3	0.0001	
Standard Deviation			4	0.0002	
	0.00005	0.00008	5	0.0000	
			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	0.00020
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

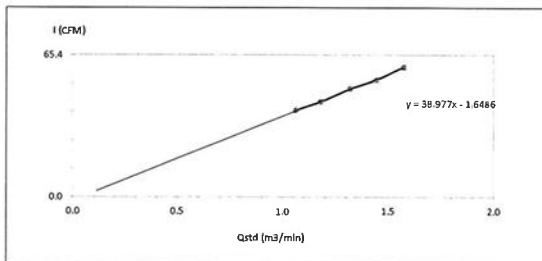
End of Report.

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd.
Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงเรือนปลูกพืชผัก
Temperature (°C) : 29
Calibrate Date : 20-Nov-24
High Volume ID : RYG_FS0292
Calibration Sheet No. : C-201124-RYG_FS0292
High Volume Model : TE-5170D
Calibrator ID : RYG_FS0205
High Volume S/N : 5497
Calibrator Model : TE-5028A
Calibrator Slope : 1.52567
Calibrator S/N : 1166
Calibrator Intercept : -0.03613

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



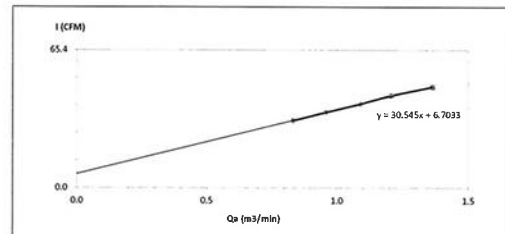
Calibrated by : (Mr.Anurak Tongkhajonsakda)
Field Scientist(2)

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

High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd.
Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงเรือนปลูกพืชผัก
Temperature (°C) : 29
Calibrate Date : 20-Nov-24
High Volume ID : RYG_FS0189
Calibration Sheet No. : C-201124-RYG_FS0189
High Volume Model : TE-5099X
Calibrator ID : RYG_FS0205
High Volume S/N : 4797
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 : 30.5454 Intercept : 6.7033 Correlation Coefficient : 0.9990
2	2.0	0.959	36	
3	2.6	1.090	40	
4	3.2	1.206	44	
5	4.1	1.363	48	



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

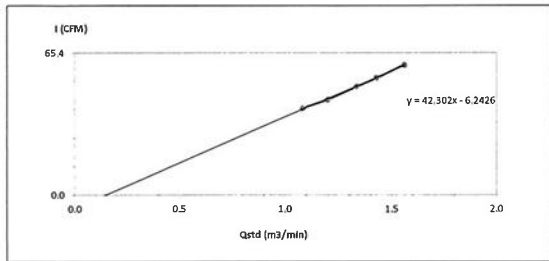
Approved by : (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงบำบัดน้ำเสีย (ท่าเรืออุตสาหกรรม) 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	1.0827	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)

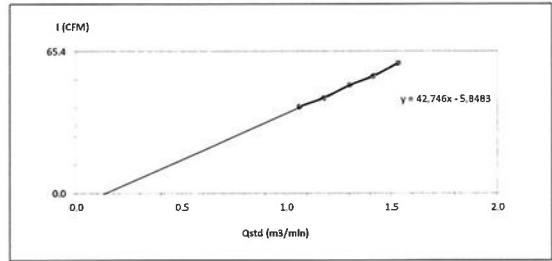
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg) : 755.2
Calibrate Location : โรงบำบัดน้ำเสีย (ท่าเรืออุตสาหกรรม) 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)

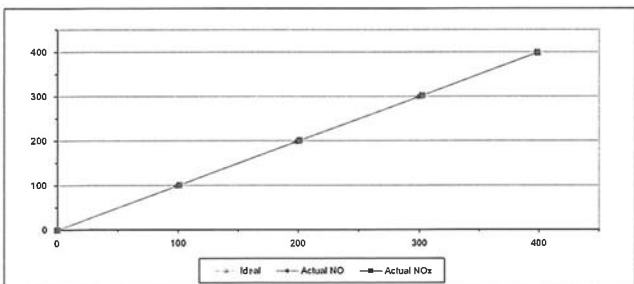
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



MULTIPOINT CALIBRATION REPORT

Calibration Date : 2-Jul-24 Equipment Name : NOx Analyzer
Manufacturer : Teledyne API Model : T200
Serial No. : 2198 Equipment ID : RYG_FS0262
Calibrator Manufacturer : Teledyne API Model : 700
Serial No. : 947
Std. Gas Concentration (PPM) : 55.88 Cylinder No. : GN0027222
Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
Certified Date : 9-Feb-22 Expired Date : 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-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 (%)				-0.63			0.43



Calibrated By

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

Approved By

(Mr. Sarayuth Jittranont)
Assistant General Manager

ALS Laboratory Group

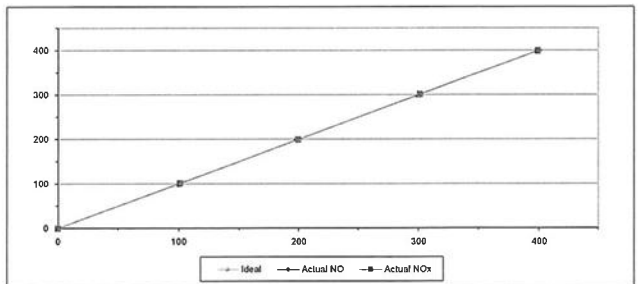
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date : 3-Jul-24 Equipment Name : NOx Analyzer
Manufacturer : HORIBA Model : APNA-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 Expired Date : 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittranont)
Assistant General Manager

ALS Laboratory Group

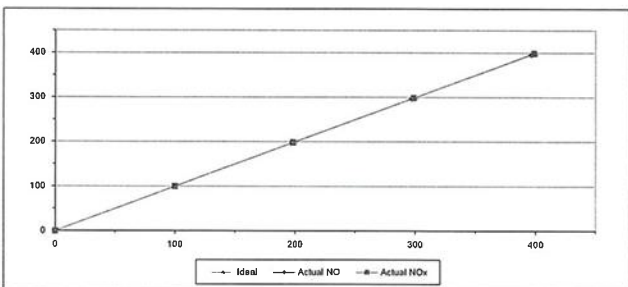
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



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	Alrgas 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. Sanyuth Jitranont)
Assistant General Manager

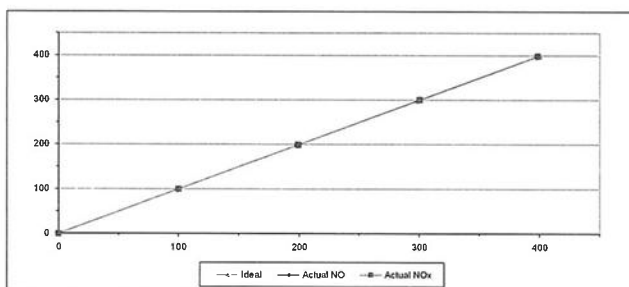
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	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	Alrgas Inc.
Certified Date	8-Feb-22	Expired Date	8-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 (%)				-0.61			-0.07



Calibrated By

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

Approved By

(Mr. Sanyuth Jitranont)
Assistant General Manager

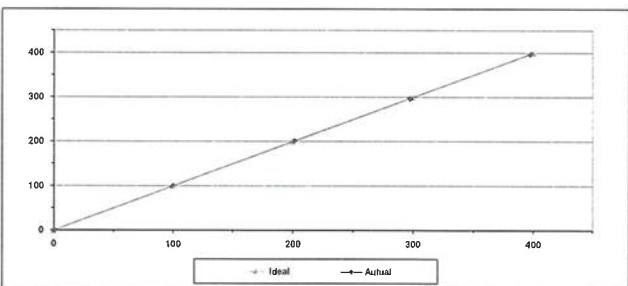
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	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	Alrgas 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. Sanyuth Jitranont)
Assistant General Manager

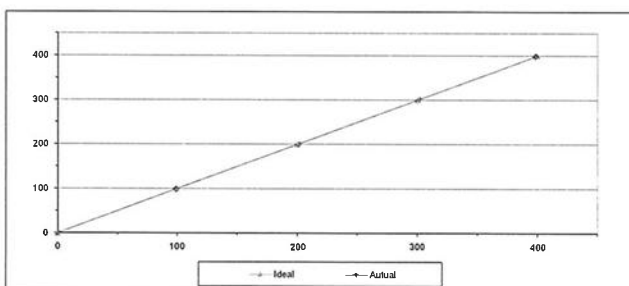
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	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	Alrgas 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. Sanyuth Jitranont)
Assistant General Manager

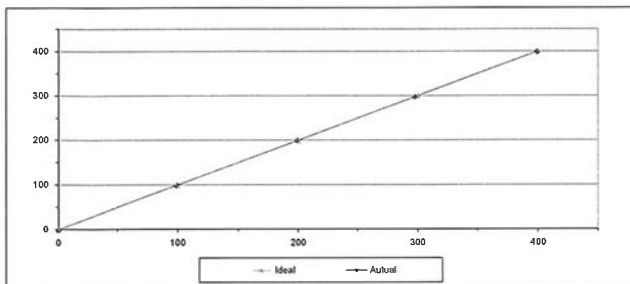
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1772	Equipment ID	RYG_FS0254
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	0.05	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

Approved By

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

(Mr.Sarayuth Jittrantorn)
Assistant General Manager

ALS Laboratory Group

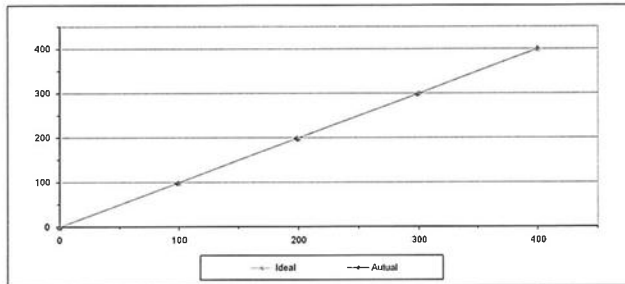
FORM NO.: F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	6060	Equipment ID	RYG_FS0532
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	-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

Approved By

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

(Mr.Sarayuth Jittrantorn)
Assistant General Manager

ALS Laboratory Group

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



Jirarat Associates Co., Ltd.
62/24 J.S. 57/22-36
P.O. Box 101, 101, Muang Phuan, Thailand
Bangkok 10110, Thailand
Tel: 02-65028412
Mobile: 090-0155443
E-mail: jirarat@jirarat.com
Web site: www.jirarat.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 17015:2017
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	Novatec
MODEL/TYPE	Sensor: WS-03F Data logger: WS-250L
SERIAL NUMBER	Sensor: A4567 Data logger: A4567
TO NUMBER	166, 450243
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 ± 1.0 hPa
PLACE OF CALIBRATION	Envi-tel wind tunnel of Jirarat Associates Co., Ltd.
CALIBRATION CONDITIONS	Wind tunnel cross section area: 300 cm ² Wind direction frontal area: 100 cm ² Diameter of mounting pipe: 10 mm Diameter of test object: 0.111 [m]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (24.2) °C, (41.9) %RH and (1007.9) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sarayuth Jittrantorn
☐ Mrs. Jirarat Jittrantorn

Remarks:
1. The cross section area of the wind tunnel
2. Provided mass section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio 1/1

Approved signature

Mr. Sarayuth Jittrantorn
Calibration Services Department Manager

REVIEW BY

APPROVED BY

NEXT CAL. DATE: 20/12/26

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 RESULTS

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 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 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.999	23.18	24.20	0.9	-0.1	0.33
2.041	24.42	24.20	1.9	-0.2	0.31
2.982	25.60	24.20	2.9	-0.1	0.31
4.108	25.82	24.20	3.8	-0.3	0.31
4.97	25.62	24.20	4.9	-0.1	0.31
5.95	25.94	24.20	6.0	0.0	0.31
7.01	25.46	24.20	7.0	0.0	0.31
7.96	25.80	24.20	8.0	0.0	0.31
9.18	25.90	24.20	9.1	0.3	0.31
9.96	25.74	24.20	10.1	0.1	0.31
10.94	24.00	24.20	11.1	0.2	0.31
12.61	25.82	24.20	12.2	0.2	0.31
12.52	24.00	24.20	13.1	0.2	0.31
14.05	25.45	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:

* Calibration results only valid 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 Jirarat Associates Co., Ltd. The Cup anemometer shows 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

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 ₁₀₀	D ₁₀₀₀	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	133	-2	0.80
	180.000	180	0	0.80
	225.000	227	2	0.80
	270.000	273	3	0.80
	315.000	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

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novallma
MODEL/TYPE : Sensor: WS-03F
Data logger: 110 WS-250L-D
SERIAL NUMBER : Sensor: WSD AS789
Data logger: AS789
ID NUMBER : RYG_FS0531
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 : 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 : 1010.6 hPa

PLACE OF CALIBRATION : Efflux-type wind tunnel of Jiranatee 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 [-]

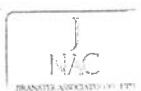
Preconditioning : 24 hours at ambient conditions.

Measurement Condition : 12 h 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 Jitraporn Lertsomphol



Approved signatory

Mr. Panyaporn Booncharoen
Calibration Department Manager

Remarks:

¹ Inside of calibration area of the wind tunnel.

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

³ Diameter of mounting pipe

⁴ Ratio, [-]

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CERTIFICATE OF CALIBRATION

Certificate No. : CDT-163-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novallmx
MODEL/TYPE : 110-WS-250L-D
SERIAL NUMBER : AS789
ID NUMBER : RYG_FS0531
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 : 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

Calibration procedure:
The temperature calibration was done by
In House calibration method as WH-CL-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 (NIMT)
Unit Scale number: 11-0047-24. Certificate
number: LR 0101 21

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 AS50, Serial No.: 167562-09,
Due date: 26 Mar 2025

2. Digital Temperature Indicator
Model: DTI-1000-A Mk II, Serial No.: 673407,
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

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 89 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.049	19.6	-0.4	0.099
60	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

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



Approved signatory

Mr. Panyaporn Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-033-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: Relative humidity with data logger

MANUFACTURER

: Hovalyx

MODEL/TYPE

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

SERIAL NUMBER

: Sensor: HW950

ID NUMBER

: Data logger: AS789

CONDITION AS RECEIVED

: Sensor: T0210901

CUSTOMER

: RYC, F50531

RECEIVED DATE

: 28 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

NOTE: 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 comparison method at WI-CI-009 and WI-CI-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: TM-0179-23 and through Iranatee 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".

