

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	RYG_FS0185	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0184	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0186	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0183	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0175	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0176	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0173	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0460	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0458	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0462	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0456	4-Jan-23	4-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0461	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0459	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0463	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0457	5-Jan-23	5-Jul-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	5-Jan-23	5-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	5-Jan-23	5-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0328	31-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	31-Jan-22	29-Jul-23	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0468	13-Jan-23	13-Jul-23	6
Stack	Total Suspended Particulate	Console Control Unit	RYG_FS0315	13-Jan-23	13-Jul-23	6
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	1-Mar-23	1-Mar-24	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Standard gas	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0438	7-Sep-22	7-Sep-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0613	12-Oct-22	12-Oct-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0027	13-Jan-23	13-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0025	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0612	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0617	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0620	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0434	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0619	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0390	18-Oct-22	18-Oct-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0030	19-Jan-23	19-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0098	15-Aug-22	15-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0096	13-Dec-22	13-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0033	2-Nov-22	2-Nov-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0384	26-Aug-22	26-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0034	2-Nov-22	2-Nov-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0219	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0223	3-Feb-23	3-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0224	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0232	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0520	24-Feb-23	24-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0360	03-Feb-23	3-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0358	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0359	02-Feb-23	2-Feb-24	12
Illuminance	Illuminance	Lux Meter	RYG_FS0201	4-Oct-22	4-Oct-23	12
Illuminance	Illuminance	Lux Meter	RYG_FS0536	2-Sep-22	2-Sep-23	12



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

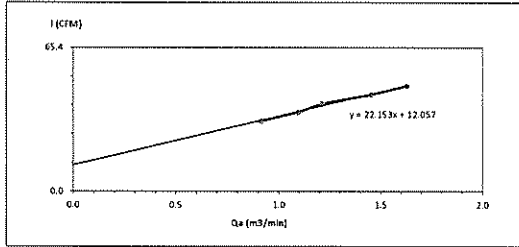
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG_FS0296	22-Jul-22	22-Jul-23	12
Rayong Lab	Temperature	pH meter	RYG_FS0574	14-Mar-22	14-Mar-23	12
Rayong Lab	Temperature	Digital Thermometer With Sensor	RYG_FS0468	7-Sep-22	7-Sep-23	12
Rayong Lab	Temperature	pH meter	RYG_FS0605	7-Sep-22	7-Sep-23	12
Rayong Lab	Temperature	pH meter	RYG_FS0420	3-Apr-23	3-Apr-24	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Water Lab	Calcium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Magnesium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Magnesium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	SAR	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	SAR	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	SAR	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_EN0188	15-Mar-23	15-Mar-24	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Water Lab	Chlorite	Ion Chromatography	BKK_EN0130	11-Jan-23	11-Jan-24	12
Water Lab	Organochlorine Pesticide	GC MSMS	BKK_EN0284	23-Nov-21	22-May-23	18



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd.
 Calibrate Location: โรงบรรจุขวดน้ำดื่ม
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-PS0185
 Calibrator ID: RYG-PS0205
 Calibrator Model: TE 5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-PS0185
 High Volume Model: TE 5009X
 High Volume S/N: 4793
 Calibrator Slope: 0.94434
 Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.914	32	Slope: 22.1531 Intercept: 12.0566 Correlation Coefficient: 0.9957
2	2.6	1.096	36	
3	3.2	1.214	40	
4	4.6	1.453	44	
5	5.8	1.630	48	



Calibrated by: Jam
 (Mr Jaradrawee Sritraksa)
 Field Scientist (2)

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

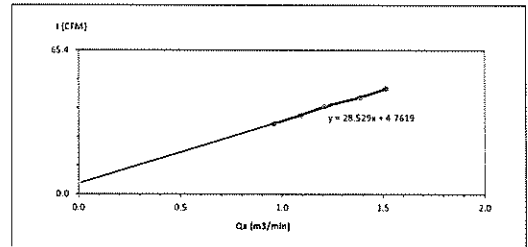
FORM NO. F-06-074 REVISION NO. : ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd.
 Calibrate Location: โรงบรรจุขวดน้ำดื่ม/หาล้างขวด
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-PS0184
 Calibrator ID: RYG-PS0205
 Calibrator Model: TE 5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-PS0184
 High Volume Model: TE 5009X
 High Volume S/N: 4792
 Calibrator Slope: 0.94434
 Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.963	32	Slope: 28.5286 Intercept: 4.7619 Correlation Coefficient: 0.9982
2	2.6	1.096	36	
3	3.2	1.214	40	
4	4.2	1.389	44	
5	5.0	1.514	48	



Calibrated by: Jam
 (Mr Jaradrawee Sritraksa)
 Field Scientist (2)

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

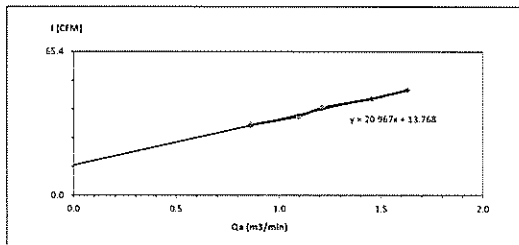
FORM NO. F-06-074 REVISION NO. : ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd.
 Calibrate Location: โรงบรรจุขวดน้ำดื่ม/หาล้างขวด
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-PS0186
 Calibrator ID: RYG-PS0205
 Calibrator Model: TE 5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-PS0186
 High Volume Model: TE 5009X
 High Volume S/N: 4794
 Calibrator Slope: 0.94414
 Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.862	32	Slope: 20.9673 Intercept: 13.7684 Correlation Coefficient: 0.9961
2	2.6	1.096	36	
3	3.2	1.214	40	
4	4.6	1.453	44	
5	5.8	1.630	48	



Calibrated by: Jam
 (Mr Jaradrawee Sritraksa)
 Field Scientist (2)

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

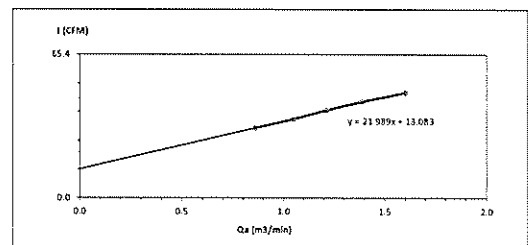
FORM NO. F-06-074 REVISION NO. : ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd.
 Calibrate Location: โรงบรรจุขวดน้ำดื่ม
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-PS0183
 Calibrator ID: RYG-PS0205
 Calibrator Model: TE 5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-PS0183
 High Volume Model: TE 5009X
 High Volume S/N: 4791
 Calibrator Slope: 0.94434
 Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.862	32	Slope: 21.9886 Intercept: 13.0828 Correlation Coefficient: 0.9989
2	2.6	1.053	36	
3	3.2	1.214	40	
4	4.2	1.389	44	
5	5.6	1.602	48	



Calibrated by: Jam
 (Mr Jaradrawee Sritraksa)
 Field Scientist (2)

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

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

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2543 8381-6, e-mail: service.thailand@sartorius.com



SARTORIUS

REVIEW BY: Pratit

APPROVED BY: P. Noppang

NEXT CAL DATE: 01/05/24

Certificate of Calibration

Model Number: LA130S-F Certificate No.: 23BCI0110
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 25409864 Reference No.: 204833
ID No.: RYG_EN0001
Manufacturer: Sartorius 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: Wednesday, March 01, 2023
Calibration Procedure No.: This calibration was conducted by Using in-house calibration procedure number (WI-003).
Based on UKAS LAB 14 : 2019

Metrological data: Ambient Conditions
Capacity: 150 g Readability: 0.0001 g Temperature: 24.2 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±
Reasons for calibration: ☐ New Installation ☐ Service / Repaired ☒ In-schedule 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	SPC-RT	C02212595	14-Sep-2023
MHB-362SD	Humidity/Barometer/Temp. Lulcon MHB-362SD	DKSH	C19220444	5-Sep-2023

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

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2543 8381-6 Fax: +66 2543-8387, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: LA130S-F Certificate No.: 23BCI0110
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 25409864 Reference No.: 204833
ID No.: RYG_EN0001
Manufacturer: Sartorius Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.	The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R113).
Nominal Value: (Low Load) 10 g Tolerance 0.0001 g	Nominal value: 50 g Tolerance 0.0004 g
Nominal Value: (High Load) 100 g Tolerance 0.0001 g	
Standard Deviation 0.00009 0.00006	Difference 1 0.0000 2 0.0000 3 -0.0001 4 0.0001 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	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00022
0.05	0.0500	0.0500	0.0000	0.00023
0.1	0.1000	0.1000	0.0000	0.00023
0.5	0.5000	0.5000	0.0000	0.00023
1	1.0000	1.0000	0.0000	0.00023
2	2.0000	2.0000	0.0000	0.00023
5	5.0000	5.0000	0.0000	0.00022
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00023
100	100.0000	100.0002	0.0002	0.00026

End of Report

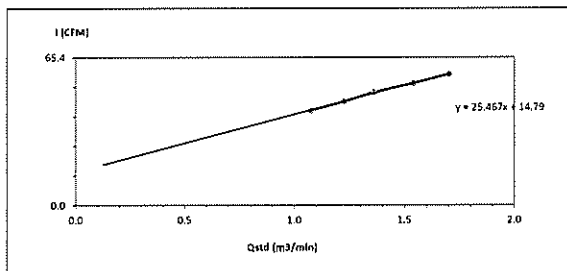
End of Report

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg): 756
Calibrate Location: โรงเก็บขนาน้ำเกลือ Temperature (°C): 31
Calibrate Date: 16-May-23 High Volume ID: RYG_FS0175
Calibration Sheet No.: C-160523-RYG_FS0175 High Volume Model: TE-S170D
Calibrator ID: RYG_FS0205 High Volume S/N: 4801
Calibrator Model: TE-S028A Calibrator Slope: 1.50765
Calibrator S/N: 1166 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{air} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0765	42	Slope: 25.4668
2	3.4	1.2281	46	Intercept: 14.7900
3	4.2	1.3627	50	Correlation Coefficient: 0.9990
4	5.4	1.5424	54	
5	6.6	1.7031	58	



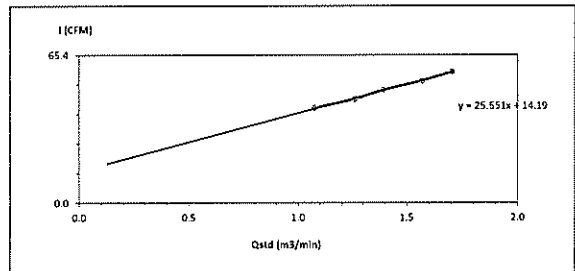
Calibrated by: Jann
(Mr. Jaradrawee Srituksa)
Field Scientist(2)

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

High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg): 756
Calibrate Location: โรงเก็บขนาน้ำเกลือ Temperature (°C): 31
Calibrate Date: 16-May-23 High Volume ID: RYG_FS0174
Calibration Sheet No.: C-160523-RYG_FS0174 High Volume Model: TE-S170D
Calibrator ID: RYG_FS0205 High Volume S/N: 4800
Calibrator Model: TE-S028A Calibrator Slope: 1.50765
Calibrator S/N: 1166 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{air} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0765	42	Slope: 25.5514
2	3.4	1.2631	46	Intercept: 14.1899
3	4.4	1.3943	50	Correlation Coefficient: 0.9983
4	5.6	1.5704	54	
5	6.6	1.7031	58	



Calibrated by: Jann
(Mr. Jaradrawee Srituksa)
Field Scientist(2)

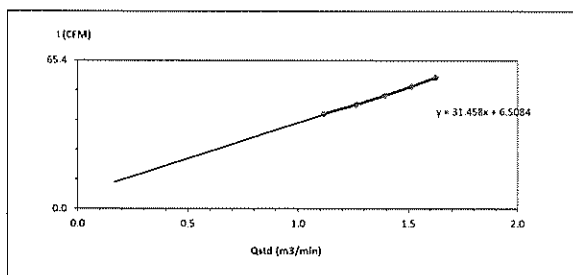
Approved by: P. Noppang
(Mr. Noppang Juntarupun)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงเรือนปลูกพืช (โรงเรือนกล้วยไม้) Temperature (°C) : 31
 Calibrate Date : 16-May-23 High Volume ID : RYG_FS0176
 Calibration Sheet No. : C-160523-RYG_FS0176 High Volume Model : TE-5170D
 Calibrator ID : RYG_FS0205 High Volume S/N : 4802
 Calibrator Model : TE-5028A Calibrator Slope : 1.50765
 Calibrator S/N : 1166 Calibrator Intercept : -0.02043

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	t : Chart (CFM)	Linear Regression	
1	2.8	1.1164	42	Slope : 31.4580 Intercept : 6.5084 Correlation Coefficient : 0.9984	
2	3.6	1.2631	46		
3	4.4	1.3943	50		
4	5.2	1.5140	54		
5	6.0	1.6248	58		



Calibrated by : Jann
 (Mr. Jaradrawee Srinuksa)
 Field Scientist (2)

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

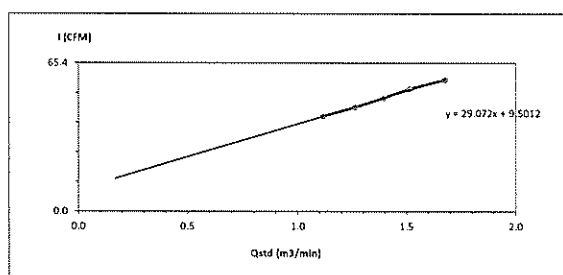
FORM NO. F-06-073 REVISION NO. : ISSUE DATE 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงเรือนปลูกพืช (โรงเรือนกล้วยไม้) Temperature (°C) : 31
 Calibrate Date : 16-May-23 High Volume ID : RYG_FS0173
 Calibration Sheet No. : C-160523-RYG_FS0173 High Volume Model : TE-5170D
 Calibrator ID : RYG_FS0205 High Volume S/N : 4799
 Calibrator Model : TE-5028A Calibrator Slope : 1.50765
 Calibrator S/N : 1166 Calibrator Intercept : -0.02043

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	t : Chart (CFM)	Linear Regression	
1	2.8	1.1164	42	Slope : 29.0720 Intercept : 9.5012 Correlation Coefficient : 0.9989	
2	3.6	1.2631	46		
3	4.4	1.3943	50		
4	5.2	1.5140	54		
5	6.4	1.6774	58		



Calibrated by : Jann
 (Mr. Jaradrawee Srinuksa)
 Field Scientist (2)

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

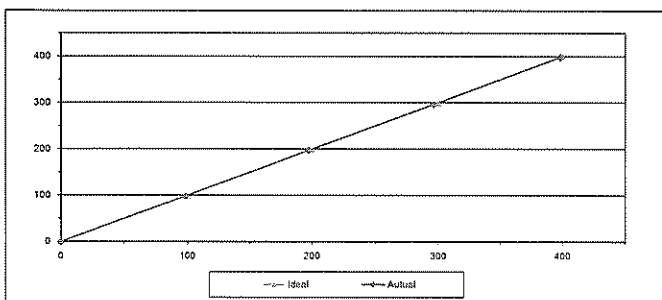
FORM NO. F-06-073 REVISION NO. : ISSUE DATE 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date : 4-Jan-23 Equipment Name : SO2 Analyzer
 Manufacturer : HORIBA Model : APBA-370
 Serial No. : VASFBLSH Equipment ID : RYG_FS0400
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 947
 Std. Gas Concentration (PPM) : 50.3 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expiry Date : 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30
2	200.00	197.80	-2.20	-1.10
3	300.00	296.60	-3.50	-1.17
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				-0.78



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

Approved By : Mr. Sarayuth Jitnantont
 Assistant General Manager

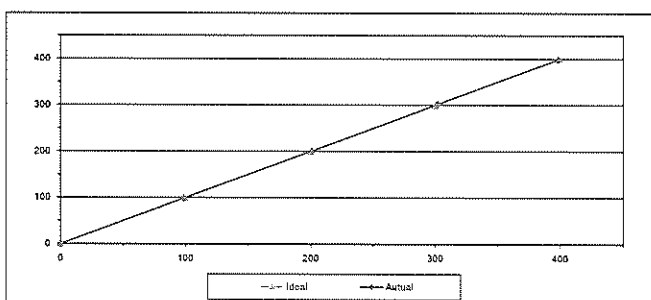
FORM NO. F-06-058 REVISION NO. : ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date : 4-Jan-23 Equipment Name : SO2 Analyzer
 Manufacturer : HORIBA Model : APBA-370
 Serial No. : PAJY077A Equipment ID : RYG_FS0458
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 947
 Std. Gas Concentration (PPM) : 50.3 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expiry Date : 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	201.10	1.10	0.55
3	300.00	302.30	2.30	0.77
4	400.00	398.60	-1.40	-0.35
AVERAGE (%)				-0.01



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

Approved By : Mr. Sarayuth Jitnantont
 Assistant General Manager

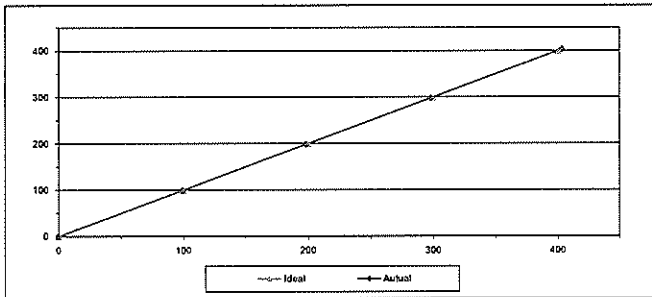
FORM NO. F-06-058 REVISION NO. : ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	XL29Y858	Equipment ID	RYG_FS0462
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
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	99.10	-0.90	-0.90
2	200.00	198.10	-1.90	-0.95
3	300.00	297.90	-2.10	-0.70
4	400.00	403.20	3.20	0.80
AVERAGE (%)				-0.33



Calibrated By

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

Approved By

(Mr. Sarayuth Jittanont)
Assistant General Manager

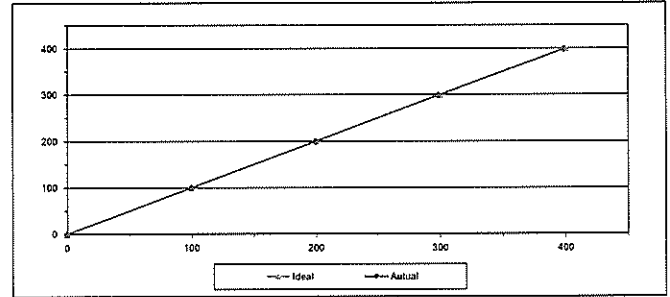
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	R0HWYDVW	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
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	99.70	-0.30	-0.30
2	200.00	199.50	-0.50	-0.25
3	300.00	298.30	-1.70	-0.57
4	400.00	398.10	-1.90	-0.47
AVERAGE (%)				-0.30



Calibrated By

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

Approved By

(Mr. Sarayuth Jittanont)
Assistant General Manager

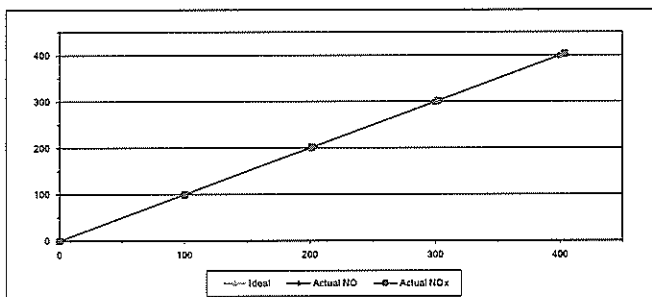
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T95HWM41	Equipment ID	RYG_FS0461
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	100.10	0.10	0.10
2	200.00	201.00	1.00	0.50	201.40	1.40	0.70
3	300.00	298.30	-1.70	-0.57	302.10	2.10	0.70
4	400.00	398.40	-1.60	-0.40	403.50	3.50	0.88
AVERAGE (%)				-0.33			0.50



Calibrated By

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

Approved By

(Mr. Sarayuth Jittanont)
Assistant General Manager

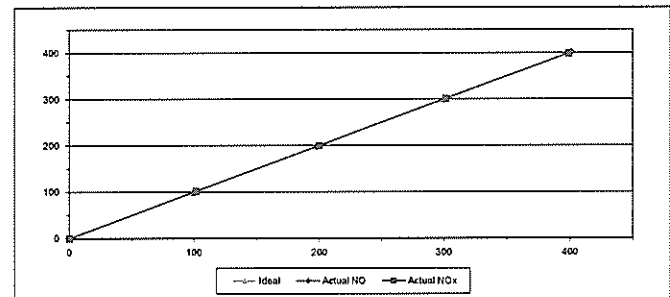
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	HVCER3YH	Equipment ID	RYG_FS0459
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.80	1.80	1.80
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.50	1.50	0.50
4	400.00	401.30	1.30	0.33	398.90	-1.10	-0.28
AVERAGE (%)				-0.08			0.39



Calibrated By

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

Approved By

(Mr. Sarayuth Jittanont)
Assistant General Manager

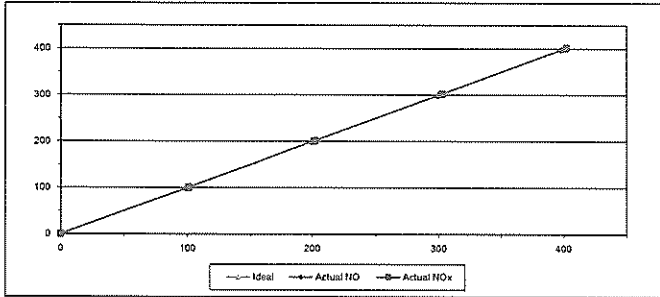
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	R06K0177	Equipment ID	RYG_FB0483
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	101.10	1.10	1.10
2	200.00	201.80	1.80	0.90	201.50	1.50	0.75
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.10	-1.90	-0.47	401.90	1.90	0.47
AVERAGE (%)				-0.18			0.66



Calibrated By

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

Approved By

(Mr.) Sarayuth Jitranont
Assistant General Manager

ALS Laboratory Group

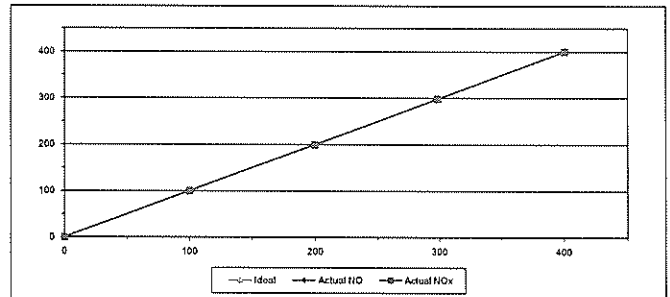
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T2T8YRL1	Equipment ID	RYG_FB0457
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	98.30	-1.70	-1.70	100.20	0.20	0.20
2	200.00	198.40	-1.60	-0.80	199.60	-0.40	-0.20
3	300.00	297.10	-2.90	-0.97	298.50	-1.50	-0.50
4	400.00	398.50	-1.40	-0.35	400.70	0.70	0.17
AVERAGE (%)				-0.74			-0.05



Calibrated By

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

Approved By

(Mr.) Sarayuth Jitranont
Assistant General Manager

ALS Laboratory Group

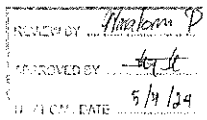
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



JIRANAT ASSOCIATES CO., LTD.
63/14 Th. 6/391, 30
Vithayakom Road, Thungyai, Bangkok
Bangkok 10250, Thailand
Tel: +662-050191
Fax: +662-050191
E-mail: jirana@jirana.co.th
Website: www.jirana.co.th

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-104-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



Certificate Number

CL-001-66

Certificate Number

CL-001-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

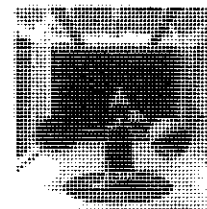
v_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{ref} (m/s)	Error (m/s)	U (m/s)
0.50	23.82	23.85	0.7	0.3	0.16
2.03	23.90	23.85	1.7	0.3	0.16
3.05	24.00	23.85	2.9	0.2	0.10
4.13	23.84	23.85	3.9	0.2	0.10
5.00	23.85	23.85	4.9	0.1	0.24
5.99	23.94	23.85	5.8	0.2	0.18
7.05	23.82	23.85	6.9	0.2	0.19
9.17	23.59	23.85	8.0	0.1	0.22
9.05	23.72	23.85	9.9	0.1	0.21
10.09	23.85	23.85	9.9	0.2	0.10
11.14	23.60	23.85	11.0	0.1	0.26
12.14	23.74	23.85	12.1	0.1	0.28
13.21	23.68	23.85	13.0	0.2	0.21
14.25	23.70	23.85	14.1	0.2	0.27
15.26	23.64	23.85	15.0	0.3	0.16
16.30	23.60	23.85	16.1	0.2	0.28

Remark:

¹ Calibration results only apply for the test circumstances and environmental conditions during which calibration took place.² Velocity of standard

Velocity of Unit under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranat Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the test object is not suitable for measuring pressure.

End of Certificate of Calibration

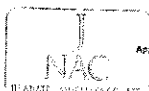
Page 3 of 2 Pages

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	Cup anemometer	Calibration procedure:
MANUFACTURER	Novalyne	The cup anemometer was calibrated against standard air velocity transducer model: B455-12 and pitot tube with precision differential pressure meter model: EPA10509 in close test section of pitot type wind tunnel with 500 cm ² cross test section area. The UWC test rig is on ISO 61420 10 x 2 m wind energy generation system - Port 12.
MODEL/TYPE	Sensor: WS-02F Data logger: WS-250L	1. Power performance measurements of electricity producing wind turbines. March 2017 was used as a calibration guideline.
SERIAL NUMBER	Sensor: Data logger: A4481	
ID NUMBER	-ENK-150041	Traceability:
CONDITION AS RECEIVED	Used item	This certificate provides a traceability of the measurement to recognized the national standards and its realization of the international system of units (SI) through the NMIs (National Metrology Institute of Thailand) via Certificate number: NM-001-21 and NM-001-22.
CUSTOMER	ALS Laboratory Group (Thailand) Co., Ltd. 106 Phatthana-Kit 40, Phatthana-Kit Rd, Khwaeng Soan Luang, Khet Soan Luang, Bangkok 10250 Thailand	Uncertainty of Measurement:
RECEIVED DATE	28 Dec 2022	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).
MEASUREMENT DATE	05 Jan 2023	
ISSUE DATE	09 Jan 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	1016 ± 10 hPa	
PLACE OF CALIBRATION	Pitot type wind tunnel of Jiranat Associates Co., Ltd.	
CALIBRATION CONDITIONS	Wind tunnel cross section area ¹	900 cm ²
	Wind direction frontal area ²	100 cm ²
	Diameter of measuring pipe ³	mm
	Blockage ratio of test object ⁴	0.11 [-]
Preconditioning	24 hours at ambient conditions	
Measurement Condition	The average values during measurement are (23.9) °C, (47.3) %RH and (1015.1) hPa	

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

Calibrated by:
13 Mr. Sarawat Thongkiet
13 Miss Jiraporn Jirapornchai



Approved signature

(Mr.) Sarawat Thongkiet
Calibration Department Manager

Remark:
¹ Inside cross section area of the wind tunnel
² Projected cross section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio A_0/A_1

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

MEASUREMENT RESULTS¹

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

Air speed	D _{ref}	D _{meas}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
0.000	0	0	0	0.58
45.000	41	41	-4	0.74
90.000	87	87	-3	0.68
135.000	134	134	-1	0.74
180.001	181	181	1	0.74
225.000	228	228	3	0.74
270.001	273	273	3	0.74
315.000	318	318	3	0.68

Remarks:

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

² Direction of unit under Calibration.

Direction of unit under Calibration.

End of Certificate of Calibration

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:
[Signature] Sr. and [Signature]
[Signature] Jirantee Associates Co., Ltd.

Remarks:

¹ Inside cross section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio 1:1

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

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel static. UUC was installed at center of the test section. The calibration was carried out under both ranging and facing 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}	Temp. wind tunnel	Temp. room	V _{meas}	Error	U (k=2)
(m/s)	(°C)	(°C)	(m/s)	(m/s)	(m/s)
0.989	24.10	24.00	0.7	-0.3	0.18
2.014	23.06	24.00	1.7	-0.3	0.16
3.051	24.06	24.00	2.9	-0.1	0.19
4.118	24.00	24.00	3.9	-0.2	0.19
4.99	24.00	24.00	4.8	-0.1	0.16
5.98	24.00	24.00	5.9	-0.1	0.18
7.05	23.90	24.00	6.9	-0.1	0.21
8.18	23.90	24.00	8.0	-0.2	0.21
9.00	23.72	24.00	9.1	0.0	0.20
10.09	23.60	24.00	9.9	-0.1	0.24
11.16	23.60	24.00	11.1	0.1	0.28
12.13	23.90	24.00	12.1	0.0	0.28
13.21	23.90	24.00	13.2	0.0	0.34
14.37	23.56	24.00	14.4	0.1	0.22
15.76	22.88	24.00	15.1	-0.1	0.27
16.32	24.00	24.00	16.4	0.1	0.28

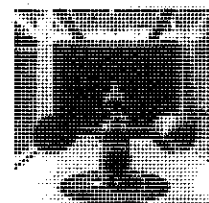
Remarks:

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

² Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jirantee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remarks: The proportion of the set up is not meant to be scaled for any other purpose.

End of Certificate of Calibration

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:
[Signature] Sr. and [Signature]
[Signature] Jirantee Associates Co., Ltd.

Remarks:

¹ Inside cross section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio 1:1

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor

Model: WS-02F

Data logger: WS-250A

Sensor: -

Data logger: A45C2

Box: F50143

Used item

AS Laboratory group (Thailand) Co., Ltd.

104 Phantanasakan 40, Phantanasakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AK400915. Data-P3-S-10 is an on close test section of Jirantee type wind tunnel with 800 cm² cross test section area. The WS-02F sensor on REC-03400-10-1 Wind energy generation systems - Part 12-1 Power performance measurement of electrically producing wind turbines, March 2017 was used as a calibration procedure.

Traceability:

This certificate provides a traceability of the measurement to recognized national standards, and to realization of the international system of units (SI) through the NMI (National Metrology Institute of Thailand) via Certificate number: TA-0555-19

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 Guide to the Expression of Uncertainty in Measurement.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

28 Dec 2022

06 Jan 2023

09 Jan 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 35.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effect type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area¹

900 cm²

Wind direction frontal area²

117 cm²

Diameter of mounting pipe³

mm

Roasting ratio of test object⁴

0.143 [1]

Preconditioning

24 hours at ambient condition

Measurement Condition

The average values during measurement are (23.9)°C, (50.1) %RH and (1015.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sirasak Thachyad

1 Miss Nitraporn Jirathongphol

Approved Signature:

Mr. Parinya Booncharoen

Calibration Department Manager

Remarks:

¹ Inside cross section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio to 1

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Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

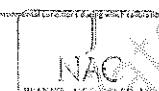
Air speed m/s	D _{ref} Degree (°)	D _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.18
	45.000	41	-4	0.74
	90.000	87	-3	0.74
	135.000	134	-1	0.74
	180.001	182	2	0.74
	225.000	228	3	0.68
	270.000	272	2	0.74
	315.000	316	1	0.74

Remark:

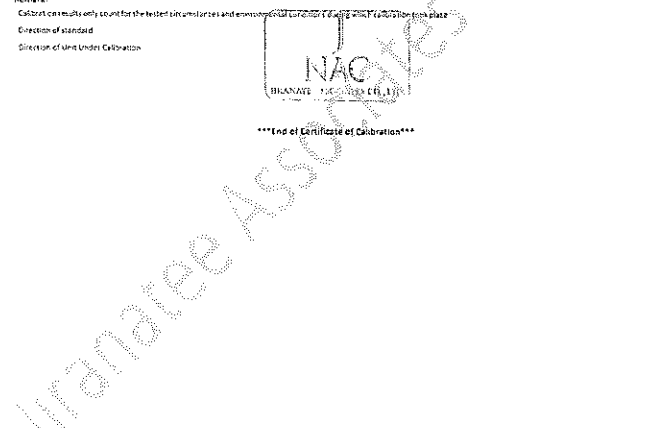
Calibration results only valid for the tested circumstances and environment conditions.

Direction of standard

Direction of Wind Under Calibration



End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-05102022

Page 1 of 2 pages

Measurement Item

Flow direction with data logger

Manufacturer

Data logger: NovaLink

Flow direction: NovaLink

Model/Type

Data logger: NovaLink 2019

Flow direction: WS-02F

Serial Number

Data logger: A45C2

Flow direction: -

ID No

Data logger: A45C2019

Flow direction: -

Customer

AS Laboratory group (Thailand) Co., Ltd.

104 Phantanasakan 40, Phantanasakan Rd, Khwaeng Suan Luang, Bangkok 10250 Thailand.

Test Conditions

Wind speed: 5.0 m/s ± 0.5 m/s

Relative Humidity: 55.0 ± 35.0 %RH

Temperature of mounting pipe: mm

Roasting ratio of test object: 0.143 [1]

Test Conditions

Flow direction: -

Flow direction: -

Flow direction: -

Calibration Procedure

Flow direction: -

Flow direction: -

Flow direction: -

Flow direction: -

Flow direction: -

Flow direction: -

Flow direction: -

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Flow direction: -

Flow direction: -

Continuation of Certificate of Calibration Number

Certificate No: WS-0510102022

Page 2 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 0.1 - 16 m/s, a resolution of 0.1 m/s.

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

V _{ref} Reading m/s	V _{meas} Reading m/s	Error (m/s)	Uncertainty (m/s)
2.078	2.0	-0.1	0.4
4.124	4.0	-0.1	1.0
6.170	6.0	-0.2	1.6
8.216	8.0	-0.2	1.9
10.262	10.0	-0.3	2.6
12.308	12.0	-0.3	3.7
14.354	14.0	-0.4	4.8
16.400	16.0	-0.4	5.9
18.446	18.0	-0.4	7.0
20.492	20.0	-0.5	8.1
22.538	22.0	-0.5	9.2
24.584	24.0	-0.6	10.3
26.630	26.0	-0.6	11.4
28.676	28.0	-0.7	12.5
30.722	30.0	-0.7	13.6
32.768	32.0	-0.8	14.7
34.814	34.0	-0.8	15.8
36.860	36.0	-0.9	16.9
38.906	38.0	-0.9	18.0
40.952	40.0	-1.0	19.1
42.998	42.0	-1.0	20.2
45.044	44.0	-1.0	21.3
47.090	46.0	-1.1	22.4
49.136	48.0	-1.1	23.5
51.182	50.0	-1.2	24.6
53.228	52.0	-1.2	25.7
55.274	54.0	-1.3	26.8
57.320	56.0	-1.3	27.9
59.366	58.0	-1.4	29.0
61.412	60.0	-1.4	30.1
63.458	62.0	-1.5	31.2
65.504	64.0	-1.5	32.3
67.550	66.0	-1.6	33.4
69.596	68.0	-1.6	34.5
71.642	70.0	-1.7	35.6
73.688	72.0	-1.7	36.7
75.734	74.0	-1.8	37.8
77.780	76.0	-1.8	38.9
79.826	78.0	-1.9	40.0
81.872	80.0	-1.9	41.1
83.918	82.0	-1.9	42.2
85.964	84.0	-2.0	43.3
88.010	86.0	-2.0	44.4
90.056	88.0	-2.1	45.5
92.102	90.0	-2.1	46.6
94.148	92.0	-2.2	47.7
96.194	94.0	-2.2	48.8

U_{ref} = 1.1 m/s, Coverage

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

Appendix 1: Calibration Log

NO	Serial	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
2	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
3	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
4	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
5	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
6	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
7	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
8	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
9	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s
10	Flow direction	NOVA	NOVA	Aug 07, 2021	MA-004-01	0 - 31 m/s

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No: WD-00012022
Page 1 of 2 pages

Measurement Item Wind direction sensor with data logger
Manufacturer Data logger: Nivalink
Wind direction sensor: Nivalink
Model/Type Data logger: 200-WS-25LB
Wind direction sensor: WS-02P
Serial Number Data logger: A5191
Wind direction sensor:
ID No Data logger: H001F0309
Wind direction sensor:
Customer A/D laboratory group (Thailand) Co., Ltd.
104 Phrasangprai Rd, Phrasangprai Rd Khwaeng Suan Luang, Bangkhu Bangkok 10250
Thailand

Environmental Condition
The measurement was carried out in an ambient temperature of 26.3±1 °C and relative humidity of 40±10 %

Measurement Method
The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and the laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counter-clockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed.

Traceability
The measurement results are traceable to the international system of units (SI) through Certificate No. QP108014. Certificate No. WD00012022

Measurement Date JAN 26, 2022
Issued Date JAN 31, 2022

Performed by
☒ Mr. Somchai Nualad
☐ Mrs. Orana Wuthakanya



Approved Signatory:
Mr. Panya Boonpradit
Director/Representative Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-00012022
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment
Calibration is in the range of 0 - 360 ° at a calibration interval of 45°
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty (°)
1	Clockwise	0/360	0	1	1	3.0
2		45	45	45	0	3.0
3		90	90	91	1	3.0
4		135	135	134	-1	3.0
5		180	180	179	-1	3.0
6		225	225	225	0	3.0
7	Counter Clockwise	270	270	272	2	3.0
8		315	315	319	4	3.0
9		0/360	0	1	1	3.0
10		45	45	45	0	3.0
11		90	90	91	1	3.0
12		135	135	134	-1	3.0
13	Counter Clockwise	180	180	179	-1	3.0
14		225	225	225	0	3.0
15		270	270	272	2	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-00012022
Page 1 of 2 pages

Measurement Item Cup anemometer with data logger
Manufacturer Data logger: Nivalink
Cup anemometer: Nivalink
Model/Type Data logger: 200-WS-25LB
Cup anemometer: WS-02P
Serial Number Data logger: A5191
Cup anemometer:
ID No Data logger: H001F0309
Cup anemometer:
Customer A/D laboratory group (Thailand) Co., Ltd.
104 Phrasangprai Rd, Phrasangprai Rd Khwaeng Suan Luang, Bangkhu Bangkok 10250
Thailand

Test Conditions
Wind speed in wind tunnel area: 9.50 m/s
Anemometer height: 1.20 m
Relative humidity: 40 %
Relative rate of wind speed: 1/11
Test Conditions
Air temperature: 27.6 ±0.7 °C
Air pressure: 1016.6 ±0.4 hPa
Relative humidity: 55.4 ±0.5 %

Calibration Procedure
Calibration was carried out in the
ISO 9001:2015 Certified Performance Measurement of Accuracy Measuring Wind
Turbines
NIST/ASME International Keyway Procedure - version 2.0.0.0

Traceability
This calibration is traceable to the international standard. While the results of the measurements according to the international system of units (SI) through National Institute of Metrology (NIM) in Thailand.

Measurement Date JAN 26, 2022
Issued Date JAN 31, 2022

Calibrated by
☒ Mr. Somchai Nualad
☐ Mrs. Orana Wuthakanya



Approved Signatory:
Mr. Panya Boonpradit
Director/Representative Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-00012022
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment
Calibration is in the range of 0 - 10 m/s at a calibration interval of 1 m/s
The results of calibration and associated measurement uncertainties are reported in table below.