Measurement Results:

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

Result of Calibration:

☒ Without Adjustment ☐ With Adjustment

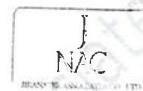
Table 1: The results of calibration of relative humidity at 30 °C are reported in table below

Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ± (%RH)
25.82	19.64	17.9	-1.7	0.53
29.30	50.70	47.5	-3.2	1.1
29.86	82.37	77.6	-4.8	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration



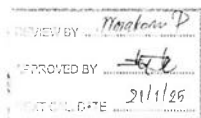
Calibrated by:

- ☐ Mr. Sorawit Thachulad
☐ Ms. Wutaporn Lertsomahol
☐ Ms. Ruangsuda Phornmit

Approved signature:

Mr. Pannya Booncharoen
Calibration Department Manager

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Certificate Number

CWS-002-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Cup anemometer

MANUFACTURER

: Hovalyx

MODEL/TYPE

: Sensor: WS-427

SERIAL NUMBER

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

ID NUMBER

: Sensor: WSO-A5616

CONDITION AS RECEIVED

: Data logger: AS616

CUSTOMER

: RYC, F50545

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 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

: Wind tunnel cross-section area

: 900 cm²

: Wind direction frontal area

: 100 cm²

: Diameter of mounting pipe

: mm

: Blockage ratio of test object

: 0.111

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (23.5) °C, (45.7) %RH and (1008.2) hPa

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer (model: WS-427) and Effel tube with precision differential pressure meter model: DP14500 in air flow temperature of Effel type wind tunnel with 900 cm² cross test section area. The WI-CI-007 based on IEC 61400-12-1 Wind energy generation systems - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used as a reference guide.

Traceability:

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

Uncertainty of Measurement:

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

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, Unit Under Calibration (UUC) was 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 10 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 3 m/s. The results of calibration are as shown and measurement uncertainties are reported in the table below.

V _{ref} ⁴ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} ⁵ (m/s)	Error (m/s)	U (m/s)
1.023	23.80	23.50	0.8	-0.2	0.31
2.078	24.00	23.90	1.8	-0.2	0.31
3.021	23.78	23.90	2.8	-0.2	0.31
4.148	23.52	23.90	3.9	-0.2	0.31
5.00	23.60	23.90	4.8	-0.2	0.31
5.99	23.68	23.90	5.8	-0.2	0.31
7.03	23.50	23.90	6.8	0.2	0.31
8.16	23.60	23.90	7.9	-0.3	0.31
9.08	23.50	23.90	8.9	0.2	0.31
10.05	23.78	23.90	9.8	-0.3	0.31
11.13	23.50	23.90	10.8	-0.2	0.31
12.11	23.78	23.90	12.0	-0.1	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

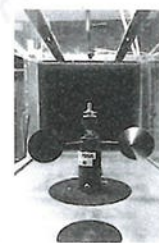
Remarks:

⁴ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

⁵ Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration setup of the cup anemometer calibration in the wind tunnel of Iranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not for the purpose of making promissory



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CERTIFICATE OF CALIBRATION

Page: 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor

Novolyne

Sensor: WS-43F

Data logger: 110-WS-25DL-D

Sensor: WSD AS816

Data logger: AS816

RYG_F50545

Used item

ALS Laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd.

Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AA00875-DMD4 P3 S UD in an close test section of Eiffel-type wind tunnel with 500 cm² cross test section area. The WS-CL-028 signal was JTC 184009-12-3. Wind energy generation systems - Part 12-2: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guide.

Traceability:

This certificate provides a traceability of the measurement to the international system of units (SI) through the National Institute of Metrology (NIMT) via Certificate number: BH-0543-22

Uncertainty of Measurement:

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 900 cm²

Win direction frontal area² 129 cm²

Diameter of mounting pipe³ mm

Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

24 hours as ambient conditions

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. Sorawit Thachalad

☐ Miss Jitraporn Lertsomphol

Approved signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

Remark:

¹ Netable cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_o}{A_t}$

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Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D ¹ _{ref} Degree (°)	D ¹ _{meas} 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
	270.001	275	5	1.0
	315.000	317	2	1.0
	360.000	359	-1	1.0

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CDT-036-66

Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novolyne

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.,

Khwang 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

1. Standard Temperature Probe Model: STS 100 A500

Serial No.: 667682 U9, Due date: 28 Mar 2024

2. Digital Temperature Indicator Model: DTI 1000 A MK II

Serial No.: 671407 00591 Due date: 22 July 2023

Calibration Condition

Temperature: (23±3) °C

Relative Humidity: (55±15) %

Traceability

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

Calibration Procedure

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

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

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 ★



Calibrated by:

☐ Mr. Sorawit Thachalad

☒ Miss Jitraporn Lertsomphol

☐ Miss Ruangrumpa Phoommij

Approved Signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

CERTIFICATE OF CALIBRATION

Calibration No.: RH-02072023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novolyx
Model/Type : 110 WS 25DL D
Serial Number : AS816
ID No. : RYG_PS0546
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phalthanahon 40, Phalthanahon Rd, Khwaeng Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

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

Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 in the humidity generation 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 (UIF) on display. Model: IIMD0, Serial number: T2320505

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	80.25	75.5	-4.8	0.51

Performed by:

- ☐ Mr. Sornwit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangsri Phoommit



Approved Signatory:

Mr. Panya Booncharoen
Mr. Panya Booncharoen
Calibration Department Manager

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

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

Certificate Number

CWS-025-67

Page 1 of 2 Pages

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novolyx
MODEL/TYPE : Sensor: WS-021
Data logger: 110 WS 25DL D
SERIAL NUMBER : Sensor: WSD-A5509
Data logger: AS509
ID NUMBER : RYG_PS0608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phalthanahon 40, Phalthanahon Rd, Khwaeng 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 : 1001.10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross section area¹ : 900 cm²
Wind direction frontal area² : 100 mm²
Diameter of mounting pole³ : - mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.5) °C, (43.4) %RH and (1005.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

- ☒ Mr. Sornwit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Panya Booncharoen
Calibration Department Manager

Remarks:

- ¹ Projected cross section area of the wind tunnel
² Projected cross section area of the tested object include mounting pole
³ Diameter of mounting pole
⁴ Ratio: b/a

Calibration procedure:

The Cup anemometer was calibrated against Standard air velocity transducer model: AS55-82 and pitot tube with precision differential pressure meter model: DPM2500 in on close test section of elliptical type wind tunnel with 900 cm² cross test section area. The WGL 003 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NMIT (National Metrology Institute of Thailand) via Certificate number: NM-0007-24 and NM-0055-23.

Uncertainty of Measurement:

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

REVIEW BY:

Random P

APPROVED BY:

Mr. Panya Booncharoen

Calibration Department Manager

NEXT CAL DATE : 11/1/26

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-025-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
0.593	24.79	24.45	0.8	-0.2	0.11
2.014	24.20	24.45	1.8	0.2	0.31
2.930	24.80	24.45	2.9	0.1	0.31
4.102	24.80	24.45	3.8	0.3	0.31
6.707	24.80	24.45	5.0	0.0	0.31
9.148	24.50	24.45	6.0	0.0	0.31
9.73	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	0.3	0.31
9.48	24.36	24.45	10.2	0.2	0.31
10.89	24.40	24.45	11.2	0.2	0.31
12.03	24.40	24.45	12.2	0.2	0.31
12.97	24.70	24.45	13.2	0.2	0.31
14.10	24.50	24.45	14.3	0.2	0.31
15.03	24.70	24.45	15.2	0.2	0.31
15.98	24.58	24.45	16.2	0.2	0.31

Remarks:

¹ Calibration results only count for the tested circumstances and environmental conditions in which calibration have place

Velocity at standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



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

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

Certificate Number

CWD-025-67

Page 1 of 2 Pages

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novolyx
MODEL/TYPE : Sensor: WS-021
Data logger: 110 WS 25DL D
SERIAL NUMBER : Sensor: WSD-A5509
Data logger: AS509
ID NUMBER : RYG_PS0608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phalthanahon 40, Phalthanahon Rd, Khwaeng 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 : 1001.10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross section area¹ : 900 cm²
Wind direction frontal area² : 129 cm²
Diameter of mounting pole³ : - mm
Blockage ratio of test object⁴ : 0.143 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

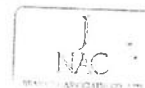
The average values during measurement are (22.4) °C, (43.3) %RH and (1004.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

- ☒ Mr. Sornwit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Panya Booncharoen
Calibration Department Manager

Remarks:

- ¹ Projected cross section area of the wind tunnel
² Projected cross section area of the tested object include mounting pole
³ Diameter of mounting pole
⁴ Ratio: b/a

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AX400319-DN04 P35 US in on close test section of elliptical type wind tunnel with 900 cm² cross test section area. The WGL 003 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NMIT (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).

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
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 ¹ ₁ Degree (°)	D ¹ ₂ Degree (°)	Error Degree (°)	U ¹ _(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

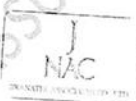
Remarks:

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
HIRANATEE ASSOCIATES CO., LTD.
Innovation Association Co., Ltd.
63/34-35, 6/35-36
Khuasakorn 2 (2), 1st Floor, Bangkok
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Tel: +66(0)21812
Mobile: +66(0)2779553
E-mail: info@hiranatee.com
Website: www.hiranatee.com

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

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-120-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novolyne
MODEL/TYPE : 110-W5-25DL-D
SERIAL NUMBER : AS909
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khuasakorn 2, 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 in WPC-1.001 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: RG7682 02,
Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DT-1000-A MKII, Serial No: 672407,
00381 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. Jiraporn Lertsomphol
☒ Mrs. Ruangsri Poommit



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



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:

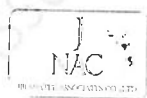
Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: U3641220.
Dimension: Diameter 12 mm, Length 80 mm.

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	40.016	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



J NAC
HIRANATEE ASSOCIATES CO., LTD.
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Website: www.hiranatee.com

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

Relative humidity and Air Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-022-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novolyne
MODEL/TYPE : Data Logger 110 W5-25DL-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: AS909
Sensor: U3641220
ID NUMBER : RYG_F50608
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khuasakorn 2, 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 ± 1.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Relative Humidity and Air Temperature calibration was done by in-house calibration method as W5-009 and W5-010 according to comparison method with Standard Digital 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 TH0079-23 and through Hiranatee Associates Co., Ltd. Certificate number CDT-001-67.

Uncertainty of Measurement:

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

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Mrs. Jiraporn Lertsomphol
☒ Mrs. Ruangsri Poommit



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Continuation of Certificate of Calibration Number: CRT-022-67

Page 2 of 2 Pages

Measurement Results:

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below
Calibration Range: 20RH to 80RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
29.79	15.49	17.5	-1.9	0.92
29.82	50.54	47.3	-3.3	1.3
29.82	81.68	77.1	-4.6	2.0

UUC*: Unit Under Calibration

End of Certificate of Calibration



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 10-Jul-24
Next Cal. Date : 10-Jan-25
Barometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 46.2
Temperature (°C) : 33.8
Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK-FS1122
Serial No. : A2003240
Correction Factor (V) : 0.9824
Next Calibration Date : 7-Nov-24

ΔH (mm H ₂ O)	Θ Minutes	Reference Dry Gas Meter Calibration						Console Control Dry Gas Meter						Dry Gas Meter Correction Factor (V)	Orifice Calibration Factor
		Vr (liters)			Tr (°C)	Vr (liters)			Tl (°C)	Tc (°C)	Avg Tr (°C)				
		Final	Initial	Total		Final	Initial	Total							
15	11:50	150.00	0.00	150.00	29.0	56698.0	56775.0	148.00	29.0	29.0	29.0	0.9842	43.8072		
25	6:40	150.00	0.00	150.00	31.0	56705.0	56810.0	147.00	32.0	32.0	32.0	1.0033	40.9751		
50	6:30	150.00	0.00	150.00	31.0	56720.0	56780.0	148.00	32.0	32.0	32.0	0.9941	41.0631		
80	4:54	150.00	0.00	150.00	31.0	56735.0	56770.0	147.00	32.0	32.0	32.0	0.9979	40.3565		
120	4:10	150.00	0.00	150.00	31.0	56720.0	56730.0	147.00	33.0	33.0	33.0	0.9973	41.0033		
											Avg		0.9974	41.5690	

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

ΔHΘ : Orifice pressure differential that equates to 71.24 in of air @ 25 °C and 760 mm of mercury, mmH₂O : tolerance for individual values ± 5.08 from average.

Procedure: 45 CFR 60 APP A METH. SEC 5.3 & 7

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

(Mr. Sakai Phaisanphit)
RYG Field Service Scientist (4)

FORM NO. 2 05/14 DATE: 06/14/22



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 : F806
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	5:00:06	5:00	6	0.00013
5	5:00:05	5:00	6	0.00010
6	5:00:05	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 : Sakai Phaisanphit

Mr. Sakai Phaisanphit

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_FS0468	Reference Temperature ID	RYG_FS0881		
Serial No. :	1302005	Serial No. :	201090014918		
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
Filter	140	141	1	±3	Pass
	100	101	1	±3	Pass
Exit	120	121	1	±3	Pass
	140	141	1	±3	Pass
	0	0	0	±3	Pass
Meter	10	10	0	±3	Pass
	20	20	0	±3	Pass
	0	0	0	±3	Pass
AUX	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

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Sakai Phaisanphit

(Mr. Sakai Phaisanphit)

RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong

(Mr. Nattapon Jengwareewong)

RYG Field Service Specialist (1)



PROBE NOZZLE DIAMETER
CALIBRATION DATA SHEET

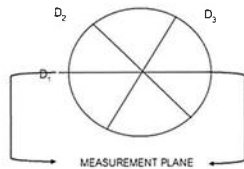
Calibration Date : 10 Jul 24		Nozzle Set ID. : BKK_FS0474			
Calibration Sheet No. : C-100724-BKK_FS0474		Vernier Caliper ID. : BKK_FS1123			
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D ₁	D ₂	D ₃		
1	0.305	0.300	0.305	0.005	0.303
2	0.455	0.455	0.455	0.000	0.455
3	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-06-027 REVISION NO. : 2 ISSUE DATE : 9 Feb 23



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mmHg) : 745.1
Relative Humidity (%) : 46.2
Temperature (C°) : 33.8
Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A2003240
Correction Factor (Y) : 0.9824
Next Calibration Date : 7-Nov-24
Console Control : Drygas Meter
Reference Dry Gas Meter Calibration
Calibration No. : C-100724-BKK_FS0556
Dry Gas Meter ID : BKK_FS0556
Serial No. : 1606041
Model No. : XC-572-V