Vel. Reading m/s	Vel. Reading m/s	Error (m/s)	Uncertainty (m/s)
2.576	2.0	0.5	0.4
4.101	4.1	0.0	1.2
5.99	6.0	0.0	0.65
8.01	8.0	0.0	0.83
10.01	10.1	0.1	0.76
12.01	12.1	0.1	0.57
13.99	14.1	0.1	0.70
15.99	16.4	0.4	2.43
18.01	18.2	0.2	3.70
19.01	19.0	0.0	0.63
21.01	21.0	0.0	0.76
23.01	23.0	0.0	0.61
25.01	25.0	0.0	0.66
26.01	26.0	0.0	1.0
28.01	28.0	0.0	4.0

UUC* Unit Under Calibration
The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor providing a level of confidence of approximately 95%.

Appendix B: Continuation of 1

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pressure	TEDEA HUNTLEIGH	1000-100	Aug 07, 2021	WA-0304291	0 - 35 mPa
2	Pressure Difference	TEDEA HUNTLEIGH	200-10	Aug 07, 2021	WA-0304291	0 - 34 mPa
3	Air velocity	TEDEA HUNTLEIGH	100-10	Aug 08, 2021	WA-0015291	0 - 9 m/s
4	Temperature	TEDEA HUNTLEIGH	200-10	Aug 07, 2021	WA-0304291	0 - 70 °C
5	Relative humidity	TEDEA HUNTLEIGH	200-10	Aug 07, 2021	WA-0304291	0 - 100 %RH
6	Air type & pressure	TEDEA HUNTLEIGH	200-10	Aug 07, 2021	WA-0304291	0 - 100 %RH
7	Wind turbine	TEDEA HUNTLEIGH	1000-100	Aug 07, 2021	WA-0304291	0 - 35 m/s

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No: WC-05012022
Page 1 of 2 pages

Measurement Item: Wind direction sensor with data logger

Manufacturer: Data logger: Notalyx
Wind direction sensor: Notalyx

Model/Type: Data logger: P00-WD-2018
Wind direction sensor: WD-001

Serial Number: Data logger: A5103
Wind direction sensor:

Lot No: Data logger: P00/P00029
Wind direction sensor:

Customer: A/S laboratory group, The and Co., Ltd.
104 Pichayaporn 40, Pathumwan Rd, Phra Pradaeng Sub-town, Pradaeng Sub-town, Bangkok 10140
Thailand

Environmental Condition:
The measurement was carried out in an ambient temperature of (23.0) °C and relative humidity of (40.0) %.

Measurement Method:
The wind direction sensor calibration according to comparison method with reference angle measurement method. Procedure and the factor is used for use. The measurement was taken at 45°. The measurement is clockwise and counter-clockwise directions.

Note: The UUC was warned up for 1 hour prior to the calibration being performed.

Traceability:
The measurement results are related to the International system of units (SI) through Certificate No: 091005346, Certificate for: NAC/050025.

Measurement Date: Jan. 26, 2022
Issued Date: Jan. 31, 2022

Continuation of Certificate of Calibration Number

Certificate No: WD-05012022
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment

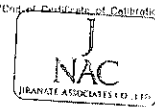
Calibration is in the range of 0 - 360 ° at a calibration interval of 45°

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0-45	0	0	0	3.0
2		45	45	45	2	3.0
3		90	91	90	0	3.0
4		135	135	135	0	3.0
5		180	180	181	1	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0-45	0	0	0	3.0
10		45	45	49	4	3.0
11		90	90	90	0	3.0
12		135	135	135	0	3.0
13		180	180	181	1	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

UUC* UUT Under Calibration. The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor for which a level of confidence of approximately 95%.

End of Certificate of Calibration



Performed by
☒ Mr. Sakdit Thairat
☒ Mr. Chait Wuthanajaya



Approved Signatory:

[Signature]
Mr. Nattaporn Jengwaraewong
Calibration Department Manager

This certificate is valid for the period of 12 months from the date of calibration. The certificate is valid for the period of 12 months from the date of calibration.



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date: 13-Jan-23
Next Cal. Date: 13-Jul-23

Barometric Pressure (mmHg): 760
Relative Humidity (%): 55.0
Temperature (°C): 30.0

Reference Dry Gas Meter Data:
Reference Dry Gas Meter ID: BKK_FS1122
Serial No.: A2003240
Correction Factor (Y): 1.0160
Next Calibration Date: 05/27/23

Console Control Meter Data:
Calibration No.: C-130123-BKK_FS0468
Dry Gas Meter ID: BKK_FS0468
Serial No.: 1302005
Model No.: XC-572-V

ΔH (mm-H ₂ O)	θ	Reference Dry Gas Meter Calibration										Console Control Dry Gas Meter										Dry Gas Meter Correction Factor (Y)	Online Calibration Factor (Avg)	
		W (AS-01)					T ₀					V _m (AS-01)					T ₀							Avg. Im (°C)
		Initial		Total		Final (°C)	Initial		Total		Final (°C)	Initial		Total		Final (°C)	Initial		Total					
		Initial	Total	Initial	Total		Initial	Total	Initial	Total		Initial	Total	Initial	Total		Initial	Total						
15	72.00	150.00	0.00	150.00	32.0	131504.8	131610.0	31.0	31.0	0.9788	31.0	31.0	0.9788	51.4134										
25	91.5	190.00	0.00	190.00	32.0	131600.0	131750.0	32.0	32.0	0.9809	32.0	32.0	0.9809	47.7540										
50	87.3	290.00	0.00	290.00	32.0	132049.6	132154.8	32.0	32.0	0.9788	32.0	32.0	0.9788	48.4021										
80	52.1	390.00	0.00	390.00	32.0	132313.8	132500.0	32.0	32.0	0.9809	32.0	32.0	0.9809	44.5005										
120	4.20	490.00	0.00	490.00	32.0	132577.6	132750.0	32.0	32.0	0.9872	32.0	32.0	0.9872	43.4509										
														40.7474										

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

Avg: Online pressure difference that exceeds to 21.23 in. of air at 75 °C and 760 mm of mercury. min/MCO: Reference for indicated values ± 5.08 from average.

Pressure: 40 CFR 69 APP A METH SEC 5.3 & 7

Calibrated by:

[Signature]
Mr. Sakdit Thairat
Field Scientist (4)

Approved by:

[Signature]
Mr. Nattaporn Jengwaraewong
Field Scientist (1)

Field Scientist (1)

Field Scientist (1)

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Field Scientist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number: BKK_FS0472
Lab test duct Number: 258-1-13-01
Calibration Sheet No: C-130123-BKK_FS0472

Calibration Date: 13 Jan 23
Standard Pitot ID: BKK_FS0441
Cp Standard: 0.99

Type S Pitot Tube Coefficient Data					
Test	Type s pitot tube Leg A B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			Cp	0.842	0.842

$$Cp(S) = Cp = \sqrt{\frac{\Delta P_{tub}}{\Delta P_{(s)}}}$$

$$Cp(A) - Cp(B) \text{ must BE } \leq 0.01$$

$$\text{Average deviation A or B} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by:

[Signature]
Mr. Sakdit Thairat
Field Scientist (4)

Approved by:

[Signature]
Mr. Nattaporn Jengwaraewong
Specialist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0473 Calibration Date 13 Jan 23
Lab test duct Number 256-1-13-01 Standard Pitot ID BKK_FS0441
Calibration Sheet No. C-130123-BKK_FS0473 Cp Standard 0.99

Type S Pitot Tube Coefficient Data

	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
\bar{C}_p				0.842	0.842

$$Cp(s) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P}}$$

$$[Cp(A) - Cp(B)] \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
Field Scientist (4)

Approved by Nattapon Jengwareepong
(Mr. Nattapon Jengwareepong)
Specialist (1)

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



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date	13 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-130123-BKK_FS0469	Relative Humidity (%)	55
Digital Temperature ID :	BKK_FS0469	Reference Temperature ID	BKK_FS0609
Serial No	1302065	Serial No	7686004
Model	XC-572-V	Model	FLUKE714
		Next Calibrate	25 Jul 23

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
	250	249	-1	±3	Pass
	300	298	-2	±3	Pass
	500	498	-2	±3	Pass
	Probe	100	99	-1	±3
120		119	-1	±3	Pass
140		139	-1	±3	Pass
Oven		100	99	-1	±3
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
	Filter	100	99	-1	±3
120		119	-1	±3	Pass
140		139	-1	±3	Pass
Exit		0	0	0	±3
	10	9	-1	±3	Pass
	20	19	-1	±3	Pass
	Meter	0	0	0	±3
25		24	-1	±3	Pass
50		49	-1	±3	Pass
AUX		0	2	2	±3
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดจากการวัด

Calibrated by Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
Field Scientist (4)

Approved by Nattapon Jengwareepong
(Mr. Nattapon Jengwareepong)
Specialist (1)

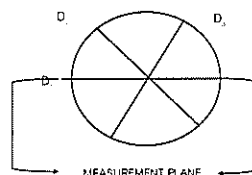
FORM NO. F-06-027 REVISION NO. 2 ISSUE DATE 9 Feb 23



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	13 Jan 23			Nozzle Set ID	BKK_FS0474
Calibration Sheet No	C-130123-BKK_FS0474			Vernier Caliper ID	BKK_FS1123
Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo	(D ₁ + D ₂ + D ₃) / 3
	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.301	0.299	0.303	0.004	0.301
2	0.450	0.450	0.450	0.000	0.450
3	0.599	0.602	0.601	0.003	0.601
4	0.779	0.780	0.779	0.001	0.779
5	0.931	0.932	0.932	0.001	0.932
6	1.094	1.092	1.094	0.002	1.093
7	1.264	1.263	1.264	0.001	1.264
8	1.599	1.601	1.600	0.002	1.600

Where
D₁, D₂, D₃ : There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm
ΔD : Maximum distance between any two diameters must be ≤ 0.100 mm
D_{avg} : (D₁ + D₂ + D₃) / 3



Calibrated by Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
Field Scientist (4)

Approved by Nattapon Jengwareepong
(Mr. Nattapon Jengwareepong)
Field Specialist (1)

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



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mmHg) 760
Relative Humidity (%) 55.0
Temperature (°C) 30.0
Reference Dry Gas Meter Data
Reference Dry Gas Meter ID BKK_FS1122
Serial No. A2003240
Correction Factor (Y) 1.0160
Next Calibration Date 05/27/23

Calibration of Date 13-Jan-23
Next Cal. Date 13-Jul-23
Console Control Meter Data
Calibration No. C-130123-RYG_FS0315
Dry Gas Meter ID RYG_FS0315
Serial No. 1706091
Model No. XC-572-V

ΔH	G	Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter						Dry Gas Meter Correction Factor	On-line Calibration Factor
		V ₁ (L/min)		T ₁ (°C)		V ₂ (L/min)		T ₂ (°C)		Avg. T ₂ (°C)			
		Final	Initial	Final	Initial	Final	Initial	Final	Initial				
15	12.16	150.00	0.00	35.0	165.00	165.00	165.00	34.0	34.0	34.0	1.0432	46.118	
25	9.33	150.00	0.00	35.0	165.00	165.00	165.00	35.0	35.0	35.0	1.0471	45.163	
50	6.61	150.00	0.00	35.0	165.00	165.00	165.00	36.0	36.0	36.0	1.0479	45.435	
80	5.20	150.00	0.00	35.0	165.00	165.00	165.00	36.0	36.0	36.0	1.0463	44.912	
120	4.21	150.00	0.00	37.0	169.00	169.00	169.00	37.0	37.0	37.0	1.0452	44.319	
											1.0451	44.924	

Y Ratio of reading of reference to dry gas meter tolerance for individual values ± 0.02 from average.
Avg Console pressure differential that equals to 21.24 in at 25°C and 760 mm of mercury. max470 tolerance for individual values ± 5.00 from average.

Procedure: 40 CFR 160.10 APP A METH SEC 5.3 & 7

Calibrated by Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
Field Scientist (4)

Approved by Nattapon Jengwareepong
(Mr. Nattapon Jengwareepong)
Field Specialist (1)

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



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 13/01/23		Ambient Temperature (°C) : 30		
Calibration sheet No : C-130123-RYG_FS0316		Relative Humidity (%) : 65		
Digital Temperature ID : RYG_FS0316		Reference Temperature ID : BKK_FS0609		
Console Serial No : 1706091		Serial No : 7688004		
Model : XC-572-V		Model : FLUKE 714		
Last Calibrate : 1/25/22				

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	1	1	
	25	26	1	
	50	51	1	
	100	101	1	
	150	151	1	
	200	201	1	
	250	251	1	
	300	301	1	
	500	501	1	
	1000	1001	1	
1200	1201	1		
Probe	100	101	1	
	120	121	1	
	140	141	1	
	160	161	1	
Filter	100	101	1	
	120	121	1	
	140	141	1	
	160	161	1	
Exit	0	1	1	
	10	11	1	
	20	21	1	
	30	31	1	
Meter	0	1	1	
	25	26	1	
	50	51	1	
	100	101	1	
AUX	0	1	1	
	25	26	1	
	50	51	1	
	100	101	1	

Calibrated by Saksit Phrasanphut
 (Mr Saksit Phrasanphut)
 Field Scientist (4)

Approved by Nattapon Jengwareewong
 (Mr Nattapol Jengwareewong)
 Specialist (1)

FORM NO. F-06-028 RETIRED NO. 4 DATE DATE 30 Jan 22

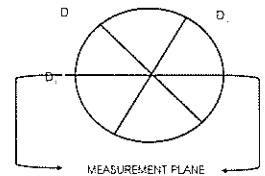


PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 13 Jan 23		Nozzle Set ID : RYG_FS0319	
Calibration Sheet No : C-130123-RYG_FS0319		Vernier Caliper ID : BKK_FS1123	

Nozzle ID #	Nozzle Diameter (mm)			Hi - Lo ΔD	D ₁ - D ₂ - D ₃
	D ₁	D ₂	D ₃		
1	0.300	0.300	0.300	0.000	0.300
2	0.470	0.465	0.465	0.005	0.467
3	0.600	0.600	0.600	0.000	0.600
4	0.770	0.760	0.765	0.015	0.762
5	0.920	0.930	0.930	0.010	0.927
6	1.080	1.080	1.085	0.005	1.082
7	1.240	1.230	1.235	0.010	1.235
8	1.594	1.598	1.597	0.004	1.596

Where
 D₁, D₂, D₃ : Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm
 ΔD : Maximum distance between any two diameters, must be < 0.100 mm
 |D₁ - D₂ - D₃| : |D₁ + D₂ - D₃|



Calibrated by Saksit Phrasanphut
 (Mr Saksit Phrasanphut)
 Field Scientist (4)

Approved by Nattapon Jengwareewong
 (Mr Nattapol Jengwareewong)
 Field Specialist (1)

FORM NO. F-06-028 RETIRED NO. 4 DATE DATE 30 Jan 22



Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG_FS0320
 Lab test duct Number : 25B-1-13-01
 Calibration Sheet No : C-130123-RYG_FS0320

Calibration Date : 13 Jan 23
 Standard Pitot ID : BKK_FS0441
 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A/B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			\bar{C}_p	0.842	0.842

$$Cp(s) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P}} \quad \left[\bar{C}_{p(A)} - \bar{C}_{p(B)} \right] \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by Saksit Phrasanphut
 (Mr Saksit Phrasanphut)
 Field Scientist (4)

Approved by Nattapon Jengwareewong
 (Mr Nattapol Jengwareewong)
 Specialist (1)

FORM NO. F-06-028 RETIRED NO. 4 DATE DATE 30 Jan 22



Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG_FS0321
 Lab test duct Number : 25B-1-13-01
 Calibration Sheet No : C-130123-RYG_FS0321

Calibration Date : 13 Jan 23
 Standard Pitot ID : BKK_FS0441
 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A/B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			\bar{C}_p	0.842	0.842

$$Cp(s) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P}} \quad \left[\bar{C}_{p(A)} - \bar{C}_{p(B)} \right] \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by Saksit Phrasanphut
 (Mr Saksit Phrasanphut)
 Field Scientist (4)

Approved by Nattapon Jengwareewong
 (Mr Nattapol Jengwareewong)
 Specialist (1)

FORM NO. F-06-028 RETIRED NO. 4 DATE DATE 30 Jan 22

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2543 8351-5, e-mail : service.thailand@sartorius.com



SARTORIUS

REVIEW BY *Thaichai*
APPROVED BY *D. Chonchai*
NEXT CAL DATE 01/03/24

Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCD115
Description : Analytical Balance Issued Date : Friday, March 03, 2023
Serial Number : 0031709552 Reference No. : 204833
ID No. : RYG_EN0003
Manufacturer : Sartorius 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 Intihana
Calibration Date : Wednesday, March 01, 2023
Calibration Procedure No. : This calibration was conducted by
Using in-house calibration procedure number (N1-003)
Based on UKAS LAB 14 : 2019

Metrological data :
Capacity 220 g Readability : 0.0001 g
Ambient Conditions :
Temperature : 23.0 °C ± 5.0 °C
Humidity : 56.0 % RH ± 10.0 % RH
Pressure : ±
Reasons for calibration :
☐ New Installation ☐ Service / Required ☒ Re-calibration / Maintenance
Equipment Condition : ☒ Good Operate ☐ Fair

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Bareneter/Temp. Lyvon MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Mr. Chonchai Intihana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2543 8351-5 Fax : +66 2543 8357, e-mail : service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCD115
Description : Analytical Balance Issued Date : Friday, March 03, 2023
Serial Number : 0031709552 Reference No. : 204833
ID No. : RYG_EN0003
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the readout of the load (i.e. 1/3 or 1/4 of maximum capacity) placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).		
Nominal Value (Low Load)	20.0000 g	200.0000 g	Nominal value	100 g	
Tolerance	0.0001 g	0.0005 g	Tolerance	0.0004 g	
Nominal Value (High Load)	200 g	200.0000 g			Difference
Tolerance	0.0001 g	0.0005 g			1 -
					2 0.0001
					3 0.0000
					4 0.0000
					5 0.0001
					6 -
Standard Deviation	0.00004	0.00005			

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.05	0.0500	0.0500	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	200.0001	0.0001	0.00032

End of Report

End of Report

SOP FM 33 03 February 2022



Lot No. 2345645-1

ANALYZER CALIBRATION DATA

Client : Gulf T84 Co., Ltd. Location : Uthai HRSG #11
Date : 18 May 23 Test Operator : Sakitt P.

O₂ ANALYZER : TELEDYNE API 200EH Serial No. : 774
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.04
Low-Level Gas	7.93	7.91	7.92	0.04
Span Gas	15.00	15.98	15.99	0.04

NO_x ANALYZER : TELEDYNE API 200EH Serial No. : 774
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	0.00	0.01
Low-Level Gas	50.41	51.39	51.41	0.01
Span Gas	80.27	80.25	80.27	0.01

SO₂ ANALYZER : TELEDYNE API 100EH Serial No. : 437
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.04	0.00	0.04
Low-Level Gas	51.61	51.57	51.51	0.04
Span Gas	79.00	78.98	79.00	0.04

CO ANALYZER : TELEDYNE API 300EH Serial No. : 451
Span (ppm) : 5000

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.00
Low-Level Gas	50.31	50.29	50.30	0.00
Span Gas	80.53	80.51	80.52	0.00

Calibrated by

Sakitt P.

(Mr. Sakitt Phalaphant)

Environmental Field Scientist (4)

FORM NO. F-06-002 REVISION NO. 2 ISSUE DATE: 306/19

ALS Laboratory Group



Lot No. 2345645-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T84 Co., Ltd. Location : Uthai HRSG #11
Date : 18 May 23 Test Operator : Sakitt P.