ΔH (mm H ₂ O)	Θ Minutes	Reference Dry Gas Meter Calibration						Console Control : Drygas Meter						Dry Gas Meter Correction Factor (Y)	Office Calibration Factor ΔH_{eq}
		Wt (Liters)		Tr (°C)		Tr (°C)		Wt (Liters)		Ti (°C)		To (°C)			
15	11.75	Fluid	150.00	0.00	150.00	29.0	20256.9	30240.0	148.00	30.0	30.0	30.0	30.0	0.9975	42.5868
25	9.24				150.00	29.0	30260.7	30350.0	147.00	30.0	30.0	30.0	30.0	1.0033	43.8741
35	6.53				150.00	30.0	30284.6	30370.0	148.00	31.0	31.0	31.0	31.0	0.9974	43.6807
45	5.19				150.00	30.0	30299.7	30385.0	147.00	31.0	31.0	31.0	31.0	0.9979	44.4416
120	4.20				150.00	30.0	30314.6	30400.0	146.00	31.0	31.0	31.0	31.0	1.0009	43.6561
													Avg.	0.9894	43.6442

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

ΔH_{eq} = Office 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: 48 CFR 49 APP A METH. SEC 5.3.4.7

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



Stopwatch Calibration Test Report

Calibration Date : 10 Jul 24
Barometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 45.2
Next Cal. Date : 10 Jan 25
Temperature (C°) : 33.8

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_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

Calibrate 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_FS0681		
Serial No. :	1606041	Serial No. :	201060014918		
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
	400	399	-1	±3	Pass
	500	499	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
Oven	140	139	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
Filter	140	139	-1	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
Exit	140	141	1	±3	Pass
	0	0	0	±3	Pass
	10	10	0	±3	Pass
Meter	20	20	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
AUX	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนจากการวัด

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-06-027 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

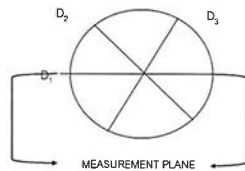
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.305	0.302	0.302	0.003	0.303
2	0.485	0.475	0.485	0.010	0.482
3	0.620	0.635	0.635	0.015	0.630
4	0.765	0.765	0.765	0.000	0.765
5	0.970	0.980	0.975	0.010	0.975
6	1.085	1.085	1.081	0.004	1.084
7	1.275	1.275	1.275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

Where :

D_1, D_2, D_3 = 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 Phaisanphut
(Mr. Saksit Phaisanphut)
RYG Field Service Scientist (4)

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

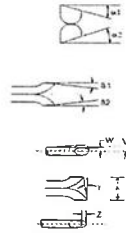
FORM NO. : F-06-124 REVISION NO. : 0 ISSUE DATE : 25/12/23



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	$0.188'' \text{ to } 0.375''$	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 Phaisanphut
(Mr. Saksit Phaisanphut)
RYG Field Services Scientist (4)

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

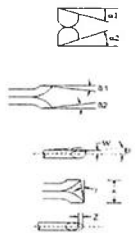
FORM NO. : F-06-124 REVISION NO. : 0 ISSUE DATE : 25/12/23



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	$0.188'' \text{ to } 0.375''$	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 Phaisanphut
(Mr. Saksit Phaisanphut)
RYG Field Services Scientist (4)

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

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



Calibration Certificate



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

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03580098/1121
Instrument serial no. : 62985947/1121
ID no. or control no. : RYG_FS0563
Manufacturer : Testo SE & Co. KGAA
Probe model : -
Probe serial no. : -
Customer name : ALS LABORATORY GROUP (THAILAND) CO., LTD.
Customer address : 101 Phatthana-kan 40, Phatthana-kan Road, Khwaeng Phatthana-kan, Khet Suan Luang Bangkok, 10250 Thailand

Total pages of certificate : 2 Pages
Receiving no. : I-240766
Receiving date. : 24 Jan-24
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.04, 21.02 % vol, Carbon Monoxide 80, 140, 200, 300 ppm, Nitrogen Dioxide 30.34, 60.66, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.6, 600.6 ppm)

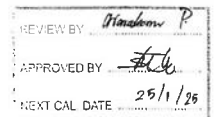
Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : $23 \pm 5^\circ \text{C}$
Humidity : $55 \pm 15\% \text{RH}$

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

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-20-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 approved 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 not valid and the results relate only to the items tested/calibrated.
The calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 26 Jan 24



Mr. Kwanchai Khairoung
Calibration Technician

Mrs. Nongluck Wangsetee
Technical Manager

FM-C-05-C Rev.2

Page 1 of 2

Issue Date 26/02/16

Entech Industrial Solution Co., Ltd.

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

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Linde	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-0049-22	Nmt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.95 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nmt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

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

Calibration conditions

Gas Temperature : 73 °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)	80.95	81.2	0.24	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	12

Remark : 1 cmol/mol = 1 l/mol, 1 μmol/mol = 1 ppm

End of Report

Certificate of Calibration

REVIEW BY: Thawit
APPROVED BY: P. Saket
NEXT CAL DATE: 22/02/2025

Model Number : MSU224S-100-DU
Description : Analytical Balance
Serial Number : 0031708552
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.Pluck Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T.Maenam Khu. A.Pluck 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 : 1017.1 mbar

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/Balometer/Temp Lutron MHB-382SD	DKSH	C1823184S	23-Aug-2024

This certificate misle 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)



Certificate of Calibration

Model Number : MSU224S-100-DU
Description : Analytical Balance
Serial Number : 0031708552
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

<p>Repeatability</p> <p>The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.</p>		<p>Eccentricity (Off-center loading error)</p> <p>The off-center loading error is yielded by the difference between the readout of the load, Le. 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).</p>	
Nominal Value : (Low Load)	20.0000	200.0001	
20 g	20.0000	200.0000	
Tolerance	20.0001	200.0001	
0.0001 g	20.0000	200.0001	
	20.0000	200.0001	
Nominal Value : (High Load)	20.0000	200.0001	
200 g	19.9999	200.0001	
Tolerance	20.0000	200.0000	
0.0001 g	20.0000	200.0000	
	20.0000	200.0001	
Standard Deviation	0.00005	0.00005	

Linearity

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

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. 24121408-1

ANALYZER CALIBRATION DATA

Client : Gulf T&S Co., Ltd. Location : Udang HR30 11
Date : 21 Nov 24 Test Operator : Sakell 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	0.15	0.05	0.40
Low-Level Gas	8.00	8.18	8.06	0.48
Span Gas	16.02	16.32	16.17	0.60

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	0.20	0.10	0.05
Low-Level Gas	82.39	82.59	82.50	0.05
Span Gas	164.40	164.70	164.55	0.07

SO₂ ANALYZER : TELEDYNE API 100EH Serial No. : 437
Model : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.02	0.01
Low-Level Gas	78.75	78.78	78.77	0.01
Span Gas	159.90	159.98	159.95	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	0.01
Low-Level Gas	79.48	79.43	79.47	0.01
Span Gas	407.40	407.35	407.39	0.01

Calibrated by

Sakell P.

(Mr.Sakell Phasamphiat)
Environmental Field Scientist (4)



Lot No. 24121409-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Udon HRSG 11
Date : 21 Nov 24 Test Operator : Sakitt P.O₂ ANALYZER : 16.02 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	0.15	0.15	0.00	0.05	0.40	0.40
Upscale Gas	16.32	16.32	0.00	16.17	0.60	0.60

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

	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	0.20	0.20	0.00	0.10	0.05	0.05
Upscale Gas	164.70	164.70	0.00	164.55	0.07	0.07

SO₂ ANALYZER : 159.90 Span (ppm) : 200
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	0.04	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)

	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 Phalsanphit) 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.
Date : 21 Nov 24
Start Time : 10:20
SO₂ Analyzer Model : TELEDYNE API 100EH
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH
CO/CO₂ Analyzer Model : TELEDYNE API 300EMRun # : 1
Location : Udon HRSG 11
Test Operator : Sakitt P.
Finish Time : 10:40
Serial No. : 437
Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:20	14.00	3.15	13.38	0.41	0.46	
10:21	14.02	3.14	13.69	0.39	0.45	
10:22	14.03	3.14	13.65	0.40	0.38	
10:23	14.03	3.13	14.64	0.38	0.34	
10:24	14.03	3.13	14.91	0.39	0.25	
10:25	14.00	3.15	14.44	0.38	0.22	
10:26	14.00	3.15	14.21	0.34	0.21	
10:27	14.01	3.15	14.08	0.36	0.16	
10:28	14.02	3.14	14.54	0.35	0.18	
10:29	14.04	3.12	15.01	0.34	0.21	
10:30	14.04	3.12	15.13	0.32	0.60	
10:31	14.03	3.13	15.39	0.32	0.14	
10:32	14.01	3.13	15.73	0.32	0.58	
10:33	14.04	3.12	16.03	0.30	0.59	
10:34	14.06	3.11	16.15	0.30	0.55	
10:35	14.05	3.11	16.05	0.07	0.54	
10:36	14.03	3.12	15.87	0.09	0.46	
10:37	14.03	3.13	15.65	0.10	0.43	
10:38	14.02	3.13	15.66	0.10	0.40	
10:39	14.01	3.13	15.54	0.11	0.39	
10:40	14.01	3.13	15.42	0.12	0.36	
Average	14.02	3.13	15.04	0.28	0.40	

(Mr.Sakitt Phalsanphit) 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 # : 2
Date : 21 Nov 24 Location : Udon HRSG 11
Start Time : 10:41 Test Operator : Sakitt P.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:01
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
10:41	14.01	3.13	15.44	0.12	0.52	
10:42	14.00	3.14	15.48	0.13	0.50	
10:43	14.00	3.14	15.31	0.15	0.45	
10:44	14.01	3.14	15.15	0.14	0.38	
10:45	14.01	3.13	15.19	0.15	0.41	
10:46	14.02	3.12	15.46	0.15	0.36	
10:47	14.02	3.12	15.72	0.17	0.39	
10:48	14.02	3.13	15.90	0.17	0.28	
10:49	14.03	3.11	15.85	0.18	0.26	
10:50	14.02	3.11	15.64	0.17	0.25	
10:51	14.01	3.13	15.60	0.19	0.23	
10:52	14.02	3.13	15.49	0.20	0.19	
10:53	14.02	3.13	15.56	0.20	0.16	
10:54	14.01	3.14	15.57	0.21	0.19	
10:55	14.01	3.13	15.62	0.22	0.20	
10:56	14.03	3.12	15.52	0.23	0.15	
10:57	14.01	3.12	15.76	0.22	0.16	
10:58	14.01	3.12	15.85	0.25	0.16	
10:59	14.00	3.15	15.65	0.24	0.19	
11:00	14.00	3.15	15.38	0.26	0.20	
11:01	14.03	3.12	15.49	0.26	0.13	
Average	14.01	3.12	15.56	0.19	0.28	

(Mr.Sakitt Phalsanphit) 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.
Date : 21 Nov 24
Start Time : 11:02
SO₂ Analyzer Model : TELEDYNE API 100EH
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH
CO/CO₂ Analyzer Model : TELEDYNE API 300EMRun # : 3
Location : Udon HRSG 11
Test Operator : Sakitt P.
Finish Time : 11:22
Serial No. : 437
Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:02	14.03	3.11	15.80	0.28	0.14	
11:03	14.02	3.12	15.80	0.28	0.17	
11:04	14.03	3.11	15.69	0.27	0.20	
11:05	14.02	3.13	15.76	0.24	0.26	
11:06	14.03	3.12	15.93	0.04	0.23	
11:07	14.01	3.11	15.72	0.05	0.28	
11:08	14.02	3.12	15.67	0.06	0.32	
11:09	14.03	3.11	15.80	0.06	0.36	
11:10	14.03	3.12	15.90	0.07	0.31	
11:11	14.02	3.12	15.76	0.08	0.34	
11:12	14.03	3.12	15.76	0.08	0.36	
11:13	14.00	3.11	15.62	0.09	0.37	
11:14	13.99	3.13	15.39	0.09	0.49	
11:15	14.01	3.13	15.26	0.11	0.45	
11:16	14.02	3.13	15.48	0.10	0.55	
11:17	14.01	3.13	15.54	0.10	0.44	
11:18	14.01	3.13	15.39	0.11	0.47	
11:19	14.02	3.12	15.33	0.13	0.48	
11:20	14.02	3.12	15.36	0.13	0.50	
11:21	14.02	3.12	15.52	0.14	0.59	
11:22	14.00	3.12	15.40	0.14	0.56	
Average	14.02	3.12	15.62	0.12	0.38	

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

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

ALS Laboratory Group



Lot No. 24121407-1

ANALYZER CALIBRATION DATA

Client : Gulf T&S Co., Ltd. Location : Ulsan 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

NO_x 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	56.28	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-06-082 REVISION NO. 4 ISSUE DATE 18/01/24

ALS Laboratory Group

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Lot No. 24121407-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Ulsan 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	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.02	0.02	0.08	0.02	0.02	0.08	0.00
Upscale Gas	16.08	16.10	16.10	0.08	16.10	16.10	0.08	0.00

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

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

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

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

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

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

Calibrated by

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-083 REVISION NO. 4 ISSUE DATE 18/01/24

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EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 1
Date : 21 Nov 24 Location : Ulsan HRSG 12
Start Time : 10:35 Test Operator : Sathaporn T.
Finish Time : 10:55

SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 410
NO_x/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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:35	14.09	3.89	12.43	0.07	3.22	
10:36	14.05	3.93	12.69	0.04	3.36	
10:37	14.04	3.43	12.75	0.03	3.13	
10:38	14.05	3.93	12.77	0.02	3.16	
10:39	14.05	3.93	12.69	0.04	3.17	
10:40	14.03	3.92	12.97	0.06	3.13	
10:41	14.04	3.93	13.04	0.04	3.04	
10:42	14.04	3.41	13.15	0.03	3.11	
10:43	14.01	3.98	13.16	0.01	3.04	
10:44	14.02	3.92	13.13	0.01	2.98	
10:45	14.02	3.93	13.16	0.01	2.98	
10:46	14.02	3.92	13.22	0.07	2.97	
10:47	14.04	3.95	13.29	0.04	2.86	
10:48	14.04	3.94	13.51	0.05	2.92	
10:49	14.05	3.95	13.70	0.04	2.86	
10:50	14.05	3.96	13.82	0.03	2.74	
10:51	14.04	3.99	13.80	0.05	2.89	
10:52	14.04	3.93	13.74	0.02	2.79	
10:53	14.04	3.94	13.78	0.08	2.80	
10:54	14.03	3.95	13.87	0.06	2.86	
10:55	14.03	3.94	13.92	0.04	2.81	
Average	14.04	3.94	13.28	0.04	2.99	

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-080 REVISION NO. 1 ISSUE DATE 18/01/24

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EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 2
Date : 21 Nov 24 Location : Ulsan HRSG 12
Start Time : 10:56 Test Operator : Sathaporn T.
Finish Time : 11:16

SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 410
NO_x/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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:56	14.04	3.89	13.96	0.04	2.75	
10:57	14.05	3.93	14.04	0.02	2.69	
10:58	14.05	3.93	14.15	0.01	2.66	
10:59	14.02	3.92	14.10	0.04	2.63	
11:00	14.00	3.92	13.93	0.01	2.67	
11:01	14.04	3.95	13.83	0.01	2.62	
11:02	14.05	3.91	14.12	0.02	2.53	
11:03	14.04	3.18	14.25	0.07	2.64	
11:04	14.03	3.93	14.25	0.05	2.55	
11:05	14.03	3.92	14.20	0.03	2.58	
11:06	14.05	3.88	14.21	0.06	2.49	
11:07	14.03	3.88	14.20	0.08	2.54	
11:08	14.03	3.98	14.12	0.04	2.48	
11:09	14.03	3.92	14.10	0.06	2.56	
11:10	14.05	3.96	14.28	0.05	2.50	
11:11	14.05	3.93	14.29	0.02	2.53	
11:12	14.05	3.92	14.28	0.01	2.48	
11:13	14.03	3.92	14.26	0.08	2.43	
11:14	14.03	3.92	14.26	0.06	2.45	
11:15	14.01	4.00	14.20	0.06	2.38	
11:16	14.02	3.99	14.23	0.02	2.38	
Average	14.04	3.93	14.15	0.04	2.55	

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-080 REVISION NO. 1 ISSUE DATE 18/01/24

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EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	3
Date	21 Nov 24	Location	Site HRSG 12
Start Time	11:17	Test Operator	Sathaporn T.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	11:37
NO _x 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
11:17	14.03	3.92	14.21	0.04	2.30	
11:18	14.02	3.90	14.20	0.08	2.38	
11:19	14.02	3.93	14.11	0.04	2.30	
11:20	14.02	3.92	14.08	0.05	2.38	
11:21	14.01	3.93	14.17	0.03	2.33	
11:22	14.03	3.95	14.24	0.03	2.32	
11:23	14.02	3.93	14.17	0.03	2.25	
11:24	14.02	3.94	14.10	0.05	2.30	
11:25	14.03	3.91	14.27	0.05	2.21	
11:26	14.02	3.95	14.26	0.05	2.13	
11:27	14.02	3.92	14.21	0.02	2.17	
11:28	14.00	3.93	14.13	0.02	2.22	
11:29	14.00	3.91	14.09	0.03	2.05	
11:30	14.01	3.94	14.16	0.03	2.12	
11:31	14.01	3.93	14.07	0.04	2.12	
11:32	13.99	3.94	14.03	0.04	2.09	
11:33	14.00	3.94	14.04	0.05	2.06	
11:34	14.02	3.92	14.05	0.05	2.01	
11:35	14.00	3.94	14.12	0.06	2.00	
11:36	14.02	3.98	14.10	0.04	1.99	
11:37	14.01	3.95	14.15	0.07	1.98	
Average	14.02	3.94	14.14	0.04	2.18	

Sathaporn T.

(Mr. Sathaporn Thakew)

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: 160-402340013-1
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/R-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	80.00 PPM	82.39 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	80.00 PPM	79.48 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	82.38 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/2022
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	CC733106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	CC708044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMS	12420868139	CC323707	4.097 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.5 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

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

Triad Data Available Upon Request

NOTES: Gross Weight: 48.5 Kg

Net Weight: 8.1 Kg



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

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ALS Laboratory Group



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: CC709509
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/R-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	54.86 PPM	G1	+/- 0.7% 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	14030753	CC434455	49.18 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D685025	9.81 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-04	CC707908	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
GMS	1242086819	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141705	KAL003190	45.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

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

Triad Data Available Upon Request

NOTES:
Gross Weight: 28.8 Kg
Net Weight: 4.8 Kg



Mahesh Kumar
Approved for Release

Page 1 of 160-402020199-1



Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Cinnaminson, NJ 08077-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E3HA00026
Cylinder Number: ND62877
Laboratory: 124 - Riverton (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: 880
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/R-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	159.9 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	17000241	E80070587	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	May 11, 2019
PRM	12368	5894116	28.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	11010414	KAL004782	99.4 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Jul 23, 2023
NTRM	1500538	CC433507	401.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 05, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APVW1100391 CO	FTIR	Jul 19, 2018
Nicolet 6700 APVW1100391 NO	FTIR	Jul 12, 2018
Nicolet 6700 APVW1100391 NO2	FTIR	Aug 03, 2018
Nicolet 6700 APVW1100391 SO2	FTIR	Aug 02, 2018

Triad Data Available Upon Request

NOTES:
Net weight: 8107 grams
Gross weight: 47890 grams

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Document EPA-600/R-12/031. All testing processes and measurements conform to the ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this cert. 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. 3082.05

Mahesh Kumar
Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E3HA0002 Reference Number: 180-402138465-1
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,S02,BALN Certification Date: Jul 15, 2021
Expiration Date: Jul 15, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 820R-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.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	78.74 PPM	G1	+/- 0.6% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	78.76 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12368	D855025	8.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200810-50	CC732428	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2028
GMS	124205889	CC323707	4.026 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15010224	KAL005523	97.59 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 23, 2021

The SRM, PRM or RGM noted above is only in reference to the GMS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret ISSO FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicoret ISSO FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicoret ISSO FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicoret ISSO FTIR AUP2010245 S02	FTIR	Jul 09, 2021

Triad Data Available Upon Request

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



Michael G. Kula
Approved for Release

Page 1 of 160-402138465-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02N199E3HA0000 Reference Number: 82-401016725-1
Cylinder Number: ND60018 Cylinder Volume: 248.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2214 PSIG
PGVP Number: B52017 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 820R-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.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.093 %	G1	+/- 0.4% NIST Traceable	10/23/2017
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRMplus	09080208	CC282337	6.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 08, 2018

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horba MPA 610-C2-77VMJ041	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-12/031. 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. H. H. H.
Approved for Release

Page 1 of 82-401016725-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N199E3HA0001 Reference Number: 180-402340010-1
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 820R-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.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.02 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06010230	K005228	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2022

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1W5-951 - O2	PARAMAGNETIC	Jan 27, 2022

Triad Data Available Upon Request

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



John
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Page 1 of 180-402340010-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N199E3HA0001 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 820R-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. The results relate only to the items listed. The report shall not be reproduced except 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	Assay Dates
OXYGEN	16.00 %	16.07 %	G1	+/- 0.4% NIST Traceable	08/05/2023
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06010205	R001516	23.2 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1W5-951 - O2	PARAMAGNETIC	Aug 16, 2023

Triad Data Available Upon Request

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



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Page 1 of 1

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E02N192E3HA0000 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: 02,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 820-R-12-031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analysis 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.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	8.000 %	8.186 %	G1	±0.3% NIST Traceable
NITROGEN	Balance			11/11/20

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	10010602	1038055	9.967 % OXYGEN/NITROGEN	±0.3% Apr 10, 2022

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-651 - 02	PARAMAGNETIC	Oct 26, 2020

Triad Data Available Upon Request

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



Approved for Release

Page 1 of 163.45666

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL BP. 83-0267

CALIBRATION CERTIFICATE

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

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : Rion Relative Humidity : (50 ± 15) %
Model : NC-74 Ambient Pressure : ((101.325 ± 1.500) kPa)
Serial No. : 34178121 (ID: RYG_FS0213)
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N I22037,
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484,
3. Programmable Attenuator Timagawa TPA-303A S/N OF 2214,
4. Digital Multimeter Agilent 34401A S/N MY44005560,
5. Pressure Transmitter Vaisala PTJ202AD S/N T0650001,
6. Audio Analyzer Keithley 2015-P S/N 1106495,
7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

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

The results hereof are only for the items tested and listed and no value assigned.
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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618 Mu 2 Tambon Bangpoo, Amphoe Muang Samutprakan,
Changwat Samutprakan 10280, Thailand
Tel: 06-0-2523151-15 ext. 315, 316
(Fax): 0-25231540
E-mail: info@tistr.or.th Website: www.tistr.or.th

Office

105 Phromyothin Road, Luchan, Chulabhorn,
Bangkok 10250, Thailand
Tel: 06-0-2-712113 ext. 5219, 5225, 5217
06-05-1811 6227

FM/BL MTC 002 Rev.5

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-KM11 Siwanon Road, Bangbuem, Bangkok, 10700 Thailand
Tel: +66 2433 8331 Email: cal@aisithiporn.com

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ASSOCIATES

Cert. No.: ACL24075
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preampifier NH-24
Serial No.: 01222716 / 143832 / 22763
ID No.: RYG_FS0020

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KJWAENG 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 Pisutpitsuri

Approved by :

Thanukul Petchurui
(Thanukul Petchurui)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
Request No. 21-67/0292 MTC No. EEL BP. 83/0267

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 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 manual.

Calibrated by : (Mr. Weerchai Deechaiyae)
Approved by : (Mr. Piyapong Kluaypa)
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 hereof are only for the items tested and listed and no value assigned.
Advertising the Report/Certificate and publication of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM/BL MTC 002 Rev.4

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Office/Laboratory:
Sri IC, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Samutprakan 10280, Thailand
Tel: 06-0-2523151-15 ext. 315, 316
Fax: 06-0-25231540
E-mail: info@tistr.or.th

Office:
105 Phromyothin Road, Luchan, Bangkok 10250,
Thailand
Tel: 06-0-25791121-31 ext. 5219, 5225, 5217
Fax: 06-0-25791121-31
E-mail: info@tistr.or.th

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL24075
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).

7. Peter

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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	11.6
C - weight	17.7
Flat	23.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.7	-0.6	-0.6	±5.0

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Summary of Measurement Result :

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

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Job No. : VC67AC0054
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	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

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Cert. No. : ACL24075
Job No. : VC67AC0054
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	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-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

T. Petchur

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Cert. No. : ACL24075
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	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	± 1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	± 1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	± 1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
One	136.4	135.3	-1.1	± 3.0

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

T. Petchur

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CALIBRATION LABORATORY

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

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Cert. No. : ACL24075
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		
89.7	89.5	-0.2	± 1.5

12. High level stability

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

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

End of Calibration Certificate

T. Petchur

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL24094
Pages : 1 of 8

Calibration Certificate

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

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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

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



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 weightings with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	ET-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	ET-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	ET-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).

7. 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 (93.9%)	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

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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
Job No. : VC67AC0058
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

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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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Job No. : VC67AC0058
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 : -5.0
	2	8	117.0	117.0	0.0	1.0 : -2.5
	200	800	134.0	134.1	0.1	± 1.0
Slow	2	8	108.0	108.0	0.0	1.5 : -5.0
	200	800	127.6	127.6	0.0	± 1.0
	0.25	1	99.0	98.9	-0.1	1.5 : -5.0
SEL	2	8	108.0	108.0	0.0	1.0 : -2.5
	200	800	128.0	128.0	0.0	± 1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
One	136.4	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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Job No. : VC67AC0058
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.8	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 / Pre-amplifier NII-24
Serial No.: 01122579 / 172172 / 74022
ID No.: RYG_FS0018

Condition As Found : GOOD

Customer : A.I.S LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG PHATTHANAKAN, KHUET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

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

Calibrated by : Nathakorn Pisutpaian

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-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. : 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...

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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

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Cert. No. : ACL24073
Job No. : VC67AC0054
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±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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Cert. No. : ACL24073
Job No. : VC67AC0054
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.1	0.1	±1.1
84.0	84.1	0.1	±1.1
79.0	79.0	0.0	±1.1
74.0	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	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

Y. Petchur

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Cert. No. : ACL24073
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, T _b (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

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Cert. No. : ACL24073
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		
89.5	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

Y. Petchur

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Cert. No. : ACC24008
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG_FS0496

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
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 Pisutpaisan

Approved by : *Y. Petchur*
(Thanakul Petchuraj)

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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).

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Cert. No. : ACC24008
Job No. : VC67AC0058
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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

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T. Petum

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Cert. No. : ACL24008
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173610 / 143485 / 22619
ID No.: RYG_FS0389

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 : 05-08 JANUARY 2024
Date of Issue : 09 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petum
(Thanakul Petchumi)

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Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

Summary of Measurement Result :

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

T. Petch

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.6

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

Frequency Weighting	Measured value (dB)
A - weight	16.2
C - weight	22.1
Flat	28.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.5	0.5	0.6	± 5.0

T. Petch

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.2	0.2	± 1.1
27.0	27.4	0.4	± 1.1
26.0	26.3	0.3	± 1.1
25.0	25.4	0.4	± 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
	0.25	1	99.0	98.9	-0.1	1.5 : -5.0
SEL	2	8	108.0	108.0	0.0	1.0 : -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

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Cert. No. : ACL23320
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RIJON
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597167 / 179118 / 87525
ID No.: RYG_TS0437

Condition As Found : GOOD

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

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

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



Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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Continuation of Calibration Certificate

Cert. No. : ACL23320
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).

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Continuation of Calibration Certificate

Cert. No. : ACL23320
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.

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23320
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	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.2
C - weight	17.5
Flat	23.1

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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
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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	63.9	-0.1	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	48.9	-0.1	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C' sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±3.0
One	136.4	136.1	-0.3	±3.0

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

QI-TS12-04-04-020664

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

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296517 (ID: RYG_FS0434)

Microphone : Type UC-52 No.135220

Preamplifier : Type NII-24 No.87527

Standards used :

- Band Pass Filter Wavetek 752A S/N 90010494.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042665.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Fluke 8520A S/N 4985007.
- Pistonphone Rion NC-72 S/N 00402446.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

The results apply only to the items described on this certificate or those attached.

Accuracy of the Report (in bold) and validity of the results except in full are provided unless written permission is obtained from the customer or TISTR.

HMLB/MTC-002 Rev.4

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Continuation of Calibration Certificate

Cert. No. : ACL23320
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 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

QI-TS12-04-04-020664

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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 Tamagawa TPA 303A S/N 2212.