O₂ ANALYZER : 18.00 Span (%) : 25

	O ₂ Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	-0.01	0.04	0.04
Upscale Gas	15.98	15.98	0.00	15.99	0.04	0.04

NO_x ANALYZER : 80.27 Span (ppm) : 200

	NO _x Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	0.00	0.01	0.01
Upscale Gas	80.25	80.25	0.00	80.27	0.01	0.01

SO₂ ANALYZER : 79.00 Span (ppm) : 100

	SO ₂ Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.04	-0.04	0.00	0.00	0.04	0.04
Upscale Gas	78.98	78.98	0.00	79.00	0.04	0.04

CO ANALYZER : 80.53 Span (ppm) : 5000

	CO Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	-0.01	0.00	0.00
Upscale Gas	80.51	80.51	0.00	80.52	0.00	0.00

Calibrated by

Sakitt P.

(Mr. Sakitt Phalaphant)

Environmental Field Scientist (4)

FORM NO. F-06-002 REVISION NO. 2 ISSUE DATE: 306/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&B Co., Ltd.	Run #	1
Date	18 May 23	Location	Unit HRSG #11
Start Time	12:06	Test Operator	Sakot P.
SO _x Analyzer Model	TELEDYNE API 100EH	Finish Time	12:28
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:05	14.12	3.82	15.60	0.12	1.61	
12:06	14.10	3.83	15.66	0.12	1.62	
12:07	14.11	3.82	15.71	0.12	1.65	
12:08	14.11	3.82	15.66	0.11	1.67	
12:09	14.10	3.83	15.42	0.12	1.60	
12:10	14.12	3.83	15.43	0.11	1.52	
12:11	14.11	3.83	15.56	0.09	1.55	
12:12	14.09	3.83	15.49	0.08	1.52	
12:13	14.07	3.84	15.29	0.09	1.52	
12:14	14.10	3.84	15.51	0.08	1.55	
12:15	14.13	3.82	15.89	0.07	1.43	
12:16	14.12	3.82	15.69	0.06	1.45	
12:17	14.12	3.82	15.55	0.10	1.48	
12:18	14.12	3.82	15.51	0.09	1.42	
12:19	14.11	3.83	15.26	0.08	1.42	
12:20	14.10	3.84	15.26	0.07	1.41	
12:21	14.13	3.84	15.34	0.08	1.38	
12:22	14.11	3.82	15.44	0.12	1.37	
12:23	14.11	3.83	15.42	0.14	1.41	
12:24	14.11	3.83	15.38	0.13	1.42	
12:25	14.12	3.82	15.36	0.15	1.37	
Average	14.11	3.82	15.48	0.10	1.40	

Sakot P

(Mr. Sakot Phaisangphat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&B Co., Ltd.	Run #	2
Date	18 May 23	Location	Unit HRSG #11
Start Time	12:28	Test Operator	Sakot P.
SO _x Analyzer Model	TELEDYNE API 100EH	Finish Time	12:48
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:26	14.11	3.83	15.35	0.20	1.44	
12:27	14.10	3.84	15.18	0.20	1.38	
12:28	14.11	3.84	15.09	0.19	1.32	
12:29	14.11	3.83	15.20	0.19	1.30	
12:30	14.10	3.83	15.58	0.18	1.32	
12:31	14.14	3.82	15.69	0.19	1.31	
12:32	14.11	3.85	15.46	0.16	1.22	
12:33	14.11	3.85	15.12	0.15	1.31	
12:34	14.11	3.85	15.13	0.16	1.24	
12:35	14.12	3.84	15.20	0.15	1.29	
12:36	14.12	3.84	15.62	0.16	1.44	
12:37	14.13	3.84	15.51	0.15	1.38	
12:38	14.12	3.84	15.95	0.14	1.36	
12:39	14.14	3.82	15.82	0.14	1.26	
12:40	14.13	3.83	15.79	0.14	1.28	
12:41	14.11	3.85	15.27	0.12	1.26	
12:42	14.11	3.85	15.24	0.12	1.25	
12:43	14.14	3.85	15.23	0.12	1.16	
12:44	14.12	3.84	15.35	0.09	1.17	
12:45	14.09	3.85	14.81	0.09	1.16	
12:46	14.10	3.86	14.66	0.09	1.15	
Average	14.11	3.84	15.34	0.16	1.28	

Sakot P

(Mr. Sakot Phaisangphat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&B Co., Ltd.	Run #	3
Date	18 May 23	Location	Unit HRSG #11
Start Time	12:47	Test Operator	Sakot P.
SO _x Analyzer Model	TELEDYNE API 100EH	Finish Time	13:07
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:47	14.10	3.86	14.84	0.09	1.12	
12:48	14.11	3.86	15.03	0.08	1.15	
12:49	14.11	3.86	15.12	0.07	1.15	
12:50	14.12	3.85	15.16	0.07	1.12	
12:51	14.14	3.84	15.33	0.10	1.12	
12:52	14.13	3.84	15.43	0.09	1.16	
12:53	14.12	3.84	15.50	0.11	1.21	
12:54	14.12	3.85	15.45	0.12	1.20	
12:55	14.12	3.85	15.50	0.15	1.22	
12:56	14.14	3.83	15.22	0.23	1.19	
12:57	14.12	3.84	15.18	0.22	1.23	
12:58	14.12	3.85	15.20	0.21	1.14	
12:59	14.14	3.85	15.51	0.21	1.20	
13:00	14.15	3.85	15.81	0.19	1.10	
13:01	14.14	3.85	15.53	0.20	1.20	
13:02	14.14	3.84	15.43	0.18	1.17	
13:03	14.15	3.85	15.33	0.18	1.14	
13:04	14.13	3.85	15.30	0.17	1.13	
13:05	14.13	3.85	15.23	0.16	1.07	
13:06	14.12	3.85	15.11	0.16	1.05	
13:07	14.13	3.85	14.93	0.17	1.20	
Average	14.12	3.84	15.28	0.15	1.16	

Sakot P

(Mr. Sakot Phaisangphat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



ANALYZER CALIBRATION DATA

Client	Gulf T&B Co., Ltd.	Location	Unit HRSG #12
Date	18 May 23	Test Operator	Anurat M.
O ₂ ANALYZER			
Model	TELEDYNE API 200EH	Serial No.	735
Span (%)	25		

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.11	0.12	0.04
Low-Level Gas	7.55	7.88	8.00	0.45
Span Gas	16.04	16.00	15.99	0.04

NO _x ANALYZER			
Model	TELEDYNE API 200EH	Serial No.	735
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.09	0.07	0.02
Low-Level Gas	54.64	55.77	55.88	0.11
Span Gas	79.42	80.33	80.09	0.33

CO ₂ ANALYZER			
Model	TELEDYNE API 100EH	Serial No.	410
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.17	0.11	0.06
Low-Level Gas	54.34	55.34	56.11	0.77
Span Gas	80.22	80.44	80.00	0.44

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.13	0.12	0.01
Low-Level Gas	54.42	54.33	53.76	0.57
Span Gas	80.16	80.22	79.65	0.57

Calibrated by

Anurat M

(Mr. Anurat Moungpat)

Environmental Field Scientist (2)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



Lot No. 2345651-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&B Co., Ltd. Location : Ulaei HRSG12
Date : 18 May 23 Test Operator : Anuratt M.

O₂ ANALYZER : 18.04 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	0.11	0.05	0.12	0.05	0.44	0.32
Upscale Gas	16.00	15.77	0.32	16.00	0.00	0.52

NO₂ ANALYZER : 79.42 Span (ppm) : 100
Cylinder Conc. (ppm)

	NO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.09	0.11	0.02	0.00	0.09	0.11
Upscale Gas	80.33	80.55	0.22	80.00	0.33	0.55

SO₂ ANALYZER : 80.22 Span (ppm) : 100
Cylinder Conc. (ppm)

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.17	0.10	0.07	0.11	0.06	0.01
Upscale Gas	80.44	80.44	0.00	80.33	0.11	0.11

CO ANALYZER : 80.18 Span (ppm) : 100
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	0.13	0.13	0.00	0.11	0.02	0.02
Upscale Gas	80.22	80.00	0.22	79.44	0.78	0.56

Calibrated by

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

FORM NO. F-06-062 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&B Co., Ltd. Run # : 1
Date : 18 May 23 Location : Ulaei HRSG12
Start Time : 10:40 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:00
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 410
CO/CO₂ Analyzer Model : TELEDYNE API 300EH Serial No. : 735
Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:40	14.15	3.92	10.96	0.76	1.49	
10:41	14.20	3.95	10.91	0.77	1.53	
10:42	14.20	3.92	11.04	0.77	1.51	
10:43	14.17	3.95	11.09	0.77	1.51	
10:44	14.16	3.93	10.93	0.76	1.49	
10:45	14.21	3.89	11.24	0.79	1.46	
10:46	14.21	3.90	11.29	0.81	1.50	
10:47	14.20	3.90	11.25	0.81	1.48	
10:48	14.20	3.91	11.24	0.78	1.52	
10:49	14.19	3.85	11.17	0.81	1.44	
10:50	14.19	3.93	10.96	0.81	1.50	
10:51	14.20	3.93	10.91	0.80	1.48	
10:52	14.20	3.97	11.04	0.84	1.46	
10:53	14.17	3.94	11.09	0.84	1.45	
10:54	14.16	3.94	10.93	0.83	1.45	
10:55	14.18	3.92	10.72	0.83	1.49	
10:56	14.15	3.95	10.99	0.86	1.47	
10:57	14.17	3.92	10.89	0.84	1.51	
10:58	14.19	3.97	10.80	0.86	1.48	
10:59	14.22	3.93	11.03	0.87	1.51	
11:00	14.15	3.94	11.23	0.86	1.50	
Average	14.18	3.93	11.02	0.82	1.48	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

FORM NO. F-06-062 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&B Co., Ltd. Run # : 2
Date : 18 May 23 Location : Ulaei HRSG12
Start Time : 11:21 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:42
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 735
CO/CO₂ Analyzer Model : TELEDYNE API 300EH Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:01	14.17	3.95	11.07	0.89	1.50	
11:02	14.18	3.95	10.89	0.90	1.49	
11:03	14.18	3.92	10.87	0.76	1.50	
11:04	14.17	3.99	10.97	0.77	1.49	
11:05	14.16	3.94	10.97	0.77	1.53	
11:06	14.18	3.95	10.85	0.77	1.44	
11:07	14.17	3.92	10.77	0.76	1.50	
11:08	14.17	3.89	10.82	0.79	1.51	
11:09	14.15	3.93	10.89	0.81	1.50	
11:10	14.18	3.91	10.76	0.81	1.51	
11:11	14.18	3.98	10.75	0.78	1.49	
11:12	14.20	3.87	10.84	0.81	1.52	
11:13	14.19	3.93	11.03	0.81	1.45	
11:14	14.19	3.91	11.30	0.80	1.50	
11:15	14.20	3.89	11.23	0.84	1.52	
11:16	14.20	3.89	11.21	0.84	1.50	
11:17	14.21	3.89	11.33	0.83	1.49	
11:18	14.19	3.92	11.29	0.83	1.49	
11:19	14.20	3.90	11.14	0.85	1.53	
11:20	14.20	3.94	11.13	0.84	1.51	
11:21	14.20	3.91	11.14	0.85	1.48	
Average	14.18	3.92	11.01	0.82	1.50	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

FORM NO. F-06-062 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&B Co., Ltd. Run # : 3
Date : 18 May 23 Location : Ulaei HRSG12
Start Time : 11:22 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:42
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 735
CO/CO₂ Analyzer Model : TELEDYNE API 300EH Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:22	14.20	3.94	11.11	0.87	1.49	
11:23	14.20	3.93	11.17	0.86	1.49	
11:24	14.22	3.93	11.21	0.89	1.51	
11:25	14.20	3.92	11.31	0.90	1.48	
11:26	14.19	3.93	11.31	0.76	1.47	
11:27	14.17	3.92	11.19	0.77	1.50	
11:28	14.19	3.98	11.07	0.77	1.49	
11:29	14.19	3.89	11.10	0.77	1.47	
11:30	14.20	3.93	11.18	0.78	1.50	
11:31	14.19	3.94	11.29	0.79	1.51	
11:32	14.20	3.89	11.19	0.81	1.47	
11:33	14.20	3.94	11.16	0.81	1.47	
11:34	14.19	3.92	11.21	0.78	1.47	
11:35	14.19	3.95	11.24	0.81	1.47	
11:36	14.22	3.88	11.20	0.81	1.50	
11:37	14.20	3.83	11.27	0.80	1.50	
11:38	14.19	3.95	11.29	0.84	1.49	
11:39	14.22	3.93	11.29	0.84	1.47	
11:40	14.20	3.92	11.45	0.83	1.43	
11:41	14.20	3.92	11.42	0.83	1.48	
11:42	14.20	3.97	11.34	0.86	1.49	
Average	14.20	3.93	11.24	0.82	1.48	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

FORM NO. F-06-062 REVISION NO. 2 ISSUE DATE 3/06/19

ALS Laboratory Group

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N100E15A0440 Reference Number: 160-401977167-1
Cylinder Number: EB0140237 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Dec 23, 2020

Expiration Date: Dec 23, 2028

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)

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	79.42 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
CARBON MONOXIDE	80.00 PPM	80.16 PPM	G1	+/- 0.5% NIST Traceable	12/14/2020
NITRIC OXIDE	80.00 PPM	79.41 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
SULFUR DIOXIDE	80.00 PPM	80.22 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
NITROGEN	Balance				

Type	Lot ID	Cylinder No	CALIBRATION STANDARDS Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12305	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	EB0079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124206859	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Dec 10, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Dec 16, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Dec 02, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Dec 02, 2020

Triad Data Available Upon Request

NOTES:

Gross Weight: 27.8 Kg
Net Weight: 4.7 Kg



Michael A. Huber
Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N100E15A0440 Reference Number: 62-401213105-1
Cylinder Number: HD33033 Cylinder Volume: 247.2 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2215 PSIG
PGVP Number: 082018 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 28, 2018

Expiration Date: Feb 28, 2028

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)

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.41 PPM	G1	+/- 0.5% NIST Traceable	02/16/2018, 02/20/2018
CARBON MONOXIDE	80.00 PPM	80.31 PPM	G1	+/- 0.5% NIST Traceable	02/16/2018
NITRIC OXIDE	80.00 PPM	80.31 PPM	G1	+/- 0.5% NIST Traceable	02/16/2018, 02/20/2018
SULFUR DIOXIDE	80.00 PPM	81.81 PPM	G1	+/- 1.2% NIST Traceable	02/16/2018, 02/20/2018
NITROGEN	Balance				

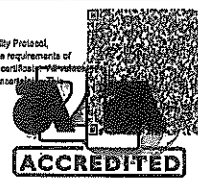
Type	Lot ID	Cylinder No	CALIBRATION STANDARDS Concentration	Uncertainty	Expiration Date
NTRM	14060759	CC414533	45.83 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Feb 23, 2020
PRM	12307	APEX100237	9.93 PPM NITROGEN DIOXIDE/AIR	+/- 0.2%	Jun 03, 2017
NTRM	16022607	CC414534	85.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.2%	Jun 03, 2020
GMIS	031821604	CC323155	4.878 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.4%	Mar 15, 2019
NTRM	16010203	CC473218	48.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 07, 2023

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP1100391 CO	FTIR	Feb 16, 2019
Nicolet iS50 FTIR AUP1100391 NO	FTIR	Feb 16, 2019
Nicolet iS50 FTIR AUP1100391 NO2	FTIR	Feb 16, 2019
Nicolet iS50 FTIR AUP1100391 SO2	FTIR	Feb 05, 2019

Triad Data Available Upon Request

NOTES:

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-820R-12-031. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All concentrations 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 AS

Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N100E15A0664 Reference Number: 160-401907846-1
Cylinder Number: EB0136209 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Oct 06, 2020

Expiration Date: Oct 06, 2028

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)

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.54 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
CARBON MONOXIDE	55.00 PPM	54.42 PPM	G1	+/- 0.8% NIST Traceable	09/29/2020
NITRIC OXIDE	55.00 PPM	54.54 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	55.00 PPM	54.54 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
NITROGEN	Balance				

Type	Lot ID	Cylinder No	CALIBRATION STANDARDS Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12305	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	EB0079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124206859	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 18, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg. Net Weight: 4.6 Kg.



Michael A. Huber
Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N100E15A0440 Reference Number: 160-401907847-1
Cylinder Number: EB0137377 Cylinder Volume: 144.4 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Oct 06, 2020

Expiration Date: Oct 06, 2028

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)

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.27 PPM	G1	+/- 1.4% NIST Traceable	09/29/2020, 10/06/2020
CARBON MONOXIDE	80.00 PPM	80.53 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020
NITRIC OXIDE	80.00 PPM	80.27 PPM	G1	+/- 1.4% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	80.00 PPM	79.00 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
NITROGEN	Balance				

Type	Lot ID	Cylinder No	CALIBRATION STANDARDS Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12305	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	EB0079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124206859	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	07080227	EB0079116	100.6 PPM NITROGEN	+/- 1.0%	Jul 23, 2023
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 18, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg. Net Weight: 4.6 Kg.



Michael A. Huber
Approved for Release

Page 1 of 160-401907847-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N182E3HA0000
Cylinder Number: GND027033
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: O2,BALN
Reference Number: 160-402340009-1
Cylinder Volume: 248.4 CF
Cylinder Pressure: 2214 PSIG
Valve Outlet: 590
Certification Date: Feb 10, 2022
Expiration Date: Feb 10, 2030

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	7.976 %	G1	+/- 0.4% NIST Traceable	02/10/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010035	K022176	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Jan 27, 2022		

Tried Data Available Upon Request
NOTES: Gross Weight: 48.3 Kg
Net Weight: 8.1 Kg



Approved for Release

Page 1 of 160-402340009-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001
Cylinder Number: GND027201
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: O2,BALN
Reference Number: 160-402340010-1
Cylinder Volume: 249.8 CF
Cylinder Pressure: 2214 PSIG
Valve Outlet: 590
Certification Date: Feb 02, 2022
Expiration Date: Feb 02, 2030

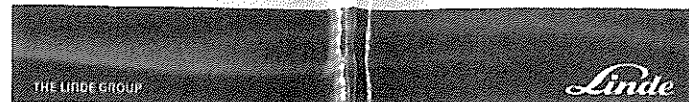
ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.04 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010230	K005228	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Jan 27, 2022		

Tried Data Available Upon Request
NOTES: Gross Weight: 48.8 Kg
Net Weight: 8.2 Kg



Approved for Release

Page 1 of 160-402340010-1

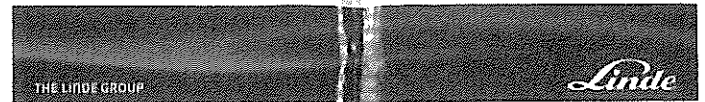


CERTIFICATE OF ANALYSIS

Customer Details:	
ALS Laboratory Group (Thailand)	
Cylinder Description: Steel 47 L	
The measurement of this reference material is traceable to SI units. The Assay of this standard has been performed in accordance with the EPA Traceability Protocol (EPA 821-R-12-013) for the assay and certification of Gaseous Calibration Standards using gravimetric calibration. The reported uncertainty is based on a standard uncertainty of approximately 0.3%.	
Certificate Number: 467615	
Cylinder Number: 550730	
Nominal Cylinder Content: 6.520 M ³	
Nominal Pressure: 145.0 Bar	
Valve Outlet: CGA 590 BRASS	
Comment:	
<ul style="list-style-type: none"> It is recommended that this product be not used below 4% of actual contents or should not be used when its gas pressure is below 1.5 MPa. Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component. Keep and use in well-ventilated and secure area. 	