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb. 2024

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P&A: MTC-002 Rev.4

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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

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency 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

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Request No. 21-67/0232

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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
1000	#DIV/0!	#DIV/0!	#DIV/0!	1.0
8000	#DIV/0!	#DIV/0!	#DIV/0!	5.0

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.0	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

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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)
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

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10. Peak C sound level

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

11. Overload indication

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

Approved by :
(Mr. Pannasit Phasingiri)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref: 2011267012400347004

End of Certificate

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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	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time	Toneburst	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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Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296515 (ID: RYG_150432)

Microphone : Type UC-52 No.179119

Preamplifier : Type NH-24 No.87526

Standards used :

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- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Fluke 8520A S/N 4985007.
- Pistonphone Rion NC-72 S/N 00402446.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
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12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

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Date of Calibration : 22-28 Feb. 2024

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FMBL/MTC.002 Rev.4

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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	114.1	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.1	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	11.9	0.10	N/A
C-Weight	17.4	0.10	N/A
Flat	23.2	0.10	N/A

Date of Calibration : 22-28 Feb. 2024

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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	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	0.0	0.0	-0.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	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 : 22-28 Feb. 2024

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency 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
1eq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 22-28 Feb. 2024

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.1	0.1	1.1	0.30	0.3
130	130.1	0.1	1.1	0.30	0.3
129	129.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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

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

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 22-28 Feb. 2024

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10. Peak C sound level

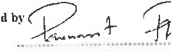
Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half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

11. Overload indication

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

12. High-level stability

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

Calibrated by 
(Mr. Pannasit Phasingsri)

Approved by: 
(Mr. Pannasit Phasingsri)
Director

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre
Ref: 2011267012400347002

End of Certificate

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Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597169 / 180411 / 88181
ID No.: RYG_FS0439

Condition As Found : GOOD

Customer : A.I.S 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 :

T. Petchurai
(Thanakul Petchurai)

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

QF-TS12-04-04-020664

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	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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	17.7
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	0.0	0.0	0.0	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.1	2.1	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23322
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	0.0	0.0	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23322
Job No. : VC67AC0011
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	25.0	0.0	± 1.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23322
Job No. : VC67AC0011
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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, 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	133.1	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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL23322
Job No. : VC67AC0011
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.7	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL-BP. 175/0167

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00709746 (ID:RYG_FS0491)

Microphone : UC-52 No.187332

Preamplifier : NII-24 No.01297

Standards used :

1. Band Pass Filter Wavelec 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2K89871.
3. Decade Attenuator Ando AL-205 S/N 00464002.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N J22037.
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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Request No. 21-67/0232

MTC No. EEL-BP. 175/0167

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				
113.93	113.8	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)
18.6	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	14.0	0.10	N/A
C-Weight	18.9	0.10	N/A
Flat	24.0	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. 175/0167

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

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

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

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

Calibration Procedure :

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

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

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

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

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

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Request No. 21-67/0232

MTC No. EEL-BP. 175/0167

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	1.3	1.3	1.4	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	-0.2	-0.2	-0.1	2.0	0.20	0.6
125	-0.2	-0.1	-0.1	1.5	0.20	0.6
250	-0.1	-0.1	-0.1	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	-0.1	3.0	0.20	0.6
8 000	0.0	0.0	-0.1	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, 175/0167

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
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	78.9	-0.1	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

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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	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	48.9	-0.1	1.1	0.30	0.3
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
28	28.0	0.0	1.1	0.30	0.3
27	27.0	0.0	1.1	0.30	0.3
26	26.1	0.1	1.1	0.30	0.3
25	25.1	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, 175/0167

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, Th (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.1	0.1	±1.0	0.20	0.3
	2	109.0	0.0	-1.0; -2.5	0.20	0.3
	0.25	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	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, 175/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Complete cycle	125.4	125.4	0.0	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 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Positive one-half cycle	Negative one-half cycle				
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 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

S. J. E.

(Mr. Tawakiat Iamsunran)

Approved by :

Prate Klanya

(Mr. Prate Klanya)

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 : 201126701240(347005

End of Certificate

9 : 9

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SITHIPORN ASSOCIATES



Cert. No. : ACC24038
Job No. : VC67AC0140
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	EL-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	V744B6069	EF-0009-24	09-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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

SITHIPORN ASSOCIATES



Cert. No. : ACC24038
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 PHATTANAKAN, 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 : 09 AUGUST 2024
Calibration Date : 23 AUGUST 2024
Date of Issue : 26 AUGUST 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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

SITHIPORN ASSOCIATES



Cert. No. : ACC24038
Job No. : VC67AC0140
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	94.17	0.17	0.80	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 (%)
2.16	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. : ACL24071
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 01222724 / 143486 / 22620
ID No. : RYG_FS0023

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTUANAKAN 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 Pisutpaian

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.

Cert. No. : ACL24071
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. : ACL24071
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. : ACL24071
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)
17.3

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

Frequency Weighting	Measured value (dB)
A - weight	14.8
C - weight	20.6
Flat	26.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.0	0.0	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.4	1.5	1.5	±5.0



4. Electrical signal tests of frequency weightings

Weighing network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	48.9	-0.1	±1.1
44.0	43.9	-0.1	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.8	-0.2	±1.1
25.0	24.9	-0.1	±1.1

7. Peter

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepack (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.9	-0.5	±3.0

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

7. Peter

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.5	-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

7. Peter

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122547 / 143452 / 22584
ID No.: BKK_FS0034

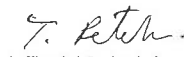
Condition As Found : GOOD

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

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

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

Calibrated by : Nalinakorn Pisupaisan

Approved by : 
(Thanakul Petchurai)

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

QI-TS12-04-04-020664

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests in 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).

QI-TS12-04-04-020664



Summary of Measurement Result :

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

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

QI-TS12-04-04-020664



Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.6

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	17.0
Flat	22.9

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	0.9	1.0	0.9	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.7	-1.7	-1.6	± 5.0

QI-TS12-04-04-020664



Continuation of Calibration Certificate

Cert. No. : ACL23370
Job No. : VC67AC0025
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QI-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23370
Job No. : VC67AC0025
Pages : 6 of 8

7. Level linearity on the reference level range

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

QI-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23370
Job No. : VC67AC0025
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

QI-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23370
Job No. : VC67AC0025
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.8	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

QI-TS12-04-04-020664

7. Petch

Certificate of Calibration

Customer : AI S Laboratory Group Thailand Co., Ltd.
Name : AI S Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthanasak 40, Phatthanasak Road, Suan Luang, Bangkok 10250
Certificate No : 24-SI-M-022
Request No : Req-2023-2675

Unit Under Calibration Details

Measurement Item : Sound Level Meter
Manufacturer : RION
Model : NL-42
Serial Number : 08678246
ID : RKK_FS0097
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : UC-52
Microphone S/N : 157785
Preamplifier Model : NH-24
Preamplifier S/N : 48094
Instrument Status : Used

Calibration Environment and Details

Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$
Humidity : $50\% \text{RH} \pm 20\% \text{RH}$
Barometric Pressure : $1013 \text{ hPa} \pm 10 \text{ hPa}$
Received Date : 29 December 2023
Calibrated Date : 29 January 2024
Calibration Procedure : In-house method CP-SI-M-01 based on IEC 61672-3:2013 Acoustics - Sound level meters - Part 3: Portable tests
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	21 August 2024	GRAS
Multi-frequency Calibrator	Quest	Questval	FFA000234	26 July 2024	TISI
Audio Generator	Svanick	Svan901	131	9 October 2024	WKC Electric

Note

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

Calibrated By : Mr. Noppon Tangsri
Service Calibration Engineer

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

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

Form: SI-M-01 Rev. 02 Issue date: 11/25

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Form: SI-M-01 Rev. 02 Issue date: 11/25

Certificate No : 24-SI-M-022
Request No : Req-2023-2675

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 30-130	Weighting Response curve		Limit
STD Setting	A (dB) C (dB) Z (dB)	(\pm dB)	(\pm dB)
63 Hz	17.8 -0.1 0.0	0.20	2.0
125 Hz	-0.1 0.0 0.0		1.5
250 Hz	-0.1 0.0 0.0		1.5
500 Hz	0.0 0.0 0.0		1.5
1000 Hz	0.0 0.0 0.0		1.0
2000 Hz	0.0 0.1 0.0		2.0
4000 Hz	0.0 0.0 0.0		3.0
8000 Hz	0.1 0.1 0.0		5.0
16000 Hz	-1.3 -1.4 0.0		+5.0 (-dB)

6. Frequency and time weightings at 1kHz

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

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

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Form: SI-M-01 Rev. 02 Issue date: 11/25

7. Long Term Stability

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

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 30-130	REF	UUC ERR		Limit
STD dB	(dB)	(dB)	(\pm dB)	(\pm dB)
128.00	128	127.9 -0.1	0.30	1.1
134.00	134	134.0 0.0		1.1
129.00	129	129.0 0.0		1.1
124.00	124	124.0 0.0		1.1
119.00	119	119.0 0.0		1.1
114.00	114	114.0 0.0		1.1
109.00	109	109.0 0.0		1.1
104.00	104	104.0 0.0		1.1
99.00	99	99.0 0.0		1.1
94.00	94	94.0 0.0		1.1
89.00	89	89.0 0.0		1.1
84.00	84	84.0 0.0		1.1
79.00	79	79.0 0.0		1.1
74.00	74	74.0 0.0		1.1
69.00	69	69.0 0.0		1.1
64.00	64	64.0 0.0		1.1
59.00	59	59.0 0.0		1.1
54.00	54	54.0 0.0		1.1
49.00	49	49.0 0.0		1.1
44.00	44	44.0 0.0		1.1
39.00	39	39.0 0.0		1.1
34.00	34	34.0 0.0		1.1
29.00	29	29.0 0.0		0.8
24.00	24	23.9 -0.1		1.1

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Form: SI-M-01 Rev. 02 Issue date: 11/25

Certificate No : 24-SLM-022
Request No : Req-2023-2675

9. Level linearity including the level range control

UUC Setting	STD REF	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)
		UUC (dB)	ERR (dB)		
FAST / A	29.60	29.8	0.2	0.30	1.1
	114	114.0	0.0		

10. Tone burst response

UUC Setting	STD Timeburst	Anticipated Ref	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)
			UUC (dB)	ERR (dB)		
Fast	200	126.0	126.0	0.0	0.20	1.0
	2	109.0	109.0	0.0		-1.0, -2.5
	0.25	100.0	99.9	-0.1		+1.5, -5.0
Slow	200	119.6	119.6	0.0	0.20	1.0
	2	100.0	100.0	0.0		-1.0, -5.0
	200	120.0	120.0	0.0		1.0
S+L	2	100.0	100.0	0.0	0.20	-1.0, -2.5
	0.25	91.0	90.9	-0.1		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated REF	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)
		UUC (dB)	ERR (dB)		
FAST / C / 55-141	136.4	136.4	0.00	0.20	3.0
STD Setting	135.4	135.2	-0.20		2.0
Complete cycle	135.4	135.2	-0.20		2.0
Positive half cycle	135.4	135.2	-0.20		
Negative half cycle	135.4	135.2	-0.20		

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ISO 17025:2017 Rev. 02 Issue date: 01/11/23

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CALIBRATION LABORATORY

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Cert. No. : ACL24226
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Pre-amplifier NH-24
Serial No.: 00658241 / 158767 / 58769
ID No.: BKK_FS0098

Condition As Found : GOOD

Customer : A/S LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KIJWAENG 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 : 02 JULY 2024
Calibration Date : 09-10 JULY 2024
Date of Issue : 12 JULY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchumai)

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.

Certificate No : 24-SL-M-022
Request No : Req-2023-2675

12. Overload indication

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

13. High Level Stability

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

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
5. Acoustic signal test of frequency weightings at 10 Hz to 10 kHz	0.70 dB
6. Electrical signal test of frequency weightings at 10 Hz to 1 kHz	0.20 dB
7. Frequency and time weightings at 1 kHz	0.20 dB
8. Long Term Stability	0.10 dB
9. Level linearity on the reference level range	0.30 dB
10. Level linearity including the level range control	0.30 dB
11. Tone burst response	0.30 dB
12. Peak C Sound level	0.35 dB
13. Overload indication	0.25 dB
14. High Level Stability	0.10 dB

* Acceptance limit and Maximum permitted Uncertainty was IEC 61672-3:2013

End of Certificate

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

ISO 17025:2017 Rev. 02 Issue date: 01/11/23

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Cert. No. : ACL24226
Job No. : VC67AC0119
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	3351JB	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EE-LBP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EE-LBP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EE-LBP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

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

Cert. No. : ACL24226
Job No. : VC67AC0119
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. : ACL24226
Job No. : VC67AC0119
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	0.0	±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
1eq	94.0	94.0	0.0	± 0.1

6. Long - term stability

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

T. Petch.

Cert. No. : ACL24226
Job No. : VC67AC0119
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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.6

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

Frequency Weighting	Weighting (dB)
A - weight	11.2
C - weight	17.4
Flat	23.2

3. Acoustical signal tests of frequency weightings

Meier 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	0.5	0.5	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.5	-1.4	-1.4	±5.0

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Cert. No. : ACL24226
Job No. : VC67AC0119
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

T. Petch.

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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

T. Petchur

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Cert. No. : ACL24226
Job No. : VC67AC0119
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.7	0.2	±1.5

12. High level stability

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

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

End of Calibration Certificate

T. Petchur

SITHIPORN ASSOCIATES CO., LTD.
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Cert. No. : ACL24095
Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21 / Microphone UC-52 / Preamplifier NI-21
Serial No.: 00376364 / 71486 / 23142
ID No.: RYG_FS0012

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 1) °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)

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Cert. No. : ACL24096
Job No. : VC67AC0058
Pages : 2 of 9

Calibration Procedure : CP-AC-02

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	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	EI-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. Petchur

Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.1	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

Z. Petch

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

Z. Petch

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
26.2

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

Frequency Weighting	Measured value (dB)
A - weight	22.9
C - weight	24.2
Flat	27.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	0.5	0.6	0.6	±5.0

Z. Petch

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1

Z. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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

SITHIPORN
associates



Cert. No. : ACL24096
Job No. : VC67AC0058
Pages : 7 of 9

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
120	94.0	94.0	0.0	±1.1
110	94.0	94.0	0.0	±1.1
100	94.0	94.0	0.0	±1.1
90	94.0	94.0	0.0	±1.1

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	41.6	41.9	0.3	±1.1
120	32.0	31.9	-0.1	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Th (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

T. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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

SITHIPORN
associates



Cert. No. : ACL24096
Job No. : VC67AC0058
Pages : 8 of 9

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	130.0	130.0	0.0	±3.0
One	133.4	132.8	-0.6	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	130.0	130.0	0.0	±2.0
Positive half cycle	132.4	132.1	-0.3	±2.0
Negative half cycle	132.4	132.1	-0.3	±2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.3	89.3	0.0	±1.5

T. Petch

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CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangburmu, Bangkok 13700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

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Cert. No. : ACL24096
Job No. : VC67AC0058
Pages : 9 of 9

12. High level stability

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

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

End of Calibration Certificate

T. Petch



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
531-1 PATTANAKARN ROAD SU 18, SUANLUANG SUANLHANT, BANOKK 10250
TEL: 0-2717-3066-24 FAX: 0-2719-9484

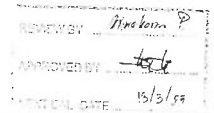


Certificate of Calibration

Certificate No. : 24PH145
Page : 1 of 2

Equipment : Lux Meter
Manufacturer : Tonnuus
Model : TM-201L
Serial No. : 190702490
ID No. : RYG_FS0471
Condition As-Received : Used Item
Received Date : 12 March 2024
Calibration Date : 14 March 2024
Reference : 2403-0352WSG
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 was 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, SN: 16221394)
4. Test Equipment: Illuminance Meter (Model: 51002, SN: 060128)
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): NSG-ONSC Accredited No. Calibration 0146

Calibrated by : Nivat Niss
Issue Date : 18 March 2024

Approved Signatory :
[] Phalinee Prutapalai
[] Wanlop Larkhem
[] Nuntawat Khamchai

6 0337449

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-016-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006716
ID NUMBER : RYG_F50221
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 : 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

Calibration procedure:
The temperature calibration was done by In-House calibration method as WI-CL-003 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.: 667682-05,
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.

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.

Handwritten signature: Nakhorn P.
Date: 10/1/25

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☒ Miss Ruangrumpal 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: 18009587.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.1	0.1	0.099
80	25.042	25.1	0.1	0.099
80	30.040	30.0	0.0	0.099
80	35.035	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: TP3276 2 S/N: 15015967.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.049	20.0	0.0	0.099
110	25.042	25.0	0.0	0.099
110	30.040	30.0	0.0	0.099
110	35.034	35.0	0.0	0.099
110	40.026	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3276.2 S/N: 15015492.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.049	20.2	0.2	0.099
75	25.042	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.034	34.9	-0.1	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-017-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006718
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

Calibration procedure:
The temperature calibration was done by In-House calibration method as WI-CL-002 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.: 667682-05,
Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI 1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

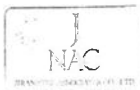
Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the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

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.

Handwritten signature: Nakhorn P.
Date: 11/1/25

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☒ Miss Ruangrumpal 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: 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	25.1	0.2	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

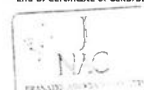
Table 3: This equipment was connected with temperature probe Model: TP3276.2 S/N: 15015496.
Dimension: Diameter 14 mm, Length 150 mm.

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 WP-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-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No. 667582 05,
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. Socratt Thachalad
☒ Miss Kittaporn Lertsomphol
☒ Miss Ruangrumpal 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: 15015854,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.054	19.7	-0.4	0.099
60	25.054	24.7	-0.4	0.099
60	30.041	29.7	-0.3	0.099
60	35.032	34.7	-0.3	0.099
60	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	25.1	0.0	0.099
110	30.041	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.020	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



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-011-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15002724
ID NUMBER : RYG_F50228
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.

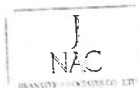
Calibration procedure:
The temperature calibration was done by
in House calibration method as WP-CL-001
according to comparison method with standard
digital temperature indicator and standard
temperature probe. The temperature scale use
was based on ITS-90.

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-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No. 667582 05,
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. Socratt Thachalad
☒ Miss Kittaporn Lertsomphol
☒ Miss Ruangrumpal 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: 15003276,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.058	20.1	0.0	0.099
60	25.050	25.0	0.0	0.099
60	30.044	30.0	0.0	0.099
60	35.037	35.0	0.0	0.099
60	40.035	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15028490,
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.058	20.1	0.0	0.099
110	25.050	25.1	0.1	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: 15031951,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.2	0.1	0.099
75	25.050	25.1	0.0	0.099
75	30.044	30.0	0.0	0.099
75	35.038	34.9	-0.1	0.099
75	40.035	39.8	-0.2	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 : 15006776
ID NUMBER : RVG_F50226
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwang 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 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-0028-23, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS00, Serial No.: 667682 05,
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 Intaraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory:

Mr. Pannya Booncharoen
Calibration Department Manager

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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.

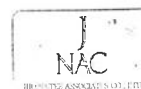
Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.0	0.1	0.099
110	25.055	25.1	0.0	0.099
110	30.041	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.018	40.1	0.1	0.099

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-013-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15020735
ID NUMBER : RVG_F50231
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwang 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.

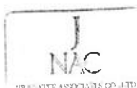
Calibration procedure:
The temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: TT-0028-23, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS00, Serial No.: 667682 05,
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 Intaraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory:

Mr. Pannya 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: 15035050.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.059	20.1	0.0	0.16
80	25.055	25.1	0.0	0.054
80	30.049	30.1	0.1	0.099
80	35.041	35.0	0.0	0.16
80	40.035	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276 2 S/N: 17023218.
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	25.055	25.1	0.0	0.099
110	30.049	30.1	0.1	0.099
110	35.041	35.1	0.1	0.099
110	40.035	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15033221.
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	25.055	24.9	-0.2	0.099
75	30.049	29.8	-0.2	0.099
75	35.041	34.7	-0.3	0.099
75	40.035	39.5	-0.5	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. : CDT-058-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: Heat Stress Monitor

MANUFACTURER

: Delta OHM

MODEL/TYPE

: HD32.2

SERIAL NUMBER

: 15020736

ID NUMBER

: RYG_50232

CONDITION AS-RECEIVED

CUSTOMER

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

RECEIVED DATE

: 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 in WH-CL-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 (NIMT) Certificate number: TT-0038-23, Certificate number: ER-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 A500, Serial No: 667682-05,
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.

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: 15027737,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.064	20.2	0.1	0.099
80	25.053	25.1	0.0	0.099
80	30.041	30.1	0.1	0.099
80	35.026	35.1	0.1	0.099
80	40.017	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276.2 S/N: 15031164,
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	25.054	25.1	0.0	0.099
110	30.040	30.1	0.1	0.099
110	35.026	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: 15015503,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.2	0.1	0.099
75	25.053	25.0	-0.1	0.099
75	30.040	29.9	-0.1	0.099
75	35.026	34.7	-0.3	0.099
75	40.018	39.6	-0.4	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jiraporn Lertsomphol
☒ Miss Ruangsiraporn Phoommit



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CDT-018-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: Heat Stress Monitor

MANUFACTURER

: Delta OHM

MODEL/TYPE

: HD32.2

SERIAL NUMBER

: 18018313

ID NUMBER

: RYG_50356

CONDITION AS-RECEIVED

CUSTOMER

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

RECEIVED DATE

: 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 in WH-CL-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 (NIMT) Certificate number: TT-0038-23, Certificate number: ER-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 A500, Serial No: 667682-05,
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.

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: 18021466,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	20.0	-0.1	0.099
80	25.045	25.0	0.0	0.099
80	30.040	30.0	0.0	0.099
80	35.039	35.0	0.0	0.099
80	40.030	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276.2 S/N: 18020493,
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.052	20.0	0.0	0.14
110	25.045	25.1	0.1	0.099
110	30.040	30.1	0.1	0.099
110	35.039	35.1	0.1	0.099
110	40.030	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021258,
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	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.039	34.9	-0.1	0.099
75	40.030	39.9	-0.1	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%.

Calibrated by:
☒ Mr. Sorawit Thachalad
☒ Miss Jiraporn Lertsomphol
☒ Miss Ruangsiraporn Phoommit



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

End of Certificate of Calibration

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Cert. No.: 24PH145
Page.: 2 of 2



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 24PH146
Page: 1 of 2

Result of calibration:- (*) Without adjustment () After adjustment

Function : Illuminance Measurement	Range :	200	lx
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(lx)	(lx)	(lx)	(± lx)
0	0.0	0.0	*
20	20.1	0.1	0.26
50	50.0	0.0	0.65
100	100.0	0.0	1.3
150	150.0	0.0	2.0
190	190.0	0.0	2.5

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

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except with the prior written approval of the head of
Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2403-0392WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %

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

104 Phathanakan 40, Phathanakan Rd.,
Khwaeng Phatthanaikan, 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-0054-22	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 requested at the point specified by customer.

3. Test Equipment : Programmable Voltage/Current Source (Model : QLE3A, SN : 16221394).

4. Test Equipment : Illuminance Meter (Model : S1002, SN : 080129).

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

6. This Certification is traceable to the International System of Unit maintained through:-

- National Institute of Metrology Thailand (NIMT)

- National Institute of Metrology (Thailand): NSC-ONSAC Accredited No. Calibration 0144

Function : Illuminance Measurement	Range :	20000	lx
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(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.

-000-

a 1206570

Calibrated by : Nival Niles
Issue Date : 16 March 2024

Approved Signatory :
[] Phalinee Prabpalal
[] Wanlap Larkorn
[x] Nuntawat Khamchai

D 0337450



Cert. No.: 24PH146
Page.: 2 of 2



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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH890
Page: 1 of 2

Result of calibration:- (*) Without adjustment () After adjustment

Function : Illuminance Measurement	Range : 200 lx		
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(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		
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(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.

-000-

a 1206569

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo 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
616/110 Moo 5, T.Maenam Khu,
A.Plusdaeng, Rayong 21140, Thailand

REVIEW BY: Pthaya T.
APPROVED BY: S.S.
NEXT CAL DATE: 29/7/25

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

Calibrated by : Warakorn Lemgagrakul
Approved by :
[] Unnopphol Harachai
[] Ponpan Palipim
[x] Salithip 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-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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

Calibration Results

Function : mV Measurement

Performing standard curve by Document Process Calibrator at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(\pm mV)	k
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 (\pm)	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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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 : SevenGo 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 :

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

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 : 2407-0332DSC-4
Procedure Used :-

Cert. No.: 24LM121
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 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: 3184175

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC ¹ Reading (°C)	Error (°C)	Uncertainty (\pm °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

UUC¹ : 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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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Certificate No.: 23E3924
Page: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No. : B834291445
ID No. : RYG_ENR157
Condition As-Received : Used Item
Received Date : 08 December 2023
Calibration Date : 14 December 2023
Reference : 2312-0151DSC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 10) %
Submitted by : ALS Laboratory Group (Thailand) Co. Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng
Rayong 21140, Thailand

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

Condition of this result of calibration

1 Reference standards Instruments :-

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435802	EE-0041-23	26 Apr 2024

2 This result of calibration was made on requested at the point specified by customer

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

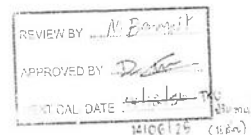
4 This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Natchanon Prasomsobon
Issue Date : 15 December 2023

Approved Signatory :

[] Phalinee Prasomsobon
[✓] Natchanon Prasomsobon
[] Pongsagorn Boonrapporn





Cert. No : 23E3924
Page : 2 of 2

Result of calibration :- (*) Without adjustment () After adjustment

Function: DC voltage measurement	Range: 2000 mV	UUC* Reading	Error	Uncertainty
Standard Value		(mV)	(mV)	(± µV)
(mV)		(mV)	(mV)	(± 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)
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TEL 0 2710 5400-29 FAX 0 2710 5404



Cert.No : 23CH1574
Page : 1 of 3

Certificate of Calibration

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. Pluakdaeng,
Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH6 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by : 
Approved Signatory

() Sathip Meangmai
() Warakorn Lemgagrakul
(x) Ponpan Palpim

Issue Date : 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services

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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	231908	26 July 2024

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

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	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	Coverage factor
	pH	mV	mV	(± mV)	k
pH Meter	4.000	177.48	177.3	0.058	2.00
S/N : B834291445	7.000	0.00	-0.1	0.058	2.00
	10.000	-177.48	-177.5	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 (±)	Coverage factor k
pH Electrode	4.008	4.013	184.1	0.0045	2.00
S/N : 3225368	6.986	6.998	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 : InLab®Expert 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 (± °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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ISO 17025:2017
CALIBRATION 0428

SARTORIUS

Certificate of Calibration

REVIEW BY: *Thantak*
APPROVED BY: *D. J. J.*
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.: 24BC10059
Issued Date: Friday, February 23, 2024
Reference No.: 229198
Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
618/10 Moo 5 T. Maenam Khu, A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
618/10 Moo 5 T. Maenam Khu, A. Pluak Daeng, Rayong 21140, Thailand.

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

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambient Conditions:
Temperature: 24.2 °C ± 5.0 °C
Humidity: 57.0 % RH ± 10.0 % RH
Pressure: ±

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

Chonchai Inthana

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Mr. Chonchai Inthana (Technical Manager)

SOP FM 33 03 February 2022

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius
Certificate No.: 24BC10059
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 reproducibility quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, (i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to DIN EN 876).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	0.0001 g	Difference		
	20.0001	199.9999	1	1	-
	20.0000	200.0000	2	2	-0.0001
	20.0001	200.0000	3	3	-0.0001
Nominal Value : (High Load)	19.9999	200.0000	4	4	0.0000
200 g	20.0000	200.0000	5	5	-0.0001
Tolerance	0.0001 g	0.0001 g	6	6	-
	19.9999	200.0001			
	19.9999	200.0000			
Standard Deviation	0.00007	0.00006			

Linearity

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

Tolerance 0.0002 g				
Nominal Value (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	0.00018
50	50.0000	49.9999	-0.0001	0.00024
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022



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Certificate of Calibration

Cert. No.: 24TM632
Page: 1 of 3

Equipment: Hot Air Oven
Manufacturer: Memmert
Model: UFE 500
Serial No.: G511-1572
ID No.: RYG_EN0010
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
618/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location: Oven Room
Received Order: 21 March 2024
Calibration Date: 21 March 2024
Ambient Temperature: (26 ± 10) °C
Relative Humidity: (50 ± 30) %
Calibrated by: Mani Pattanapongsaiboon
Approved by: *Mani Pattanapongsaiboon*
() Pomthippa Tameyakul
() Unnopphol Harachal
(✓) Suwit Imjai
Issue Date: 22 March 2024

REVIEW BY: *Thantak*
APPROVED BY: *D. J. J.*
NEXT CAL DATE: 21/09/25

Equipment: Hot Air Oven
Condition As-Received: Used Item
Reference: 2403-0563OC-1

Cert. No.: 24TM632
Page: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

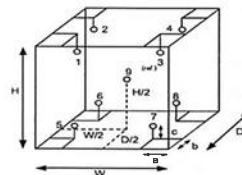
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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

Result of Calibration :-

Function of UUC*: Temperature Source
Fresh air setting: Close



Probe Installation Details: Dimension of Chamber:
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	57	59
AC Supply (Volt)	222	224

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

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2403-0563OC-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No. : 24TM632
 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
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	103.921	103.786	103.757	103.759	103.950	103.817	104.213	103.672	103.673	0.42
180.0	179.614	179.270	179.145	179.599	180.001	180.423	180.293	180.629	179.429	1.1

Average* : The average of 30 values in each position.
 Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
 Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
 Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
 UUC* : Unit Under Calibration
 Note : The reported uncertainty of measurement was Included stability and excluded uniformity .