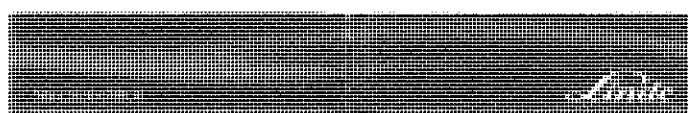
Production Order Number: 90132928
Material Number: 478100-J-44
Certification Date: 20-Jan-2016
Expiry Date: 20-Jan-2024

Analyst:
THIRAT LOYPAT
Approve:
SIEMENS OXYMAT 6
To Re-Order Please Quote:
478100-J-44



CERTIFICATE OF ANALYSIS

Analytical Result					
Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen	8.00 %	7.93 %	± 1% relative	(2) 1-PB-354	20-Jan-2015
In Nitrogen					
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen	24362SSG	25.08 ± 0.13 %	19-Aug-2017		
In Nitrogen					
Analytical Instruments used in Assay					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Servomex 4100 O2 Analyzer	Paramagnetic		23-Dec-2015		
Method of Analysis:					
1 Gas Chromatograph					
2 Paramagnetic Oxygen Analyzer					
3 Electrochemical Oxygen Analyzer					
4 Electrochemical Moisture Analyzer					
5 Total Hydrocarbon Analyzer					
6 Other specified					
Cylinder Number: S50730			Certification Date: 20-Jan-2016		
Production Order Number: 90132928			Expiration Date: 20-Jan-2014		



CERTIFICATE OF ANALYSIS

CERTIFICATE OF ANALYSIS					
Analytical Result					
Component	Requirer Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	16.0 %	16.0 %	+/- 1% relative	(2) I-PB-354	24-Sep-2016
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen in Nitrogen	243625SG	25.88 ± 0.13 %	19-Aug-2017		
Analytical Instruments used in Assay					
Instrument Make/Model	Analytical Principle	Last Multipoint Calibration			
Servomex 4100 O2 Analyzer	Paramagnetic	24-Sep-2016			
Method of Analysis 1 Gas Chromatograph 2 Paramagnetic Oxygen Analyzer 3 Electrochemical Oxygen Analyzer 4 Electrochemical Moisture Analyzer 5 Total Hydrocarbon Analyzer 6 Other specified					
Cylinder Number:363075 Production Order Number:90137389		Certification Date:24-Sep-2016 Expiration Date:24-Sep-2024			

Page 2 of 2

Linde (Thailand) Public Company Limited
P.O. Box 10000 Bangkok 10100
"S" Floor, Bangna Tower A, 2/3 Moo 14, Bangna Freo Km. 6 S Road, Bangkok
Bangkok, Samutprakarn 10540. Tel (66) 2354-6100 Fax (66) 2338-6133
Westgate Plant 105 Moo 9, T.Bangpakong, A.Bangpakong, Charoenngao 24100
Thailand. Tel (66) 34 570-6799 Fax (66) 34 570-2323

[illegible]

Linde (Thailand) Public Company Limited
 15th Floor, Bangkok Tower A, 2/3 Moo 14, Bangna 116 Km. 4.5 Road, Bangkok
 Bangkok, Samprakan 10548, Tel (66) 2318-6100 Fax (66) 2312-6539
 Wellpore Plant 101 Moo 5, Bangsamlak, A Bangkok, Chachoengsao 24120
 Thailand Tel (66) 38 572 419 Fax (66) 38 572 313

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY



NSC-TISI-TL 17025
CALIBRATION QMS

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :
This equipment was calibrated by based on IEC-60942-2003 Standard.
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	EA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA	34560495	EA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744R6069	EH-0010-22	07-Feb-23

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 :

3.2 Thailand Institute of Scientific and Technological Research (TISTR)

Approved by :

Nethakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

QI-TS12-04-04-020/64

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

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

End of Calibration Certificate

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



Cert. No. : ACL22194
Pages : 1 of 8

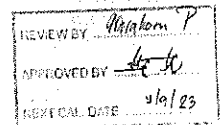
Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RUON
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597168 / 179117 / 87524
ID No.: RYQ_FS0438

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 : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022



Calibrated by : Nathakorn Pisutpaian

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

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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Exp. Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP, 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-DP, 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-DP, 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	18.1
Flat	23.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.7	1.8	1.8	±5.0

QF-TS12-04-04-020664

T. Peth.

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	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	0.1	±2.0
4000	0.1	0.1	0.1	±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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

T. Peth.

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
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	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

T. Peth.

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
SEL	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

QF-TS12-04-04-020664

T. Peth.

Continuation of Calibration Certificate

Cert. No. : ACL22194
Job No. : VC65AC0081
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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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



Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 1 of 8

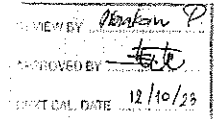
Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623388 / 198635 / 26416
ID No.: -

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 28 SEPTEMBER 2022
Calibration Date : 12-17 OCTOBER 2022
Date of Issue : 18 OCTOBER 2022



Calibrated by : Nadhakorn Pisutpaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

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other than in full, except with the prior written approval of the head of Calibration Laboratory.

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Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.4
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	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.8	0.9	0.9	±5.0

QF-TS12-04-04-020664

r A.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	93.9	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	93.9	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

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

QF-TS12-04-04-020664

r A.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
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	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-04-020664

r B.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

QF-TS12-04-04-020664

r B.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

451-451/1 Sirinhor Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 2435-8800 Fax: 2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23041
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734221 / 145286 / 34371
ID No.: RVG_FS0027

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nuthakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced
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Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
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

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Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	13.4
C - weight	19.6
Flat	25.5

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.5	1.6	1.6	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	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 of 1 kHz

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

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	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. : ACL23041
Job No. : VC66AC0024
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	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	24.8	-0.2	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
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
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
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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Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload Indication

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

12. High level stability

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

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

End of Calibration Certificate

451-451/1 Sirinthorn Rd, Bangumru, Bangplud Bangkok 10700 THAILAND.
Tel:0-2435-8900 Fax:0-2433-1679 e-mail:center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23077
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00233184 / 144837 / 23232
ID No.: RVG_FS0025

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchursi)

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Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
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

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Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
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Result of calibration:

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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	17.1
Flat	22.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.8	±5.0

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	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	0.1	±2.0
4000	0.0	0.1	0.1	±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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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T. Petch

Continuation of Calibration Certificate

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7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23077
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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, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	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	-
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	132.9	-0.1	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23077
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Pages : 8 of 8

11. Overload indication

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

451-451/1 Sindhorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-0800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACC22023
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178123
ID No. : RYG_FS0215

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 : 22 AUGUST 2022
Calibration Date : 31 AUGUST 2022
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nathakorn Pirutpaian

Approved by :

(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACC22023
Job No. : VC65AC0077
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACC22023
Job No. : VC65AC0077
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.04	0.04	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.5	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.70	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22226
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier MH-24
Serial No.: 00623387 / 198634 / 26415
ID No.:

Condition As Found : GOOD

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

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

Received Date : 28 SEPTEMBER 2022
Calibration Date : 12-17 OCTOBER 2022
Date of Issue : 18 OCTOBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
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

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.5

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.1	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.4	0.5	0.5	±5.0

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Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
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	-0.1	±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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	0.0	-
C-weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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T. Pich...

Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	132.9	-0.1	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.1	0.1	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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T. Pich...

Continuation of Calibration Certificate

Cert. No. : ACL22226
Job No. : VC65AC0086
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

QF-TS12-04-04-020664

T. Pich...

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd., Bangbunro, Bangkok 10700 THAILAND.
Tel: 0-2435-0800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22238
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623392 / 198639 / 26420
ID No. : -

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 : 07 OCTOBER 2022
Calibration Date : 20-21 OCTOBER 2022
Date of Issue : 21 OCTOBER 2022

Calibrated by : Nathakorn Pisulpaisan

Approved by :

T. Petchumai
(Thanakul Petchumai)

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Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_03/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.4
Flat	24.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.8	0.8	0.8	± 5.0

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Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	0.0	-
C-weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.8	-0.2	±1.1
25.0	24.8	-0.2	±1.1

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Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
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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Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 8 of 8

11. Overload Indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22241
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RUON
Model : NL-42A/Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623395 / 198642 / 26423
ID No.: -

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KJIEI 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 OCTOBER 2022
Calibration Date : 20-21 OCTOBER 2022
Date of Issue : 21 OCTOBER 2022

Calibrated by : Nithakorn Pisutpaisan

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

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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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
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

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.4
Flat	22.1

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	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.4	0.5	0.5	± 5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

P. P. L.

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
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
SBL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
Pages : 6 of 8

7. Level linearity on the reference level range

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

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P. P. L.

Continuation of Calibration Certificate

Cert. No. : ACL22241
Job No. : VC65AC0089
Pages : 8 of 8

11. Overload Indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

P. P. L.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23080
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296517 / 135220 / 87527
ID No.: RYG_PSO434

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nethakorn Pisutpaisan

Approved by :

T. Petchum
(Thanakul Petchum)

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QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
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	SerialNo.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.DP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.DP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.DP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.1

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	19.9
Flat	25.5

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.5	-1.4	-1.4	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	0.0	-
C-weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	±0.1
Leq	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. : ACL23080
Job No. : VC66AC0031
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	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
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 ; -2.5
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23080
Job No. : VC66AC0031
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

QF-TS12-04-04-020664

T. Petch.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22240
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623394 / 198641 / 26422
ID No. :

Condition As Found : GOOD

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

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

Received Date : 07 OCTOBER 2022
Calibration Date : 20-21 OCTOBER 2022
Date of Issue : 21 OCTOBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchum
(Thanakul Petchum)

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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	17.1
Flat	23.0

3. Acoustical signal tests of frequency weightings

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

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

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Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

- 0.1

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
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	135.1	0.1	±1.1
134.0	134.1	0.1	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.1	0.1	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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- 0.1

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
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	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
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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- 0.1

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

- 0.1

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbunru, Bangplud Bangkok 10700 THAILAND
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Cert. No. : ACL22237
Pages : 1 of 8

Calibration Certificate

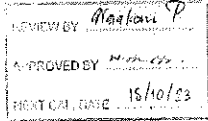
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NII-24
Serial No. : 01173611 / 172173 / 74023
ID No. : RYG_FS0390

Condition As Found : GOOD

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

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

Received Date : 03 OCTOBER 2022
Calibration Date : 18-19 OCTOBER 2022
Date of Issue : 20 OCTOBER 2022



Calibrated by : Nathakorn Pisutpaisan

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

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QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.1
Flat	23.9

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	0.5	0.4	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.2	-0.2	-0.1	±5.0

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Continuation of Calibration Certificate

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	0.0	-
C-weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	±0.1
Leq	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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T. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22237
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8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	-
One	136.4	135.4	-1.0	±3.0

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

QF-TS12-04-04-020664

T. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

T. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Rth.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC23085
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG JS0496

Condition As Found : GOOD

Customer : A.L.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 : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchurni)

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23085
Job No. : VC66AC0824
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACC23085
Job No. : VC66AC0824
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23059
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01022261 / 180399 / 88169
ID No.: BKK FS0030

Condition As Found : GOOD

Customer : A.L.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 : 17 JANUARY 2023
Calibration Date : 19-20 JANUARY 2023
Date of Issue : 23 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchurni)

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.

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 03/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. P. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
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

QF-TS12-04-04-020664

T. P. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.7

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	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.0	1.1	1.1	±5.0

QF-TS12-04-04-020664

T. P. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighing network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	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. P. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
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	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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T. Petchum

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
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
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; 2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

QF-TS12-04-04-020664

T. Petchum

Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthon Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22177
Pages : 1 of 8

Calibration Certificate

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

Condition As Found : GOOD

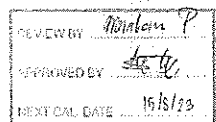
Customer : ALS I LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 25 JULY 2022
Calibration Date : 15-18 AUGUST 2022
Date of Issue : 19 AUGUST 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchum
(Thunakul Petchumai)



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T. Petchum

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
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

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Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	18.0
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.6	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.7	-1.7	-1.7	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	± 1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	± 1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	± 1.0

10. Peak C sound level

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

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Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinithorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22286
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00658239 / 157785 / 48094
ID No. : DKK FS0096

Condition As Found : GOOD

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

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

Received Date : 30 NOVEMBER 2022
Calibration Date : 13-16 DECEMBER 2022
Date of Issue : 19 DECEMBER 2022

Calibrated by : Nathekom Pisutpaisan

Approved by : T. Petchurui
(Thanakul Petchurui)

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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Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAJ	34560495	AA-3005-22	22-Feb-23

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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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.1
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	± 1.5
1000	-0.1	0.0	0.0	± 1.0
8000	-1.2	-1.3	-1.2	±5.0

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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
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

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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
1eq	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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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
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	-
One	136.4	135.8	-0.6	±3.0

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

QF-TS12-04-04-020664

T. Petchum.

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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



Cert. No. : ACL22253
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 01122504 / 169436 / 72457
ID No. : BKK_FS0033

Condition As Found : GOOD

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

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

Received Date : 01 NOVEMBER 2022
Calibration Date : 02-03 NOVEMBER 2022
Date of Issue : 04 NOVEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchum.
(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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22286
Job No. : VC66AC0015
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchum.

SITHIPORN / SITHIPORN ASSOCIATES CO.,LTD.
ASSOCIATES
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on JEC-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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchum.

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
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

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T. Retch

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.4

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	19.9
Flat	25.7

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.3	-1.2	-1.1	±5.0

QF-TS12-04-04-020664

T. Retch

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
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	0.1	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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	±0.2
Flat	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

6. Long - term stability

Frequency Weighting	SIM Display at initial (dB)	SIM 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. Retch

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
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	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.8	-0.2	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

T. Retch

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
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	128.1	0.1	±1.0

10. Peak C sound level

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10709 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22182
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00873109 / 171842 / 73485
ID No. : RYG_FS0384

Condition As Found : GOOD

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

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

Received Date : 22 AUGUST 2022
Calibration Date : 26-31 AUGUST 2022
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Reth*
(Thanakul Petchurau)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22253
Job No. : VC66AC0004
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
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	✓	-	0.4	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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.5

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	17.6
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.4	-2.4	-2.4	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
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	-0.1	-0.1	-0.1	±1.5
500	-0.1	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

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Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-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	-
One	136.4	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthon Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22254
Pages : 1 of 8

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 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 01 NOVEMBER 2022
Calibration Date : 02-03 NOVEMBER 2022
Date of Issue : 04 NOVEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22182
Job No. : VC65AC0077
Pages : 8 of 8

11. Overload Indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0094
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	33218A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
Pages : 4 of 8

Result of calibration:

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.8

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	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	0.6	0.6	0.6	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.2	-2.2	-2.1	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
29.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

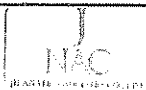
Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

7. Petch

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

CERTIFICATE OF CALIBRATION

Certificate No. : CL-036-06
Page 1 of 2Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 15006714
ID No: RYG_FS0210Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 304 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.Received date: 07 Feb 2023
Calibration date: 14 Feb 2023
Issue date: 14 Feb 2023Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682 09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI 1000 A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%Calibration Procedure
The temperature calibration was done by In House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22. Certificate number: ER-0092.
22Calibrated by
Mr. Sorawit Thachalad
Miss Jitratporn LertsompholApproved Signatory: Mr. Panyaa Booncharoen
Calibration Department Manager

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

7. Petch

63/14 15,67/35-36, Soi Petchkasem 7,7/1, Petchkasem Rd.
Walthapra, Bangkhokhyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.comCertificate No. : CL-036-06
Page 2 of 2Result 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: 22035263.
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.062	20.4	0.3	0.099
60	25.060	25.4	0.3	0.099
60	30.051	30.4	0.3	0.099
60	35.050	35.4	0.3	0.099
60	40.048	40.4	0.4	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015491
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.5	0.4	0.099
70	25.060	25.3	0.2	0.099
70	30.051	30.2	0.1	0.099
70	35.050	35.1	0.0	0.099
70	40.048	40.1	0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17023217.
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.062	20.3	0.2	0.099
110	25.060	25.3	0.2	0.099
110	30.051	30.3	0.2	0.099
110	35.050	35.3	0.2	0.099
110	40.048	40.3	0.3	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No.: CL-018-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006718
ID No: RYG_FS0223

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

Received date: 23 Jan 2023
Calibration date: 03 Feb 2023
Issue date: 06 Feb 2023

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

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

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

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

REVIEW BY *Manon P*
APPROVED BY *Mr. Panyo Booncharoen*
NEXT CAL. DATE *3/15/24*

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Panyo Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Certificate No.: CL-037-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006720
ID No: RYG_FS0224

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

Received date: 07 Feb 2023
Calibration date: 14 Feb 2023
Issue date: 14 Feb 2023

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

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

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

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

REVIEW BY *Manon P*
APPROVED BY *Mr. Panyo Booncharoen*
NEXT CAL. DATE *12/12/24*

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Panyo Booncharoen
Calibration Department Manager

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

Certificate No.: CL-018-65
Page 2 of 2

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 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.062	20.1	0.0	0.099
60	25.054	25.1	0.0	0.099
60	30.042	30.1	0.1	0.099
60	35.031	35.1	0.0	0.14
60	40.014	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015496.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.2	0.1	0.099
70	25.053	25.2	0.1	0.099
70	30.042	30.1	0.1	0.099
70	35.029	35.1	0.1	0.099
70	40.016	40.0	0.0	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20019638.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.062	20.2	0.1	0.099
110	25.053	25.2	0.1	0.099
110	30.042	30.2	0.2	0.099
110	35.031	35.3	0.3	0.099
110	40.013	40.3	0.3	0.099

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

★ End of Certificate ★



Certificate No.: CL-037-66
Page 2 of 2

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 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.048	19.7	-0.3	0.099
60	25.058	24.7	-0.4	0.099
60	30.049	29.7	-0.3	0.099
60	35.046	34.7	-0.3	0.099
60	40.046	39.7	-0.3	0.099

Table 2: 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)
70	20.048	20.3	0.3	0.099
70	25.058	25.1	0.0	0.099
70	30.049	30.0	0.0	0.099
70	35.046	34.8	-0.2	0.099
70	40.046	39.7	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20032619.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.048	20.0	0.0	0.099
110	25.058	25.0	-0.1	0.099
110	30.049	30.0	0.0	0.099
110	35.046	35.0	0.0	0.099
110	40.046	40.0	0.0	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Certificate No. : CL-038-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15020736
ID No: RYG_FS0232

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

Received date: 07 Feb 2023
Calibration date: 14 Feb 2023
Issue date: 14 Feb 2023

Reference Used During Calibration

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

Calibration Condition

Temperature: (23±3) °C
Relative Humidity: (65±15)%

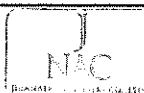
Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory: *Pornth*
Mr. Pannya Booncharoen
Calibration Department Manager

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 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.047	20.1	0.1	0.099
60	25.058	25.1	0.0	0.099
60	30.049	30.2	0.2	0.099
60	35.046	35.1	0.1	0.099
60	40.046	40.1	0.1	0.099

Table 2: 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)
70	20.048	20.1	0.1	0.099
70	25.058	25.0	0.1	0.099
70	30.049	29.9	-0.1	0.099
70	35.046	34.8	-0.2	0.099
70	40.046	39.6	-0.4	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15031164.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.048	20.1	0.1	0.099
110	25.058	25.1	0.0	0.099
110	30.049	30.1	0.1	0.099
110	35.046	35.1	0.1	0.099
110	40.046	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

☆ End of Certificate ☆



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TION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

CERTIFICATE OF CALIBRATION

Certificate No. : CL-042-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 20032240
ID No: RYG_FS0520

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

Received date: 21 Feb 2023
Calibration date: 24 Feb 2023
Issue date: 28 Feb 2023

Reference Used During Calibration

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

Calibration Condition

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory: *Pornth*
Mr. Pannya Booncharoen
Calibration Department Manager

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: 21001213.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.064	20.1	0.0	0.099
60	25.061	25.2	0.1	0.099
60	30.054	30.2	0.1	0.099
60	35.046	35.2	0.2	0.099
60	40.045	40.2	0.2	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001790.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.064	20.1	0.0	0.099
70	25.061	24.9	-0.2	0.099
70	30.054	29.9	-0.2	0.099
70	35.046	34.8	-0.2	0.099
70	40.045	39.7	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001245.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.064	20.1	0.0	0.099
110	25.061	25.1	0.0	0.099
110	30.054	30.1	0.0	0.099
110	35.045	35.1	0.1	0.099
110	40.045	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

☆ End of Certificate ☆



CERTIFICATE OF CALIBRATION

Certificate No.: CL-016-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 18018316
ID No: RYG_FS0360

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

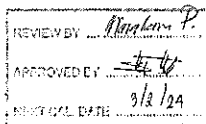
Received date: 23 Jan 2023
Calibration date: 03 Feb 2023
Issue date: 06 Feb 2023

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

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

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

Traceability
The measurement results are traceable to the
International system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22



Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol

Approved Signatory: [Signature]
Mr. Parinya Booncharoen
Calibration Department Manager

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: 18021471.
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	-0.1	0.099
60	25.053	25.0	-0.1	0.099
60	30.042	30.0	0.0	0.099
60	35.029	35.0	0.0	0.099
60	40.014	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021266.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.1	0.0	0.099
70	25.053	25.0	-0.1	0.099
70	30.043	30.0	0.0	0.099
70	35.030	34.9	-0.1	0.099
70	40.015	39.9	-0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020502.
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.1	0.0	0.099
110	25.053	25.1	0.0	0.099
110	30.044	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.017	40.1	0.1	0.099

UUC*: Unit Under Calibration

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

* End of Certificate *



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CERTIFICATE OF CALIBRATION

Certificate No.: CL-014-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 18018313
ID No: RYG_FS0358

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

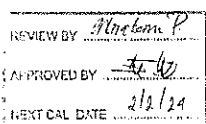
Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023

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

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

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

Traceability
The measurement results are traceable to the
International system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22



Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol

Approved Signatory: [Signature]
Mr. Parinya Booncharoen
Calibration Department Manager

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: 18021467.
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.055	20.1	0.0	0.099
60	25.048	25.1	0.1	0.099
60	30.039	30.1	0.1	0.099
60	35.029	35.1	0.1	0.099
60	40.018	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021270.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.051	20.2	0.1	0.099
70	25.051	25.1	0.0	0.099
70	30.039	30.0	0.0	0.099
70	35.029	35.0	0.0	0.099
70	40.021	39.9	-0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020497.
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.1	0.0	0.099
110	25.050	25.1	0.1	0.099
110	30.038	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.020	40.1	0.1	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 *



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

CERTIFICATE OF CALIBRATION

Certificate No.: CL-015-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 18018314
ID No: RYG_FS0359

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

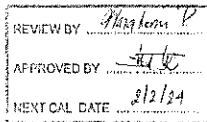
Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023

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

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

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

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034 22, Certificate number: ER-0092-
22



Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Certificate No.: CL-015-66
Page 2 of 2

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: 18021465.
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	-0.1	0.099
60	25.048	25.0	0.0	0.099
60	30.045	30.0	0.0	0.099
60	35.030	35.0	0.0	0.099
60	40.021	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021262.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.1	0.0	0.099
70	25.048	24.9	-0.1	0.099
70	30.040	29.9	-0.1	0.099
70	35.032	34.8	-0.2	0.099
70	40.021	39.8	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20008280.
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.0	-0.1	0.099
110	25.050	25.1	0.1	0.099
110	30.039	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.022	40.1	0.1	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%.



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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUAN LUANG, BANGKOK, 10250
TEL: 0-2717-3962-24 FAX: 0-2719-9481



Certificate of Calibration

Certificate No.: 22PH515
Page: 1 of 2

Equipment: Lux Meter
Manufacturer: Delta OHM
Model: HD2102 21
Serial No.: 10002047
ID No.: RYG_FS0201

Condition As-Received: Used Item
Received Date: 28 September 2022
Calibration Date: 04 October 2022

Reference: 2209-0911W/SC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %

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

104 Phatthanakan 40 Phatthanakan Rd
Khwang Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand

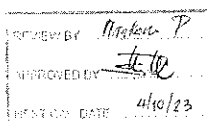
Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against
luminous-intensity standard lamp (source-based method) According to the inverse square law measurement
method.

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) High-accuracy Irradiance Standard	OL FET-U	F-1472	TP-1030-21	15 Dec 2022

2. This result of calibration was made on requested at the point specified by customer
3. Test Equipment : Programmable Voltage/Current Source (Model : CL83A, S/N : 69220284)
4. Test Equipment : Illuminance Meter (Model : 51002, S/N : 000129)
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 at:-
-National Institute of Metrology Thailand (NIMT)



Calibrated by: Nivat Nitaa
Issue Date: 05 October 2022

Approved Signatory:
☐ Phalinee Prabpaijai
☐ Chatchawan Khunpluek
☒ Nuntawat Khomchai

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

Function: Illuminance Measurement	Range: Autorange	Standard Value	UUC* Reading	Error	Uncertainty
		(lx)	(lx)	(lx)	(± lx)
		0	0.00	0.00	0.060
		15	14.42	-0.58	0.24
		100	96.51	-3.49	1.6
		500	483.5	-16.5	7.9
		1000	974.2	-25.8	16
		2000	1976.3	-23.7	32
		3000	2970	-30	48
		4000	4011	11	64
		5000	5031	31	80

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 %

Calibration with probe sensor s/n. 20011661

UUC* = Unit Under Calibration.

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Cert. No.: 22PH515
Page: 2 of 2



Certificate of Calibration

Certificate No.: 22PH447
Page: 1 of 2

Equipment: Lux Meter
Manufacturer: PEAK METER
Model: PM6612L
Serial No.: H12A-D10324
ID No.: RYG_FS0535
Condition As-Received: Used Item
Received Date: 31 August 2022
Calibration Date: 02 September 2022
Reference: 2208-1093WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwang Phatthanakan, Khosuan Luang,
Bangkok 10250 Thailand
Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against
luminous-intensity standard lamp (source-based method) According to the inverse square law measurement
method.

Condition of this result of calibration

1. Reference standards Instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1) High-accuracy Irradiance Standard	CL-FEL-U	F-1471	TP-1037-21	18 Oct 2022
2) Photometry & Encoder	LMguide 9.5 m	120RC003	61-140008-1	30 Apr 2023

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

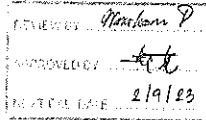
3 Test Equipment: Programmable Voltage/Current Source (Model: OL63A, S/N: 09220204)

4 Test Equipment: Illuminance Meter (Model: 51002, S/N: 080129)

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

6 This Calibration is traceable to the International System of Unit maintained at:-

National Institute of Metrology Thailand (NIMT)



Result of calibration:- () Without adjustment (*) After adjustment
Function: Illuminance Measurement Range: Autorange

Standard Value	Before Adjust	After Adjust	Error	Uncertainty
(lx)	(lx)	(lx)	(lx)	(± lx)
0	0.00	0.00	0.00	0.060
15	-	14.25	-0.75	0.22
100	-	96.5	-3.5	1.5
500	-	492	-8	7.3
1000	881	992	-8	16
2000	-	1986	-14	30
3000	-	2990	-10	45
4000	-	4020	20	59
5000	4550	5060	60	74

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 %

Before adjustment light source factor setting mode: $L_0 = 1.058$

After adjustment light source factor setting mode: $L_0 = 1.209$

UUC* = Unit Under Calibration.

-000-

Calibrated by: Nivat Niiss
Issue Date: 06 September 2022

Approved Signatory:

☐ Phatinee Prabpaipal
☐ Chalchawan Khunluak
☒ Nuntawit Khomchai

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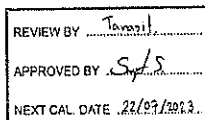
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Certificate of Calibration

Cert. No.: 22CH988
Page.: 1 of 3

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenGoS2
Serial No.: B712869291
ID No.: RYG_FS0296
Condition As-Received: Used Item
Received Date: 21 July 2022
Calibration Date: 22 July 2022
Reference: 2207-0610DSC-1
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu, A. Phrakdaeng,
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-CH8 by comparison with standard thermometer



Calibrated by: Warakorn Lerngagrakul

Approved by:
Approved Signatory

☒ Molee Bulkruea
☐ Sathip Meangmai
☐ Warakorn Lerngagrakul

Issue Date: 27 July 2022

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

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030040	130RC116	21E2682	25 Aug 2022
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at -
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials

The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AP-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	823320	20 June 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 2023

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 (± mV)	Coverage factor k
			mV	pH		
pH Meter S/N: B712869291	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	-178	10.00	0.58	2.00

Cert.No.: 22CH988
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode	4.008	4.01	176	0.0085	2.05
S/N : 9055659	6.985	6.99	2	0.0089	2.00
	10.008	10.01	-166	0.011	2.07

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Go-ISM

- Serial No : 9055659

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.003	24.8	-0.203	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

-000-

Mettler

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METTLER TOLEDO

METTLER TOLEDO

Certificate Number CPH-0073-22

Certification Tools

Certified digital voltmeter Manufacturer: HEWLETT PACKARD / 34401A
Type :
Serial number: U52633161
Certificate number: E11214188
Date of Certification: October 5, 2022Certified Temperature Resistors Manufacturer: METTLER TOLEDO
Type: S1302410
Serial number: A227
Certificate number: S3351
Date of Certification: March 19, 2022

Designation	Nominal value	Certified value
NTC 30 k Ω , 0 °C	64 560 k Ω	64 5636 k Ω
NTC 30 k Ω , 25 °C	35 650 k Ω	35 6015 k Ω
NTC 30 k Ω , 50 °C	19 600 k Ω	19 6548 k Ω
NTC 30 k Ω , 75 °C	4 528 k Ω	4 52656 k Ω
NTC 30 k Ω , 100 °C	2 070 k Ω	2 06918 k Ω

Certificate Number CPH-0073-22

Calibration Certificate
Seven2Go™ pH/mV meter S2REVIEW BY: Pithayath
APPROVED BY: Spt.S.
NEXT CAL. DATE: 4/21/23

Customer

Company: ALS LABORATORY GROUP (THAILAND) CO., LTD.

Address: 616/10 Moo 5

RAYONG 21140

Customer ID number: 321611423_1

Customer representative:

Instrument

Type: Seven2Go™ pH/mV S2

Instrument Serial Number: C22225500

Internal Identification:

Firmware version: 1.01

Technical specifications

Measuring Range	-1592.0	1592.9 mV	-2	20 pH
Resolution	1 mV		0.01 μ M	
Limit of Error	\pm 1 mV		\pm 0.01 pH	
Temperature range MTC	-5	105 °C		
Temperature range ATC	-5	105 °C		
Resolution	0.1 °C			
Limit of Error	\pm 0.3 °C			

Procedure Statement

METTLER TOLEDO Seven2Go Service Manual Section B (Doc. No. 30232219) will be used as referring documentation to adjust and certify the instrument indicated in the "Type" and "Serial number" section. The measurement results of this certification were obtained at ambient conditions.

Certificate Number CPH-0073-22

Certification Measurements

pH/mV Sensor Input	Designation	Certified value	Measured value	Max. Tolerance	Passed / Failed
	-1920 mV	-1920 mV	-1920 mV	1 mV	Passed
	-1000 mV	-1000 mV	-1000 mV	1 mV	Passed
	-500 mV	-500 mV	-500 mV	1 mV	Passed
	-180 mV	-180 mV	-180 mV	1 mV	Passed
	0 mV	0 mV	0 mV	1 mV	Passed
	180 mV	180 mV	180 mV	1 mV	Passed
	500 mV	500 mV	500 mV	1 mV	Passed
	1000 mV	1000 mV	1000 mV	1 mV	Passed
	1920 mV	1920 mV	1920 mV	1 mV	Passed

Temperature Sensor Input	Designation	Nominal value	Measured value	Max. Tolerance	Passed / Failed
	NTC 30 k Ω , 0 °C	60 °C	60 °C	0.5 °C	Passed
	NTC 30 k Ω , 25 °C	25.0 °C	25.0 °C	0.5 °C	Passed
	NTC 30 k Ω , 50 °C	50.0 °C	50.1 °C	0.5 °C	Passed
	NTC 30 k Ω , 75 °C	75.0 °C	75.0 °C	0.5 °C	Passed
	NTC 30 k Ω , 100 °C	100.0 °C	100.0 °C	0.5 °C	Passed

Summary of Certification

Certification of Instrument

Passed

The instrument referred to in this certificate has fulfilled the criteria of the certification. This is indicated by the notation Passed in the column above.

Remarks:

Certification of the Instrument was performed by

Name: Sopitjai Sitwatt

Function: Service Technician

Company: METTLER TOLEDO

Date: March 14, 2022

Signature: Electronic Signature

Performance Test

Attachment to Certificate No. CPH-0073-22

pH Electrode

Type: InLab Expert Go-ISM SN: 2015870

Certified standards used

Standard 1:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Dec-22
	Nominal value: pH (25.00 °C):	4.01	Lot No.: 1F351F
Standard 2:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Dec-22
	Nominal value: pH (25.00 °C):	7.00	Lot No.: 1F345G
Standard 3:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Jan-23
	Nominal value: pH (25.00 °C):	9.22	Lot No.: 10012G
Standard 4:	Type: Redox Solution	Manufacturer: METTLER TOLEDO	Exp. date: -
	Nominal value: pH (25.00 °C):	-	Lot No.: -

Adjustment

Set Calibration Buffer		B1 (25 °C) 2.00, 4.01, 7.00, 9.21, 11.00					
Select Calibration Mode		1-Point calibration		2-Point calibration		3-Point calibration	
3-Point Calibration		°C	pH	°C	pH	°C	pH
Cal 1		ATC	24.0	7.00	ATC	-	-
Cal 2		ATC	23.9	4.01	ATC	-	-
Offset (mV)		5		-		-	
Slope % (or mV/pH)		98.0		-		-	
Cal 3		ATC	24.0	9.22			
Slope % (or mV/pH)		98.8					

Measurements

Before adjustment				After adjustment			
Buffer Values		Measured	Difference	Buffer Values		Measured	Difference
pH	°C	pH	pH	pH	°C	pH	pH
4.01	23.9	ATC	3.97	4.01	24.1	ATC	4.02
7.00	23.9	ATC	6.95	7.00	24.0	ATC	7.01
9.22	24.3	ATC	9.14	9.23	24.2	ATC	9.23

Redox Measurement Result = mV

Note: The difference result of calibrated electrode should be within ± 0.05 pH

Remarks

Place: Laboratory room Calibration Date: March 14, 2022
Service Specialist: Sookjai Sriwattani Signature: Electronic Signature

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANI UANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9183



Certificate of Calibration

Certificate No.: 22T1601
Page: 1 of 2

Equipment: Digital Thermometer With Sensor

Manufacturer: Testo

Model: 105

Serial No.: 31282167/504

ID No.: RYG_FS0608

Condition As-Received: Used Item

Received Date: 01 September 2022

Calibration Date: 07 September 2022

Reference: 2209-0057DSC

Ambient Temperature: (25 \pm 3) °CRelative Humidity: (50 \pm 20) %

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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. Rayong Branch
010/10 Moo 5 T. Maenam Khu. A. Phukdaeng, Rayong
21140, Thailand

Procedure used: Calibration was conducted using in-house calibration procedure CP-T01 according to comparison with
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Exp. Date
1) Black Stack Thermometer	1560	8C454	221616	23 May 2023
2) PRT Scanner Module	2562	A01303	221616	23 May 2023
3) Industrial Platinum Resistance Thermometer	5627-12	571971	221616	23 May 2023

2. The 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 maintained at -

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	Tanong
APPROVED BY	Sus
NEXT CAL DATE	09/09/23

Calibrated by: Satopom Mukkamsoo
Issue Date: 15 September 2022

Approved Signatory:

J. Phalinee Prapapal
J. Chaitawan Khunpilaek
Wanlop Larpkum

B 0296764

RYG_FS0605

METTLER TOLEDO

Cert. No.: 22T1601
Page: 2 of 2

Certificate Number CPH-0205-22

Calibration Certificate

Seven2Go™ pH/mV meter S2

Customer

Company: ALS LABORATORY GROUP (THAILAND) CO., LTD.

Address: 616/10 Moo 5, T. Maenamkoo, A. Phukdaeng

RAYONG 21140

Customer ID number: M1606073

Customer representative:

Instrument

Type: Seven2Go™ pH/mV S2

Instrument Serial Number: C32158424

Internal Identification:

Firmware version: 1.01

Technical specifications

Measuring Range	-1999.9 - 1999.9 mV	± 20 µV
Resolution	1 mV	0.01 pH
Limit of Error	± 1 mV	± 0.01 pH
Temperature range MTC	-5 - 105 °C	
Temperature range ATC	-5 - 105 °C	
Resolution	0.1 °C	
Limit of Error	± 0.5 °C	

REVIEW BY	Tanong
APPROVED BY	Sus
NEXT CAL DATE	Sep 7, 23

Procedure Statement

METTLER TOLEDO Seven2Go Service Manual Section D (Doc. No. 3232718) will be used as referring
documentation to adjust and certify the instrument indicated in the "Type" and "Serial number" section. The
measurement results of this calibration were obtained at ambient conditions.

Certificate Number CPH-0205-22

Certificate Number CPH-0205-22

Certification Tools

Certified digital voltmeter Manufacturer: METTLER TOLEDO / 23041A
 Type: 23041A
 Serial number: M53000301
 Certificate number: E10228931
 Date of Certification: September 2, 2022

Certified Temperature Resistor Manufacturer: METTLER TOLEDO
 Type: 5332410
 Serial number: A239
 Certificate number: 53811
 Date of Certification: April 27, 2022

Designation	Nominal value	Certified value
NTC 30 kΩ 0 °C	94 620 kΩ	94 5814 kΩ
NTC 30 kΩ 25 °C	20 000 kΩ	19 9927 kΩ
NTC 30 kΩ 50 °C	10 000 kΩ	10 0053 kΩ
NTC 30 kΩ 75 °C	4 528 kΩ	4 5284 kΩ
NTC 30 kΩ 100 °C	2 610 kΩ	2 60525 kΩ

Certification Measurements

Designation	Certified value	Measured value	Max. Tolerance	Passed / Failed
1000 mV	1000.0 mV	999.9 mV	1 mV	Passed
1000 mV	1000.0 mV	1000.0 mV	1 mV	Passed
500 mV	500.0 mV	500.0 mV	1 mV	Passed
100 mV	100.0 mV	100.0 mV	1 mV	Passed
0 mV	0.0 mV	0.0 mV	1 mV	Passed
100 mV	100.0 mV	100.0 mV	1 mV	Passed
500 mV	500.0 mV	500.0 mV	1 mV	Passed
1000 mV	1000.0 mV	1000.0 mV	1 mV	Passed
1000 mV	1000.0 mV	1000.0 mV	1 mV	Passed

Designation	Nominal value	Measured value	Max. Tolerance	Passed / Failed
NTC 30 kΩ 0 °C	94 620 °C	94 6 °C	0.5 °C	Passed
NTC 30 kΩ 25 °C	25.0 °C	25.1 °C	0.5 °C	Passed
NTC 30 kΩ 50 °C	50.0 °C	50.2 °C	0.5 °C	Passed
NTC 30 kΩ 75 °C	75.0 °C	75.1 °C	0.5 °C	Passed
NTC 30 kΩ 100 °C	100.0 °C	100.0 °C	0.5 °C	Passed

Summary of Certification

Certification of instrument **Passed**

The instrument referred to in this certificate has fulfilled the criteria of the certification. This is indicated by the notation 'Passed' in the column above.

Remarks: Service Address: ID: 637021003

Test high impedance at 1000.0 mV Results: 1000 mV

Difference: + 0.0% Value: MPE: (± 1%)

Certification of the instrument was performed by:

Name: Watinee Thongrod Function: Service Technician

Company: METTLER-TOLEDO

Date: September 28, 2022

Signature: Watinee T.