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

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

Certificate of Testing

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

Issue Date : 26 July 2023

B 0320211



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

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No. : 15E100464

Titration Method (Azide Modification Method) (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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Cert. No. : 23LA1125
 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 Hlahib
 Approved by :
 Approved Signatory
 () Pornthippa Tameyakul
 () Malee Butkruea
 (✓) Suwit Injai
 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
Cert. No.: 23LM125
Page: 2 of 2

Procedure Used :-

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

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2186080	2211285	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Certificate of Calibration

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

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP750

Serial No. : V818.0084

ID No. : RYG_END154

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 Palpin
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 07 November 2024

REVIEW BY *Thanitak*
APPROVED BY *D. Kunchit*
NEXT CAL DATE 01/05/26

The Uncertainties are for a confidence probability of approximately 95%

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a 1159515



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Cert. No.: 24TM1663
Page: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY44073381	24LM73	TPA	18 May 2025

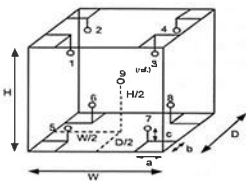
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.60 m
W = 1.0 m
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
Cert. No.: 24TM1663
Page: 3 of 3

Result of Calibration :-

Function of UUC* : Temperature Source

Fresh air setting : Close

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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Certificate of Calibration

Cert.No.: 24CG3711
Page: 1 of 2

Equipment : Burette
Capacity : 50 mL
Serial No. :
ID. No. : RYG_EN0216
Manufacturer : Wileg
Made in : Germany
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng
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-ngeunkam Wongsu
Approved by :
(✓) Srisuda Khamtha
() Ponpan Palpim
() Unnopphol Harachai
Issue Date : 24 September 2024

REVIEW BY: *Thanitak*
APPROVED BY: *Dharmas*
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	24I175	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	40.0033	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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Certificate of Calibration

Cert. No.: 24TM634
Page : 1 of 3

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 110
Serial No. : B423.0853
ID No. : RYG_EN0213
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 - 22 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpalboon
Approved by :
() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Suwit Imjai
Issue Date : 23 March 2024

REVIEW BY: *Thanitak*
APPROVED BY: *Dharmas*
NEXT CAL DATE: 21/03/25



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

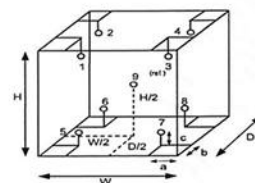
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	59	59
AC Supply (Volt)	224	223

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

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 : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM634
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
104.0	104.0	104.0	0.065	0.52	0.90	2
180.0	180.0	180.0	0.20	1.2	2.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.995	180.127	180.138	180.895	179.313	180.211	1.1

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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Certificate of Calibration

Cert. No.: 24TM535
Page : 1 of 3

Equipment :	Water Bath	<div>REVIEW BY <i>Thanitak</i> APPROVED BY <i>D. Hume</i> NEXT CAL DATE: 21/09/25</div>
Manufacturer :	Memmert	
Model :	WNB22	
Serial No. :	L513.0648	
ID No. :	RYG_EN0061	

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

Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by : *S. Suwit*
Approved Signatory

() Pornthipha Tameyakul
() Unnopphol Harachal
(✓) Suwit Imjai

Issue Date : 23 March 2024

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

Cert. No.: 24TM635
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

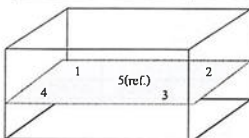
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

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



Front

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



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

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

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

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Certificate of Calibration

Equipment : Chamber (Cold Room)
Manufacturer : MODULAR
Model : IREVCOHCOO
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

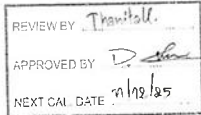
Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By : Preecha Phisassutthikul (Temperature Calibration Manager)

Date of Issue : 12 JUN 2024

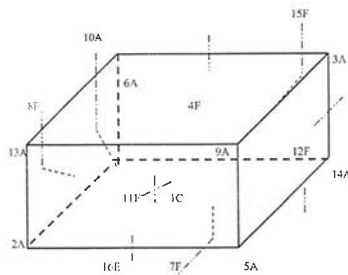
The uncertainties are for a confidence probability of approximately 95%.

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.



TNI-L14 (19/10/05-06)

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:

TNI-L15 (19/10/05-06)

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-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	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-TIS-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
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment (X) after adjustment

Approved By:

TNI-L15 (19/10/05-06)

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	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	2.92	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						
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 due 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:

TNI-L15 (19/10/05-06)



Certificate of Calibration

Certificate No.: C06230441 Page 2 of 3

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

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

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

Environment Condition: Temperature 23.9 °C ± 0.2
Humidity 65.3 %RH ± 1.4

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

Calibration By: Mr.Nattapat 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 Star Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584
The standard for Photometric Certificate No. 9114984 and 111588
The standard for Stray light Certificate No. 111586 and 111585
The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapat 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 associated 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.
Unit: Results provided in full
DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Phra Pradaeng, Bangkok 10250
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

Delivering Growth - In Asia and Beyond.

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	
748.48	748.7	-0.22	0.13	
807.03	807.4	-0.37	0.13	

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2830	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.028	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4585	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
	0.2481	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
	0.2579	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Phra Pradaeng, Bangkok 10250
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CAL-FM-C06-15: 12 Sep 2022



Certificate No.: C06230441 Page 3 of 3

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
	0.2684	0.280	-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)	
280.62 +/- 0.11 nm	280.6	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	266.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4566	0.2780		
Absorbance (A)	0.413	0.300		

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องวัด: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

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

เพิ่มเส้นผ่านศูนย์กลาง: *656.1nm=656.1nm

*486.0nm=485.5nm

Mr.Nattapat Rungueang
Service Engineer

บริษัท ดีเคเอส อีซี จำกัด
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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CAL-FM-C06-15: 12 Sep 2022

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CAL-FM-R31-03: 20 Jul 2022

Certificate of Calibration

Certificate No.: C29240011

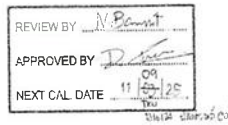
Page 2 of 4

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 I.D.): 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 Phunook

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.: TC22/0080

(Mr. Thanathorn Phunook)

Person in charge

(Mr. Udon Srichana)

Authorized signatory

This certificate issues the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standards or other recognized national standards laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested/calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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CAL-FM-C29-07 20 Jul 2022

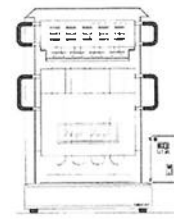
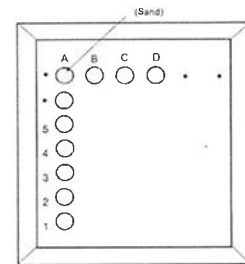


Fig 1.: Front view



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 positions or location

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Certificate No.: C29240011

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Calibration Results:

Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	360	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

Certificate No.: C29240011

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Calibration Results:

Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	360	365	365	362.5	17.5	1.5
A2				362.4	17.4	1.5
A3				362.1	17.1	1.5
A4				379.7	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				376.5	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

ชนิดเครื่องมือ: Block Digestion Unit รุ่น: KT-20s
หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<i>General</i>			
<input type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	5. สลัก Hole	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อเสนอแนะ

Mr. Thanathom Phunook
Service Engineer

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Agilent 5100, 5110 Preventive Maintenance Checklist



Introduction

Customer Information

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

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Agilent 5100, 5110 Preventive Maintenance Checklist



Important Customer Web Links

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

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Agilent CrossLab Start Up Services Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY	Thitima B.
APPROVED BY	Sam L. M.
NEXT CAL. DATE	29/01/2025

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

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	G3010A / M11010005
Instrument System Site and Location	RLS Laboratory Group (Thailand) Co., LTD

List System Component, Product Numbers	List the Serial Numbers of each Component
1 G3010A	FW 16010005
2 G3410A	AU 15440764
3 G3242 - 90201	2004 - 20159
4	
5	
6	
7	
8	
9	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	<u>Sea Spray</u> One Neb Conical Other
Spray Chamber	Cyclonic Single Pass Cyclonic Double Pass Other
Torch	<u>Radial</u> Dual View Other
Torch Type	One Piece Semi-Dismountable Fully Dismountable Other
Injector Diameter	2.4mm 1.8mm 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.
- ☒ Refill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization
- ☐ Inspect X and Z axis belts for wear. Replace is necessary
- ☐ Clean X and Z axis slide shafts
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial

SPS 4 Auto sampler

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

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

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

Record Post-PM instrument performance

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

Restore Instrument

- ☒ For HF applications, ask the customer to re-install 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 SRRR	1531.1	2646.3	1510.0	2642.7
Mn 257.512 nm SRRR	1555.1	12552.6	7534.9	13959.3
Al 356.152 nm SRR	2.1	15.0	5.9	18.3
K 766.491 nm SRR	3.3	61.0	5.4	92.0

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

Instrument Test Results Table

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

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

ICP-OES Status Results Table

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

Measurement	Standby Mode	Plasma On
Main Voltage	215.33 V	VAC 215.19 V
Main Current	0.09 A	A 0.11 A
Instrument Temperature	21.8 °C	23.2 °C
RF Air Flow (sensor speed)	14.0 Hz	13.0 Hz
Plasma Exhaust Temperature	No measurement	50.1 °C
Water Flow Oscillator	No measurement	1.20 L/min
Water Flow Detector	1.14 L/min	1.09 L/min
Water Inlet Temperature	22.5 °C	22.6 °C
Polydromicor Temperature	25.0 °C	25.0 °C
CCD Temperature	+45.1 °C	+45.0 °C
Thermal Stabilizer	21.3 °C	21.4 °C
Argon Supply Pressure	614.34 kPa	561.70 kPa
Purge Gas Supply Pressure*1	610.14 kPa	514.30 kPa
Option Gas Supply Pressure*1	- kPa	- kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	276.06 kPa
Plasma Gas Flow	No measurement	11.89 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1146.6 W
RF Supply Current	No measurement	9.66 A
RF Supply Voltage	No measurement	144.81 V

*1 If option installed

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Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G6010-60014	G6010A, G6011A, G6014A/G6015A	1
Radial Pre-Optic Window	G6010-60015	All	1
Agilent Cool Clear Coolant Fluid	57994037	Agilent Water Recirculator	1
Purge Gas Filter	G6010-60136	All	1
Air inlet filter	G6000-60202	All	1
High Capacity Air Filter	G6010-60189	Optional	1
Rotar seal for 6 port valve for AVS6/7	G8494-60002	G8494A/G8495	1
Rotar seal for 4 port valve for AVS4	G8493-60002	G8493A	1
Rinse solution to nebulizer station 2.5mm id x 7m	G8410-80125	SPS 4	1
Barb connector 2.5mm id 5mm id	G8410-80124	SPS 4	1
PVC waste tubing 5mm id x 5mm id, 2m	G8410-80122	SPS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047300	SFS 3	1
Z axis drive belt	5410047400	SFS 3	1
Peristaltic pump tubing, PVC SolkaFlex, 3 bridged	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
------------------	-------------	------------------------------	-------------------

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Signature Page

Service Engineer Comments (optional)

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

Service Verification

Service Request Number: 606602534
Service Engineer Name: Nukoon
Service Engineer Signature: Nukoon
Total number of pages in this document: 14

Date Service Completed: Feb 24, 2024
Customer Name:
Customer Signature:

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Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. 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

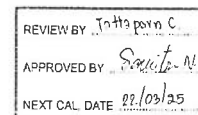
Date of Receipt : 13 September 2023

Calibrated By : Saneek Musikanwan (Site Calibration Manager)

Approved By : / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 26 SEP 2023

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



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Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 22 September 2023
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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	T151	T230014	17 January 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 20 Minute At 95 °C

Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max

☐ Close

☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

Approved By.

FM-L13 108/30-05-57



Metrological Center

SCI ECO Services Company Limited

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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No T231676

Page 4 of 6

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51	95.17
	Min	94.57	93.95	94.75	94.92	94.00	94.72
	Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
CAL POINT	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
CAL POINT	Max	95.37	95.30	95.22	95.21	95.33	95.31
	Min	94.99	95.09	94.78	94.82	94.88	94.96
	Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
CAL POINT	Max	95.59	94.42	94.52	94.24	94.63	94.67
	Min	95.21	94.06	94.13	93.86	94.28	94.27
	Average	95.40	94.24	94.35	94.06	94.45	94.47
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
CAL POINT	Max	95.19	95.38	92.93	95.30	95.14	95.03
	Min	94.83	95.03	92.36	94.95	94.79	94.70
	Average	95.01	95.20	92.75	95.12	95.46	94.87
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35	TN36
CAL POINT	Max	94.63	94.90	94.77	94.31	94.24	95.47
	Min	94.24	94.55	94.44	93.98	93.92	93.56
	Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
CAL POINT	Max	94.30	94.44	94.04	93.81	94.89	95.35
	Min	93.95	94.05	93.67	93.48	94.39	94.90
	Average	94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27	TN28
CAL POINT	Max	95.99	95.63	95.28	95.29	95.45	94.87
	Min	95.57	95.15	94.82	94.84	94.99	94.48
	Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By.

FM-L13 108/30-05-57



Metrological Center

SCI ECO Services Company Limited

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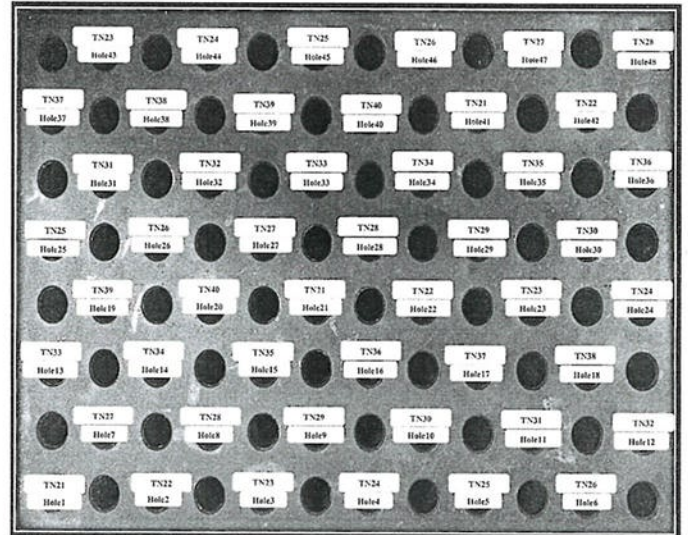
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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By.

FM-L13 108/30-05-57



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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No T231676

Page 5 of 6

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44	105.27
	Min	104.94	103.95	105.15	105.04	104.11	104.96
	Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
CAL POINT	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
CAL POINT	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
CAL POINT	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
CAL POINT	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
CAL POINT	Max	104.75	104.86	104.80	105.20	104.50	104.39
	Min	104.54	104.63	104.59	105.00	104.32	104.18
	Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
CAL POINT	Max	104.30	104.90	104.85	104.65	104.88	104.83
	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
CAL POINT	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: _____

FM-L13 108/30-05-57

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

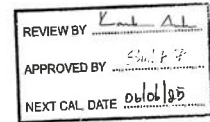
5. Adjustment :

(X) without adjustment () after adjustment

Approved By: _____

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

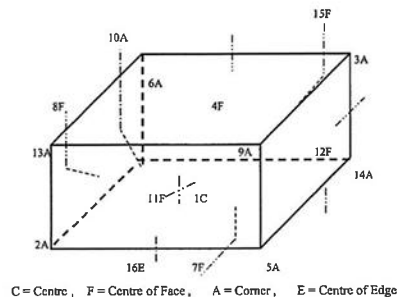


The uncertainties are for a confidence probability of approximately 95%.