Mettler-Toledo (Thailand) Limited

METTLER TOLEDO

Performance Test

Attachment to Certificate No. CPH-0205-22

pH Electrode

Type: InLab Expert Go-ISM SN: 2304440

Certified standards used

Standard 1	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	Jun-24
		Nominal value: pH (25.00 °C): 4.01		Lot No.	1H1585	
Standard 2	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	Jan-24
		Nominal value: pH (25.00 °C): 7.00		Lot No.	1H0130	
Standard 3	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	May-24
		Nominal value: pH (25.00 °C): 9.20		Lot No.	1H133A	
Standard 4	Type	Redox Solution	Manufacturer	METTLER TOLEDO	Exp. date	
		Nominal value: pH (25.00 °C): -		Lot No.	-	

Adjustment

Set Calibration Buffer		82 (25 °C) 2.00, 4.01, 7.00, 9.21, 11.00					
Select Calibration Mode		3-Point calibration		2-Point calibration		2-Point calibration	
3-Point Calibration		°C		°C		°C	
Cal 1		ATC	25.3	4.01	ATC	25.0	-
Cal 2		ATC	25.2	7.00	ATC	25.0	-
Offset (mV)		10		-		-	
Slope % (or mV/pH)		97.7		-		-	
Cal 3		ATC	25.3	9.21	-		-
Slope % (or mV/pH)		99.0		-		-	

Measurements

Before adjustment				After adjustment					
Buffer Values		Measured	Difference	Buffer Values		Measured	Difference		
pH	°C	pH	pH	pH	°C	pH	pH		
4.01	25.4	ATC	3.98	-0.03	4.01	25.3	ATC	4.02	0.01
7.00	25.1	ATC	0.56	-0.04	7.00	25.1	ATC	7.01	0.01
9.20	25.2	ATC	9.13	-0.07	9.20	25.3	ATC	9.21	0.01

Redox Measurement Result: mV

Note: The difference result of calibrated electrode should be within ± 0.05 pH

Remarks:

Place: Chemical Laboratory Calibration Date: September 28, 2022

Service Specialist: Watinee Thongrod Signature: Watinee T.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
 511/1 PATTANAKARN RD (SOI 4) AND LUNG SUAN HANG BANGKOK 10250
 TEL: 02-217-8800 FAX: 02-216-0494



Cert.No.: 23CH441
 Page: 1 of 2

Certificate of Calibration

Equipment: pH Meter
 Manufacturer: Mettler Toledo
 Model: Seven2Go
 Serial No.: 8531256371
 ID No.: RYG_FS0420
 Condition As-Received: Used Item
 Received Date: 31 March 2023
 Calibration Date: 03 April 2023
 Reference: 2303-1133DSC-1
 Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
 616/10 Moo 5, T. Maenam Khu,
 A. Phrakdaeng, 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)

Calibrated by: Warakorn Lernagatrakul

Approved by: Approved Signatory

(/) Malee Butkrua
 () Sathip Meangmai
 () Warakorn Lernagatrakul

Issue Date: 5 April 2023

The Uncertainties are for a confidence probability of approximately 95%
 This certificate is valid for a period of 12 months from the date of issue.
 Approval of the final report is subject to the receipt of the final report.



Cert. No.: 23CH441
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	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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	863832	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: B521256371	4.00	177.48	177	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	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.: 2465866	4.008	4.01	191	0.0071	2.00
	6.987	6.99	16	0.011	2.00
	10.010	10.02	-162	0.0095	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/1 PATTANAKARN ROAD SUE 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9383

Cert. No.: 23LM85
Page: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B531256371
ID No. : RYG_F50420
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 : 31 March 2023
Calibrated Date : 05 April 2023
Ambient Temperature : (26 \pm 10) °C
Relative Humidity : (50 \pm 30) %
AC Line Voltage : (220 \pm 22) V
Calibrated by : Preecha Hiahib
Approved by : Malee
() Ponnhippa Tameyakul
(/) Malee Butkrua
() Suwit Imjai

Issue Date : 21 April 2023

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

A 0045967



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2303-1133QSC-2

Cert. No.: 23LM85
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	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1502A	A52847	2211325	31 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.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 2465866

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (\pm °C)	Coverage Factor k
25.0	100	25.003	25.3	0.297	0.16	2.00
30.0	100	30.003	30.3	0.297	0.16	2.00
40.0	100	40.001	40.4	0.399	0.16	2.00
50.0	100	50.003	50.6	0.497	0.16	2.00

UUC* : Unit Under Calibration

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

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Cert.No.: 22CH1733
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 : 21 December 2022
Calibration Date : 22 December 2022
Reference : 2212-0602DSC-1
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 \pm 2.5) °C
Relative Humidity : (50 \pm 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 Lerngratukul
Approved by : Malee
(/) Malee Butkrua
() Sathip Meangmai
() Warakorn Lerngratukul
Issue Date : 26 December 2022

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

A 0048758



Cert.No.: 22CH1733
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	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: B934291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.068	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 22CH1733
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 1475518	4.008	4.011	185.2	0.0052	2.08
	6.987	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM
- Serial No. : 1475518

Dimension of probe;

- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.001	24.9	-0.101	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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53/4 PATANAKARN ROAD SUB 18, SUANI UANG, SUANI UANG, BANGKOK 10250
TEL: 0-2717-3000-24 FAX: 0-2719-9181



Certificate of Calibration

Certificate No.: 22E4098
Page: 1 of 2

Equipment : pH Meter
Manufacturer: Mettler Toledo
Model : SevenExcellence
Serial No.: B934291445
ID No.: RYQ_EN0152
Condition As-Received: Used Item
Received Date: 21 December 2022
Calibration Date: 23 December 2022
Reference: 2212-060209C
Ambient Temperature: (23 \pm 2) °C
Relative Humidity: (50 \pm 10) %
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
516/10 Moo 5, T. Maenam Khu, A. Phrakdaeng,
Rayong 21140, Thailand

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi Product Calibrator

Condition of this result of calibration

1 Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	22E1431	05 May 2023

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

3 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 at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Wuthareporn Wongchulkrana
Issue Date: 26 December 2022

Approved Signatory :
[] Pralino Pradpaipat
[] Nuntawat Khumchani
[] Porethippa Tamayakul

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Cert. No.: 22E4098
Page.: 2 of 2

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

Function:	DC voltage measurement	Range:	2000	mV	
	Standard Value	UUC* Reading	Error	Uncertainty	
	(mV)	(mV)	(mV)	(\pm μ V)	
	-200.0000	-200.0	0.0	72	
	-150.0000	-150.0	0.0	69	
	-100.0000	-100.0	0.0	65	
	-50.0000	-50.0	0.0	62	
	0.0000	0.0	0.0	58	
	50.0000	50.0	0.0	62	
	100.0000	100.0	0.0	65	
	150.0000	150.0	0.0	69	
	200.0000	199.9	-0.1	72	

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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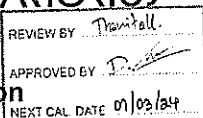
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Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8381-8, e-mail: service.thailand@sartorius.com



SARTORIUS



Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC10112
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 0026207038 Reference No.: 204833
ID No.: RYG_EN0002
Manufacturer: Sartorius 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. Pluakdaeng, Rayong 21140, Thailand

Calibrated By: Mr. Chonchai Inthana
Calibration Date: Wednesday, March 01, 2023
Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14: 2019

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambient Conditions:
Temperature: 23.6 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±
Reasons for calibration:
☐ New Installation ☐ Service / Required ☒ Re-calibration / Maintenance
Equipment Condition: ☒ Good Operate ☐ Fail

Measurement Method UKAS Publication Ref: Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to 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	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8381-8 Fax: +66 2843 8387, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC10112
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 0026207038 Reference No.: 204833
ID No.: RYG_EN0002
Manufacturer: Sartorius 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 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 g	199.9999 g	Nominal value:	100 g	
Tolerance	20.0000 g	200.0000 g	Tolerance	0.0004 g	
0.0001 g	20.0000 g	200.0000 g			
Nominal Value: (High Load)	20.0000 g	199.9999 g			
Tolerance	20.0000 g	200.0000 g			
0.0001 g	20.0000 g	200.0000 g			
Standard Deviation	0.00003	0.00005			

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0001	0.0001	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report

End of Report

SOP FM 33 03 February 2022

RYG_EN0010



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534 PATTANAKARN ROAD SOI 18, SIAM LUNG, SIAM LUNG BANGKOK 10220
TEL: 0-2710-9000-27 FAX: 0-2710-9000-28



Cert. No.: 22TM1517
Page: 1 of 3

Certificate of Calibration

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)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location: Oven Room
Received Order: 20 October 2022
Calibration Date: 20 October 2022
Ambient Temperature: (26 ± 10) °C
Relative Humidity: (50 ± 30) %
Calibrated by: Man Pattanapongpalboon
Approved by:
() Pernthippa Tameyaskul
() Malee Butkrua
() Suwit Imjai

Issue Date: 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Sartorius (Thailand) Co., Ltd.



Equipment: Hot Air Oven
Condition As-Received: Used Item
Reference: 2210-03760C-2
Procedure Used:

Cert. No.: 22TM1517
Page: 2 of 3

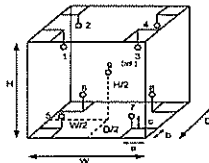
Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

- Reference standard instrument:-
- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.

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)	25	25
REL. Humid. (%)	54	58
AC Supply (V)	223	225

Ref. Std. ID No.: @ Calibration Point		
Position:	(180) °C	(104) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2210-037600-2
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 22TM1517
 Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.408	180.361	180.114	180.131	180.243	179.605

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 %.

-o0o-

Walee .

a 1132465



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

Cert.No.: 22TW34
 Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
 Manufacturer : YSI
 Model : 5000-115V
 Serial No. : 15E102796
 ID No. : RYG_EN0032
 Received Date : 11 February 2022
 Test Date : 14 February 2022
 Reference : 2202-0404DSC-4
 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 : Walee Sirinthean

Approved by : Saithip
 Approved Signatory

() Malee Butkuea
 (✓) Saithip Meangmal
 () Warakorn Lernagatrakul

Issue Date : 18 February 2022

REVIEW BY	<u>N. Banis</u>
APPROVED BY	<u>D. K</u>
NEXT CAL DATE	<u>15/8/23</u>



Cert.No.: 22TW34
 Page.: 2 of 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)
8.02	8.02	0.0084

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

-o0o-

Saithip

a 1094744



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Cert. No.: 22LM12
 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 : 11 February 2022
 Calibrated Date : 21 February 2022
 Ambient Temperature : (26 ± 10) °C
 Relative Humidity : (50 ± 30) %
 AC Line Voltage : (220 ± 22) V

Calibrated by : Kunchit Promprai

Approved by : Walee
 Approved Signatory

() Pornthippa Tameyakul
 (✓) Malee Butkuea
 () Suwit Imjai

Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0038008



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2202-0404DSC-5
Procedure Used :-

Cert. No.: 22LM12
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	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

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.

Result of Calibration :- (°) Without Adjustment

Function : Temperature measurement.

This instrument was connected with Temperature sensor, S/N.: 15E100464

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	45	20.001	19.88	-0.121	0.15	2.00

UUC* : Unit Under Calibration

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

-00-



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0 2717 3000 27 FAX 0 2719 9161



Certificate of Calibration

Cert. No.: 22TM317
Page.: 1 of 3

Equipment : Low Temp. Incubator

Manufacturer : Menmert

Model : IPP750

Serial No. : V818.0084

ID No. : RYG_EN0154

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

Location : BOD Room

Received Order : 22 April 2022

Calibration Date : 22 April 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :
Approved Signatory

() Pongthipha Tameyakul
() Malee Butkrues
() Suwit Imjai

Issue Date : 3 May 2022

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

a 1095714

A 0040735



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2204-0146OC-1
Procedure Used :-

Cert. No.: 22TM317
Page.: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44031769	21LM12	02 Sep 2022

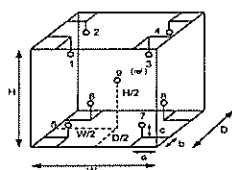
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (°) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 10 cm D = 0.60 m
b = 10 cm W = 1.0 m
c = 10 cm H = 1.2 m
Capacity = 0.75 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL. Humid. (%)	54	58
AC Supply (Volt)	221	223

Position :	Ref. Std. ID No.:
1	9RTD-2/1
2	9RTD-2/2
3	9RTD-2/3
4	9RTD-2/4
5	9RTD-2/5
6	9RTD-2/6
7	9RTD-2/7
8	9RTD-2/8
9 (ref.)	9RTD-2/9



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2204-0146OC-1
Result of Calibration :- (°) Without Adjustment

Cert. No.: 22TM317
Page.: 3 of 3

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)	Uncertainty (± °C)	Coverage Factor k
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Measured Temperature (°C)									
Calibration Point (°C)	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.209	20.174	20.199	20.110	20.075	20.062	20.027	20.069	20.030

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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a 1106485

a 1106484



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TEL. 0 2717 8099-27 FAX 0 2719 9484



Cert. No.: 22TM1492
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UM 400
Serial No. : b495.0859
ID No. : RYG_EN0006
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 : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Precha Hahib
Approved by :
() Pornthippa Tameyakul
(x) Malee Butkruea
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approved on the basis of Corporate Services & Equipment Calibration and Testing Services

A 0046905



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1
Procedure Used :

Cert. No.: 22TM1492
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 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	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

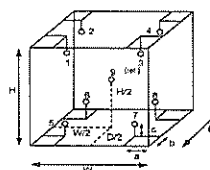
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- () Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :

D = 0.33 m
W = 0.40 m
H = 0.40 m
Capacity = 0.053 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	20	29
REL.Humid. (%)	43	47
AC Supply (Volt)	220	221

Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	10-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	10-10RTD-08
9 (ref.)	10-10RTD-09

1132473

a 1132473

RYG_EN0061



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1
Result of Calibration :- () Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1492
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C)							
	Position							
70.0	1	2	3	4	5	6	7	8
	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149
								9 (ref.)
								70.328

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sense

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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a 1132472



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TEL. 0 2717 8099-27 FAX 0 2719 9484



Cert. No.: 22TM1491
Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath
Manufacturer : Memmert
Model : WN82
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. Pluakdaeng,
Rayong 21140, Thailand
Location : Wet Chemistry Lab
Received Order : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Precha Hahib
Approved by :
() Pornthippa Tameyakul
(x) Malee Butkruea
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approved on the basis of Corporate Services & Equipment Calibration and Testing Services

A 0046906



Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2210-0376OC-4
 Procedure Used :-

Cert. No.: 22TM1491
 Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 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:-

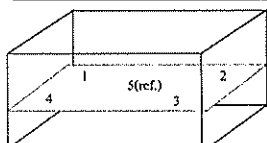
Instrument Model Serial No. Cert. No. Due Date
 1) Data Acquisition 34970A MY44035217 21LM30 23 Dec 2022

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.

Result of Calibration :- (') Without Adjustment

Function of UUC* : Temperature Source

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730



Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2210-0376OC-4
 Result of Calibration :- (') Without Adjustment
 Function of UUC* : Temperature Source

Cert. No.: 22TM1491
 Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
85.0	85.0	85.0	1	2	3	4	5 (ref.)
			84.527	84.563	84.628	84.516	84.580

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
85.0	0.12	0.081	0.18	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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Mdu .

a 1132471

Mdu .

a 1132470



Metrological Center
 SCI ECO Services Company Limited
 33/2 Moo 3, T.Banpa, A.Kaengkhloi, Saraburi 18110, Thailand
 Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
 Bangkok Tel : +668 9205 6851 , +668 8247 2360
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 SCI ECO Services Company Limited
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Certificate No. T230116

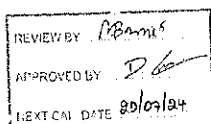
Page 2 of 4

Certificate No. T230116

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling 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 : 23 January 2023
 Calibrated By : Atiphong Rongrat (Technician)
 Approved By : Bunchoi Suriyawong / Bunchoi Suriyawong (Site Calibration Manager)
 Date of Issue : 07 FEB 2023



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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM114117 11-05-64

Calibration Report

Equipment : Chamber (Cooling Room)
 Date of Calibration : 25 January 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	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

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 - Minute At 3 °C
 Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

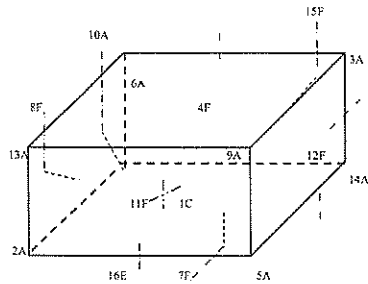
5. Adjustment :

(X) without adjustment () after adjustment

Approved By: Bunchoi Suriyawong

FM114117 15-05-64

Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C = TN141	12F = TN152
2A = TN142	13A = TN153
3A = TN143	14A = TN154
4F = TN144	15F = TN155
5A = TN145	16E = TN156
6A = TN146	
7F = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11F = TN151	

Approved By:

FM151117 15-05-63

BKK_EL0037

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24	3.34
	TN153	TN154	TN155	TN156								
	3.28	3.22	3.28	3.21								

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min, Max	Average				
3.0	2.8, 4.1	3.5	1.20	1.20	1.90	2.07

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:

FM151117 15-05-63

Agilent Technologies

Agilent Technologies (Thailand) Limited
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888 Rama 4 Road, SAI MAE BANGKOK
Bangkok 10500 Thailand

Tel: +662 637 6363
Fax: +662 637 4334
Email: ccc-sm@agilent.com
Website: www.agilent.com/thai

Service Confirmation Number: 6904803024

Service Confirmation Date: 20.03.2023

Customer Contact:

ALS Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Phet Suan
TAX ID: 0105540004859
Chanatagarn Inthorn@alsglobal.com
27603068

Invoice To:

ALS Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Phet Suan

Delivery Site:

ALS Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Phet Suan

Location:

Room
Bldg
Lab
Dept

SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 6006033811	Service Confirmation: 6004800024

REVIEW BY:

APPROVED BY:

EXTENSION DATE: 14 Sep 2024

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IO-5100	ICP-OES 5100/5110 System			
G8010A	Agilent 5100 SVDV ICP-OES Spectrometer	MY16010005	ICP OES 5100	SYS-IO-5100
G8410A	SPS 4 Autosampler	AU15440764	ICP OES 5100	SYS-IO-5100

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EDG	Enterprise Operational Qualification	1.00	Agreement Entitlement + 100 % covered	20.03.2023	20.03.2023

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Attn: No. 812 4452 007
THB Krung Thai Bank PCL
Sam Square Bldg 416/1-2 Rama 1 Rd Pathumwan, BKK 10330
Thailand

ORIGINAL



Metrological Center

SCI ECO Services Company Limited

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

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

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

Service Information:

Problem Description: WU-S-GQ-10-5109-5861143313		
Service Provided: Complete OGHV 5100/CP0ES Equipment ID: BKK_EL0037, all tests passed		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 4.0	Travel Hours: 2.0	
Customer Field Service Representative Name: Kanyakorn Sukphatjaroen	Customer Field Service Representative Signature: 	Date: 20 Mar 2022
Customer Name: Thitima Boonpeng	Customer Signature: 	Date: 20 Mar 2022
Additional Comments:		

Page 3 of 3

Certificate No. T220730

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 : 30 March 2022
Calibrated By : Watcharapon Sangtong (Technician)
Approved By : / Sujjar Naknukred (Site Calibration Manager)
Date of Issue : 12 APR 2022

REVIEW BY	T. Watcharapon C.
APPROVED BY	Sujjar Naknukred
NEXT CAL DATE	7/10/23

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-12 108 30-05-57



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Certificate No. T220730

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 7 April 2022
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 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.
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

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 25 Minute At 95 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

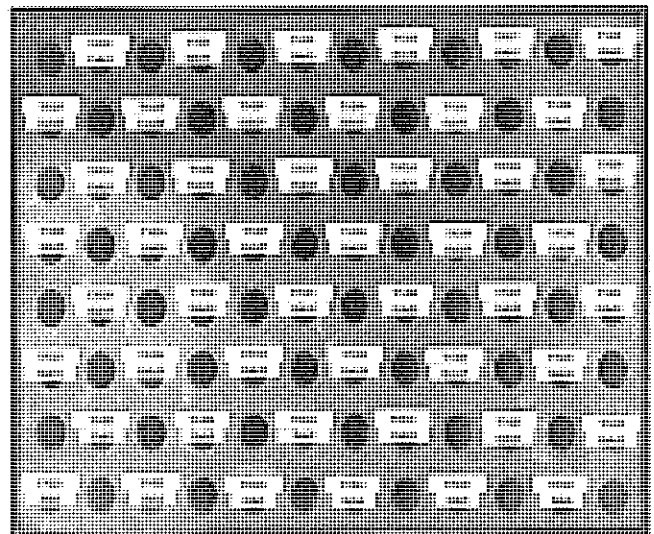
() without adjustment (X) after adjustment

Approved By.