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FM-L14 119/18-08-66

Calibration Report



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: _____



Certificate No. T232160

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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	
	Min	Max					Average	Factor k
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 data 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:

PM-L15 118/18-08-66

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Patthanasakam 40, Patthanasakam Rd., Kweng 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:
APPROVED BY:
NEXT CAL. DATE: 21-May-26

CDS Logon Verification - GC

Logon: esbkk.ern03

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 MMl

Setpoint Status: Pass

Setpoint Actual

Inlet Pressure: 25.0 psi 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended: <= 1.2

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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REVIEW BY:
APPROVED BY:
NEXT CAL. DATE: 18 Jan 2025

ARCHEMICA

Certificate of Calibration

ICS-2100: Anion (ID#659)

This certificate is to verify that Instrument below are calibrated
by Archemica Lab Co., Ltd.

ICS-2100 S/N: 15010977
AS-HV S/N: 5450A36659

For
ALS Laboratory Group (Thailand) Co., Ltd.

Operator Signature:
(Mr.Nutdanai Laekhwan)
Application Chemist

Date: Jan 12, 2024

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 228.2 °C

Accuracy: -1.8 °C

Agilent Recommended: >= -1.0 °C

<= 1.0 °C

% setpoint in K (-5.0 °C)

% setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.7 °C

Accuracy: 0.7 °C

Agilent Recommended: >= -1.0 °C

<= 1.0 °C

% setpoint in K (-3.7 °C)

% 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

Setpoint/Average

Temperature: 100.0 100.7333 °C

Stability: 0.1 °C

Agilent Recommended: <= 0.5

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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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

Name: Front MMI / External TQ

7000D

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1

Name: Front MMI / External TQ

Injection Tower

7693A

Source: EI - Extractor

Setpoint Status:

Completed

Injection Volume on Column:

1.0 uL

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1

Name: Front MMI / External TQ

Injection Tower

7693A

Source: EI - Extractor

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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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

Name: Front MMI / External TQ

Injection Tower

7693A

Source: EI - Extractor

Setpoint Status:

Pass

Injection Volume on Column:

0.5 uL

RSD:

2.23 %

Agilent Recommended:

<= 5.00

Overall Mass Ratio Precision Test Status

Pass

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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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: 7693A
Model Number: G4513A
Serial Number: CN18180003
Firmware Revision: A.11.02
Usage: Sample Injection
Location: Front
Syringe Volume (uL): 10Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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Sampler 2

Manufacturer: Agilent Technologies
Type: Tray
Name: 7693A
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: YesDate: November 21, 2024 2:12:44 PM
System ID: GM-10

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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	US1826U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Liquid Injection Scouting Run Standard	OPN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of Filaments	2

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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Electronic Signature

Purpose

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

Details

Full Name of Signer: 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 assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: supasek.nimsongtham			System ID: GM-10	
Report Generated by Hostname: SCG115HKK			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 11:58:17 AM	Audit	Session Created	Session	Host Name: SCG115HKK, Drive Serial Number: C2031778
November 21, 2024 11:58:17 AM	Start	Configuration	Session	None
November 21, 2024 11:58:17 AM	Audit	Entitlement	Unlocking	User is Field Engineer and does not require an unlock code
November 21, 2024 12:01:59 PM	Audit	Exp loaded	Session	EQP details for primary technique [GC] - File path: (PhysicalPath)\GC\Configurations\GC02.55\GC02.55 eqp, EQP File Name: (GC02.55 eqp), EQP Name: (AgilentRecommended)\Photo via Review (GC02.55) EQP details for hyphenated technique [GCMS] - File path: (PhysicalPath)\GCMS\Configurations\GC02.55\GC02.55 eqp, EQP File Name: (GCMS02.55 eqp), EQP Name: (AgilentRecommended)
November 21, 2024 12:02:04 PM	End	Configuration	Session	None
November 21, 2024 12:02:12 PM	Start	Qualification	Session	OQ
November 21, 2024 12:02:12 PM	Start	Execution	CDG Logon Verification - GC - 7800 - Qualitative test	None
November 21, 2024 12:03:09 PM	End	Execution	CDG Logon Verification - GC - 7800 - 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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Agilent CrossLab LabCom

User Name: supasek.nimsongtham
 Report Generated by Hostname: SCG115HKK

System ID: GM-10
 Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Optional Information
November 21, 2024 12:02:11 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7800 - Qualitative Test - No setpoints associated
November 21, 2024 12:03:20 PM	End	Execution	System Inspection and Basic Safety and Operation - 7800 - Qualitative Test - No setpoints associated
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
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
November 21, 2024 12:03:30 PM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K
November 21, 2024 12:05:02 PM	Audit	Data	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K
November 21, 2024 12:06:05 PM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K
November 21, 2024 12:06:07 PM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K
November 21, 2024 12:06:20 PM	Audit	Data	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K

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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: SCG1115HKG
System ID: GM-10
Print Date: November 21, 2024 2:12:45 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 - 7000 - Temperature : Oven - S: 100.0°C - L: >+ -1.0 AND <= 1.0 % setpoint to K	Run Count: 1
November 21, 2024 12:06:25 PM	start	Execution	GC Oven Temperature Stability - None - 7000 - Temperature : Oven - S: 100.0°C - L: <= 0.3°C	
November 21, 2024 12:07:10 PM	Audit	Data	GC Oven Temperature Stability - Manual Data Entry - 7000 - Temperature : Oven - S: 100.0°C - L: <= 0.3°C	
November 21, 2024 12:07:14 PM	End	Execution	GC Oven Temperature Stability - 7000 - Temperature : Oven - S: 100.0°C - L: <= 0.3°C	Run Count: 1
November 21, 2024 12:07:16 PM	start	Execution	Tune EI - 7000D TO - Source - None EI - Extractor Flamm 1 (Qualitative - No setpoints associated)	
November 21, 2024 12:07:26 PM	End	Execution	Tune EI - 7000D 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 - 7000D TO - Source - None EI - Extractor Flamm 2 (Qualitative - No setpoints associated)	
November 21, 2024 12:07:39 PM	End	Execution	Tune EI - 7000D 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, None Front MM, TO - Source - EI - Extractor - Part of GCMS System Preparation	

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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: SCG1115HKG
System ID: GM-10
Print Date: November 21, 2024 2:12:45 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:08:53 PM	Audit	Data	Scouting Run - Injection Tower, Front MM, TO - Source - EI - Extractor - Part of GCMS System Preparation	Data File Path: C:\GM-10\OQ2024\DL001.D
November 21, 2024 12:09:23 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 12:09:50 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 12:15:45 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\OQ2024\DL001.D
November 21, 2024 12:16:48 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\OQ2024\DL002.D

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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: SCG1115HKG
System ID: GM-10
Print Date: November 21, 2024 2:12:45 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:10:48 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\OQ2024\DL003.D
November 21, 2024 12:15:46 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\OQ2024\DL004.D
November 21, 2024 12:16:47 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\OQ2024\DL005.D
November 21, 2024 12:16:47 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\OQ2024\DL006.D
November 21, 2024 12:16:47 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\OQ2024\DL007.D
November 21, 2024 12:16:47 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\OQ2024\DL008.D
November 21, 2024 12:16:47 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\OQ2024\DL009.D

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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: SCG1115HKG
System ID: GM-10
Print Date: November 21, 2024 2:12:45 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 MM, TO - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: C:\GM-10\OQ2024\DL010.D
November 21, 2024 12:18:15 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 MM, TO - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Run Count: 1
November 21, 2024 12:22:52 PM	start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TO - Source - EI - Extractor - L (RSD) <= 5.00%	None
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TO - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10\OQ2024\MRP002.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TO - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10\OQ2024\MRP003.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TO - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10\OQ2024\MRP004.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: supasak.suwanphim
Report Generated by: H04name: SCG1115HNC

System ID: GM-10
Print Date: November 21, 2024 2:42:46 PM

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:27:30 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: C:\GM-10\022024M\RP003.D Tower, Front MM, TQ -> O22024M\RP003.D Source: EI - Extractor - L (RSD) ≤ 5.00%
November 21, 2024 12:27:30 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: C:\GM-10\007024M\RP006.D Tower, Front MM, TQ -> O07024M\RP006.D Source: EI - Extractor - L (RSD) ≤ 5.00%
November 21, 2024 12:27:39 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: C:\GM-10\022024M\RP007.D Tower, Front MM, TQ -> O22024M\RP007.D Source: EI - Extractor - L (RSD) ≤ 5.00%
November 21, 2024 12:33:20 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - (Integration Type) Injection/Baseline Correction Noise Adjustment/Initial Slope Sample/10 Initial Peak Width 0.01 Initial Area Reject 0 Initial Height/Reject S0000/Integration: Off at 0 Integration On at 4
November 21, 2024 12:36:42 PM	End	Execution	Mass Ratio Precision - Injection	Run Count: 1 Tower, Front MM, TQ -> Source: EI - Extractor - L (RSD) ≤ 5.00%
November 21, 2024 12:37:11 PM	End	Quarantine	Session	DQ
November 21, 2024 12:37:11 PM	Start	Reporting	Session	None
November 21, 2024 1:11:02 PM	Audit	Reporting	Session	Report Generated: Certificate
November 21, 2024 1:37:32 PM	Audit	Reporting	Session	Report Generated: Report

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Date: November 21, 2024 2:42:46 PM
System ID: GM-10

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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Rama4 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-1800
Manufacturer Shimadzu
Serial No. A11454908533 CD
ID No. BKK_EN0018
Date of receipt 13 September 2024
Date of calibration 13 September 2024
Date of issue 13 SEP 2024

REVIEW BY *Junda K*
APPROVED BY *Santhi P*
NEXT CAL DATE *13/9/2025*

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

Temperature (25.3 - 26.7) °C (On site)
Humidity (50.4 - 55.5) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Preparation Lab

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

Traceability Wavelength Accuracy is traceable to certificate No. 106372 and 106371
Photometric Accuracy is traceable to certificate No. 106364 and 111398
Stray Light is traceable to certificate No. 106377
The above certificate are traceable to SI unit through Starna Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janloy

Approved by

Santhi
Mr. Santhi Temboonsakdi
Service Manager

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

FM-UV-706-02 Rev.01 (23/01/23)



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



Certificate of Calibration

Certificate No. BSCC-UV-374/24 Number of Page(s) 2 of 3

Calibration Results:

1. Wavelength Accuracy

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

2. Photometric Accuracy (UV)

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

*CNR = Customer not request

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FM-UV-706-02 Rev.01 (23/01/23)



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Siam Bangkok Bangkok Thailand 10500
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www.barscientific.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
	1.0189	1.0174	-0.0015	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
	1.0026	1.0011	-0.0015	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5235	0.5232	-0.0003	0.0042
	0.6814	0.6598	-0.0216	0.0042
	0.9456	0.9444	-0.0012	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5249	0.5245	-0.0004	0.0042
	0.6975	0.6958	-0.0017	0.0042
	1.0009	0.9994	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5590	0.5585	-0.0004	0.0042
	0.7725	0.7708	-0.0017	0.0042
635.0	1.1125	1.1114	-0.0011	0.0042
	0.0000	0.0000	0.0000	0.0042
	0.5666	0.5666	0.0000	0.0042
	0.7620	0.7604	-0.0016	0.0042
	1.0982	1.0971	-0.0011	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Wavelength (nm)	Transmission (%)	Absorbance (A)
200.85±0.11nm	199.58	0.9520	2.0217

The Stray light transmission reference is less than 1.0% and Stray light absorbance reference is greater than 2.00A
*Stray Light not NIS-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.
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FM-UV-706-02 Rev.01 (23/01/23)



Agilent Technologies (Thailand) Limited
U CHU LING BLDG 22/F UNIT A D
SUKHUMVIT 4 ROAD, SUKHUMVIT, BANGKOK
Bangkok 10550 Thailand

Tel: 662 637 6183
Fax: 662 637 4334
Email: ocs-srm@agilent.com
Website: www.agilent.com/thai

Service Confirmation Number: 6905338201
Service Confirmation Date: 12.12.2023

Customer Contact:

ALS Laboratory Group (Thailand) Co.
Ltd.
104 Prachinankasri 40 Prachinankasri Rd
Klongkum Prachinankasri Klong Klong
TAX ID : 010554004859
Chanatagarn.lmchom@agilent.com
27003008

Invoice To:

ALS Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Prachinankasri 40 Prachinankasri Rd
Klongkum Prachinankasri Klong Klong

Delivery Site:

ALS Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Prachinankasri 40 Prachinankasri Rd
Klongkum Prachinankasri Klong Klong

Location:

Room
Bldg
Lab
Dept

SERVICE REPORT

Customer Purchase Order Number:	Customer Number:
70371013	70371013
Service Request:	Service Request Date:
Service Order:	Service Confirmation:
6906041263	6905338201

REVIEW BY	Supakwan M.
APPROVED BY	Savitree M.
EXT CAL DATE	12/10/2025

Direct Inquiries To:

Contact Name: Customer Contact Center
Contact Email: ocs-srm@agilent.com
Contact Telephone: 662 637 6363
Contact Fax: 662 632 4334

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	JP12091612	ICP MS 7700 (HPLC)	SYS-IM-7700-E

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQ	Enterprise Operational Qualification	1.00	Agreement Entitlement 100 % covered	12.12.2023	12.12.2023
1010	5185-6850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement 100 % covered		

Additional Information:

Products / Applications / Software / Services

Learn more about Agilent's Service Offer, Products, Services and our full range of laboratory productivity solutions online at www.agilent.com/chem applications and we welcome you to visit us at www.agilent.com/chem

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Tax ID : 010554004859

Dusit N.A. Bangkok Branch
339 Interchange 21 Building Sukhumvit Road, Klongkum, New
Sub-district Wattana District Bangkok 10110 Thailand
A/C No: 002-4452 607
The King Thai Bank PCL
Siam Square Bldg 216/117 Rama 1 Rd, Pathumwan, BKK 10330
Thailand

Service Confirmation Number: 6905338201
Service Confirmation Date: 12.12.2023



REVIEW BY	Chanatagarn M.
APPROVED BY	Savitree M.
EXT CAL DATE	12/10/24

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: ALS 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 Phrom, Bangkok
Bangkok 10150 Thailand

Certified by
Thunraphol Sakdayos
Service Engineer

Service Information:

Problem Description: WU OQ (M/HPLC-7700-6001143313)		
Service Provided: Perform OQ Hardware control test CSD Ilogon, Autosampler, 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:	Travel Hours:	
6.0	1.0	
Customer Field Service Representative Name:	Customer Field Service Representative Signature:	Date:
Panthep Kuresathala		12 Dec 2023
Customer Name:	Customer Signature:	Date:
Sapakwan Mak		12 Dec 2023
Additional Comments:		