Certificate No. T220730

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By.

Certificate No. T220730

Page 4 of 6

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	93.60	93.82	94.05	94.20	94.36	94.26
	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
CAL POINT	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
CAL POINT	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.45	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
R4 Hole19-Hole24		TN239	TN240	TN241	TN242	TN243	TN244
CAL POINT	Max	94.89	94.82	95.73	95.85	95.73	95.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30		TN245	TN246	TN247	TN248	TN249	TN250
CAL POINT	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	95.01	95.10	95.02	95.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36		TN251	TN252	TN253	TN254	TN255	TN256
CAL POINT	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42		TN257	TN258	TN259	TN260	TN261	TN262
CAL POINT	Max	96.46	96.15	96.19	96.06	96.35	97.09
	Min	96.13	95.84	95.85	95.72	96.04	96.78
	Average	96.30	95.99	96.02	95.89	96.20	96.93
R8 Hole43-Hole48		TN263	TN264	TN265	TN266	TN267	TN268
CAL POINT	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

 Approved By: 

FM-L13 108-30-05-57

Certificate No. T220730

Page 5 of 6

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	104.47	104.65	104.79	105.31	105.47	105.45
	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
CAL POINT	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.65	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
CAL POINT	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
R4 Hole19-Hole24		TN239	TN240	TN241	TN242	TN243	TN244
CAL POINT	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
R5 Hole25-Hole30		TN245	TN246	TN247	TN248	TN249	TN250
CAL POINT	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.59	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
R6 Hole31-Hole36		TN251	TN252	TN253	TN254	TN255	TN256
CAL POINT	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
R7 Hole37-Hole42		TN257	TN258	TN259	TN260	TN261	TN262
CAL POINT	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
R8 Hole43-Hole48		TN263	TN264	TN265	TN266	TN267	TN268
CAL POINT	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

 Approved By: 

FM-L13 108-30-05-57

Certificate No. T220730

Page 5 of 6

Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min, Max	Average		
100.0	100.0, 100.4	100.1	0.29	0.53
105.0	105.0, 105.4	105.1	0.20	0.79

* 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-L14 117-01-02-64

Certificate No. T221644

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold 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 : Environmental Laboratory

Date of Receipt : 27 June 2022

Calibrated By : Sujjar Nakkakred (Site Calibration Manager)

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 6 JUL 2022

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L14 117-01-02-64

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 30 June - 1 July 2022
Environment : Temperature : 18.9-23.7 °C
Line Voltage : 222.9-226.5 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	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 6244).

4. Condition of calibrated item : good

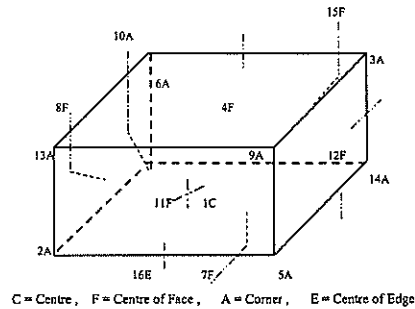
Equipment Description :

Time Constant ☒ 3 Hour ☐ Minute At ☒ 3 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment (X) after adjustment

Calibration Report



1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7F	=	TN167
8F	=	TN168
9A	=	TN169
10A	=	TN170

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By

FM-L15 11/7/15-05-63

Approved By

FM-L15 11/7/15-05-63

Calibration Report

Measurement Results:

Average Standard Reading at each position (°C)									
Calibration Point	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169
3	2.71	2.82	2.75	2.89	2.95	3.68	3.02	2.96	3.03
	TN171	TN172	TN173	TN174	TN175	TN176			
	2.97	3.02	2.89	3.04	2.97	3.33			

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	4.0	3.2	2.99	1.05	1.30	1.66

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By

FM-L15 11/7/15-05-63

RYG_EN0188

Certificate of Calibration

Equipment: Block Digestion Unit
Model: KT-20s
Serial No. (or ID.): 6720210009/5770200073
Manufacturer: Garhardt
Condition: In Condition
Certificate No.: C29230010
Issued Date: 18 March 2023
Job No.: KSPR2304382
Page: 1 of 4
Digestion Block: 20 holes.

Customer: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
016/10 Moo 5 T.Maenam Khu, A.Plusdaeng,
Rayong 21140, Thailand.

Environment Conditions: Temperature: 25 °C ± 0.5 °C
Humidity: 65 %RH ± 3.7 %RH
Voltage: 231 VAC ± 3.1 VAC

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

Calibration By: Mr. Nekarín Rueros
Calibration Date: 15 March 2023
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.: TC220080

REVIEW BY: N. Rueros
APPROVED BY: D. Srichana
NEXT CAL. DATE: 15/03/24

(Mr. Nekarín Rueros)
Person in charge

(Mr. Udon Srichana)
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 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, compared or sampled. The report should not be reproduced except in full without approval of DKSH Technology Limited.

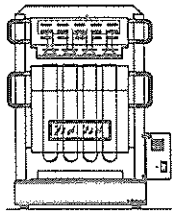
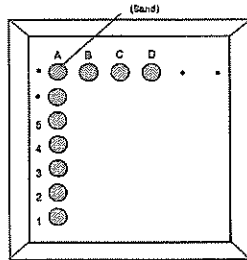


Fig. 1.: Front view



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.

Calibration Results:

Before adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	300	300	300	378.1	-4.9	1.5
A2				374.3	-5.7	1.5
A3				374.8	-5.4	1.5
A4				376.3	-3.7	1.5
A5				373.2	-6.8	1.5
B1				374.4	-5.6	1.5
B2				374.3	-5.7	1.5
B3				374.6	-5.4	1.5
B4				375.2	-4.8	1.5
B5				375.1	-4.9	1.5
C1				373.5	-6.5	1.5
C2				372.8	-7.2	1.5
C3				372.1	-7.9	1.5
C4				372.2	-7.8	1.5
C5				374.5	-5.5	1.5
D1				374.7	-5.3	1.5
D2				375.3	-4.7	1.5
D3				375.5	-4.5	1.5
D4				375.8	-4.2	1.5
D5				375.1	-4.9	1.5

Calibration Results:

After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	300	300	300	379.0	-1.0	1.5
A2				378.7	-1.3	1.5
A3				379.4	-0.6	1.5
A4				379.2	-0.8	1.5
A5				379.2	-0.8	1.5
B1				379.8	-0.2	1.5
B2				379.2	-0.8	1.5
B3				379.5	-0.5	1.5
B4				378.9	-1.1	1.5
B5				379.1	-0.9	1.5
C1				379.1	-0.9	1.5
C2				377.7	-2.3	1.5
C3				378.4	-1.6	1.5
C4				378.2	-1.8	1.5
C5				378.0	-2.0	1.5
D1				379.5	-0.5	1.5
D2				378.7	-1.3	1.5
D3				379.7	-0.3	1.5
D4				379.6	-0.4	1.5
D5				379.4	-0.6	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เครื่องหมายเลข: KSPR2304352

ชนิดเครื่อง: Block Digestion Unit รุ่น: KT-20a

หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ครั้ง)		หมายเหตุ
15 Mar 2023			15 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ลงนาม:

Mr. Nakerin Ruangs

Service Engineer



Cert.No.: 22CH1733
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 : 21 December 2022
Calibration Date : 22 December 2022
Reference : 2212-0602DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5 T.Moenam 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-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lernagatrakul

Approved by : Malee
Approved Signatory

(/) Malee Bulkruea
() Saitip Meangmal
() Warakorn Lernagatrakul

Issue Date : 26 December 2022

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 22CH1733
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 | 22E2769 | 24 Aug 2023 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 221306 | 27 Oct 2023 |
- This certification is traceable to the International System of Unit maintained at -
- Traceable to National Institute of Metrology (Thailand), NIMT

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	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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 (±mV)	Coverage factor k
			pH	mV		
pH Meter	4.000	177.48	177.3	4.000	0.058	2.00
S/N.: B834291445	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 22CH1733
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 S/N.: 1475518	4.008	4.011	185.2	0.0052	2.06
	6.987	6.990	10.4	0.0088	2.00
	10.008	10.014	-168.5	0.0072	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe.

- Model : InLab Expert Pro-ISM
- Serial No. : 1475518

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	25.001	24.9	-0.101	0.13	2.00

Remark : * UUC* = Unit Under Calibration

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

-000-



Certificate of Calibration

Certificate No.: 22E4098
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No. : B834291445
ID No. : RYG_EN0152

Condition As-Received: Used Item
Received Date : 21 December 2022
Calibration Date : 23 December 2022

Reference : 2212-0602DSC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 10) %
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
610/10 Moo 5, T Moenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Procedure used: Calibration was conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

Condition of this result of calibration

- 1 Reference standards instruments
- | Instrument | Model | Serial No. | Certificate No. | Due Date |
|-----------------------------|-------|------------|-----------------|-------------|
| 1) Multi-Product Calibrator | 5500A | 6315011 | 22E1431 | 05 May 2023 |
- 2 This result of calibration was made on requested at the point specified by customer
- 3 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 at -
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Wuthareenpong Wongchulkrane
Issue Date : 26 December 2022

Approved Signatory : Malee
(/) Phaisan Prempaisai
() Nuntawat Khamchai
() Pornthip Tanyakul



Cert. No.: 22E4088
Page: 2 of 2

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

Function:	DC voltage measurement	Range:	2000	mV	
	Standard Value	UUC* Reading	Error	Uncertainty	
	(mV)	(mV)	(mV)	(± μV)	
	-200.0000	-200.0	0.0	72	
	-150.0000	-150.0	0.0	69	
	-100.0000	-100.0	0.0	65	
	-50.0000	-50.0	0.0	62	
	0.0000	0.0	0.0	58	
	50.0000	50.0	0.0	62	
	100.0000	100.0	0.0	65	
	150.0000	150.0	0.0	69	
	200.0000	199.9	-0.1	72	

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.

-o0o-

a 1140616

REVIEW BY: Autcharawan S.
APPROVED BY: Somrat M.
NEXT CAL DATE: 11 Jan 24



Certificate of Calibration

ICS-2100: Anion (ID#488)

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

ICS-2100 S/N: 11080010

AS-HV S/N: 5050A23120

For

ALS Laboratory Group (Thailand) Co., Ltd.

Operator Signature: [Signature] Date: Jan 11, 2023
(Mr. Nutdanai Laekhwan)
Application Chemist

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Certificate of System Qualification

GC-00 - GCMS-00

Agilent CrossLab Compliance Services

REVIEW BY: [Signature]

APPROVED BY: [Signature]

CAL DATE: 20/11/23

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn 40, Pathanakarn Rd., Kwang Suan Luang, Khet Suan Luang, Bangkok 10250
Date: November 23, 2021 1:12:35 PM
EQP Name: Agilent Recommended, Agilent Recommended
EQP Revision: GC 02.52, GCMS 02.51
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Nantawadee Somluon

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front MM
Setpoint Status: Pass
Setpoint: 25.0 psi Actual: 24.9 psi
Accuracy: 0.1 psi
Agilent Recommended: <= 1.2

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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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: 230.0 229.8 °C
Accuracy: -0.2 °C
Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)
<= 1.0 % setpoint in K (5.0 °C)
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 100.0 99.8 °C
Accuracy: -0.2 °C
Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)
<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint/Average
Temperature: 100.0 99.78333 °C
Stability: 0.1 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	7600D			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1	Front	MMI	/ External	TQ
Name:	7693A			
Source:	EI - Extractor			
Setpoint Status:	Completed			
Injection Volume on Column:	1.0 uL			

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1	Front	MMI	/ External	TQ
Name:	7693A			
Source:	EI - Extractor			

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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Setpoint Status:	Pass	
Injection Volume on Column:	1.0 uL	
Minimum RSD:	5.79 %	Area
Agilent Recommended:	<= 12.00	Retention Time
Status:	Pass	0.05 %
Instrument Detection Limit:	1.04600 fg	<= 1.00
Agilent Recommended:	<= 4.03600	Pass
Status:	Pass	

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	7693A			
Source:	EI - Extractor			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0 uL			
RSD:	4.07 %	Area Mass 1	Mass Ratio	
Agilent Recommended:	<= 5.00	Abundance's	2.68 %	
	Pass	<= 5.00	Pass	

Overall Mass Ratio Precision Test Status

Pass

Date: November 23, 2021 1:12:35 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	7690
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.11.03
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN16170137
Firmware Revision	A.11.03
Vial Heater	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	7690
Model Number	G3442B
Serial Number	CN18153080
Firmware Revision	B.02.05
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	7690
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	TQ
Name	7000D
Serial Number	US1626U109
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	QFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Electronic Signature

Purpose

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Details

Full Name of Signer:	Jaruwat Channarong
Logged On User Name:	jaruwat.channarong@agilent.com
Signature Creation Date:	November 23, 2021
Reason for Signature:	Executed protocol and published this original version of document

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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User Name: jaruwat.channarong

Hostname: ASBRKWX265

System ID: GM-10

Print Date: November 23, 2021 11:23:35 PM

ALS_GM10 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:13:35 AM	Audit	SessionCreated	Session	None
November 23, 2021 10:13:35 AM	Start	Configuration	Session	None
November 23, 2021 10:13:35 AM	Audit	Entitlement	Licensing	User is Field Engineer and does not require an unlock code
November 23, 2021 10:20:27 AM	Audit	EqLoaded	Session	EQP details for primary technique [GC]. File path: [ProtocolPacks\GC\Configuration\02.02.02.57.eqp]. EQP File Name: [GC_02.57.eqp]. EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GCMS]. File path: [ProtocolPacks\GCMS\Configuration\02.51\GCMS_02.51.eqp]. EQP File Name: [GCMS_02.51.eqp]. EQP Name: [AgilentRecommended]
November 23, 2021 10:20:37 AM	End	Configuration	Session	None
November 23, 2021 10:21:34 AM	End	Configuration	Session	None
November 23, 2021 10:21:52 AM	Start	Qualification	Session	QQ
November 23, 2021 10:21:54 AM	Start	Execution	CDS Login Verification - GC	None
November 23, 2021 10:25:49 AM	End	Execution	CDS Login Verification - GC	Run Count: 1

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User Name: jaruwat.channarong Hostname: ASDRHWX265		System ID: GM-10 Print Date: November 23, 2021 11:23:35 PM		
ALS_GM10 Transaction Log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:28:42 AM	Start	Execution	System Inspection and Basic Safety and Operation: 7850 - Qualitative Test: No setpoints associated	None
November 23, 2021 10:28:54 AM	End	Execution	System Inspection and Basic Safety and Operation: 7850 - Qualitative Test: No setpoints associated	Run Count: 1
November 23, 2021 10:28:56 AM	Start	Execution	Inlet Pressure Accuracy: Front MS - Pressure Controlled Inlet S: 25.0 psi L: +/- 1.2 psi	None
November 23, 2021 10:27:01 AM	End	Execution	Inlet Pressure Accuracy: Front MS - Pressure Controlled Inlet S: 25.0 psi L: +/- 1.2 psi	Run Count: 1
November 23, 2021 10:27:05 AM	Start	Execution	GC Oven Temperature Accuracy: 7850 - Temperature Oven S: 230.0°C L: >= 1.0 AND <= 1.0 % setpoint in K	None
November 23, 2021 10:27:28 AM	Audit	Data	GC Oven Temperature Accuracy: 7850 - Temperature Oven S: 230.0°C L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
November 23, 2021 10:27:31 AM	End	Execution	GC Oven Temperature Accuracy: 7850 - Temperature Oven S: 230.0°C L: >= 1.0 AND <= 1.0 % setpoint in K	Run Count: 1
November 23, 2021 10:27:33 AM	Start	Execution	GC Oven Temperature Accuracy: 7850 - Temperature Oven S: 300.0°C L: >= 1.0 AND <= 1.0 % setpoint in K	None
November 23, 2021 10:27:44 AM	Audit	Data	GC Oven Temperature Accuracy: 7850 - Temperature Oven S: 300.0°C L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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User Name: Janewat.Channarong

Hostname: ASDKRWX265

System ID: GM-10

Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:27:45 AM	End	Execution	GC Oven Temperature Accuracy - 7850 - Temperature Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Run Count: 1
November 23, 2021 10:28:26 AM	Start	Execution	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:25:24 AM	Start	Execution	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:35:59 AM	Start	Execution	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:37:48 AM	Start	Execution	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:39:20 AM	Audit	Data	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
November 23, 2021 10:39:33 AM	End	Execution	GC Oven Temperature Stability - 7850 - Temperature Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
November 23, 2021 10:39:26 AM	Start	Execution	Tune EI - 7000D TQ - Source: None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
November 23, 2021 10:41:10 AM	End	Execution	Tune EI - 7000D TQ - Source: None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count: 1

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: Janewat.Channarong Hostname: ASDKRWX265			System ID: GM-10 Print Date: November 23, 2021 1:12:38 PM	
ALS_GM10 Transaction log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:41:13 AM	Start	Execution	Tune EI - 7000D TQ - Source: None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
November 23, 2021 10:41:34 AM	End	Execution	Tune EI - 7000D TQ - Source: None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	Run Count: 1
November 23, 2021 10:43:42 AM	Start	Execution	Scouting Run - Injection Tower - Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	None
November 23, 2021 10:44:20 AM	Audit	Data	Scouting Run - Injection Tower - Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:19 AM	End	Execution	Scouting Run - Injection Tower - Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	Run Count: 1
November 23, 2021 10:45:14 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	None
November 23, 2021 10:45:29 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:35 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: janewat.channarong

Hostname: ASDKHWA265

System ID: GM-10

Print Date: November 23, 2021 1 12:38 PM

ALS_GM10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:45:29 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: Janewat.Channarong

Hostname: ASDKRWX265

System ID: GM-10

Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:45:29 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_010.D
November 23, 2021 10:46:50 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Run Count: 1
November 23, 2021 10:47:03 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	None
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_001.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_002.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_003.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_004.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor: L (RSD) <= 8.00%	Data File Path D:\MassHunter\GCMS1\data Agilent\002021\01_005.D

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: jenswatschmanrong
Host Name: ASDHKGW231

System ID: GM-10
Print Date: November 23, 2021 1:12:38 PM

AL9_GM10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower: Front MMR, TQ: - Source: EI - Extractor L (RSD): ± 5.00%	Data File Path: D:\MassHunter\GCMS\Fdata -Agilent002321\JRRP_008.D
November 23, 2021 10:48:02 AM	End	Execution	Mass Ratio Precision - Injection Tower: Front MMR, TQ: - Source: EI - Extractor L (RSD): ± 5.00%	Run Count: 1
November 23, 2021 10:48:07 AM	End	Qualification	Session	OQ
November 23, 2021 10:48:07 AM	Start	Reporting	Session	None
November 23, 2021 1:01:43 PM	Audit	AcqClosed	Session	None
November 23, 2021 1:03:30 PM	Audit	AcqRestarted	Session	None
November 23, 2021 1:03:32 PM	Audit	SessionReloaded	Session	None
November 23, 2021 1:03:37 PM	Start	Qualification	Session	OQ
November 23, 2021 1:11:56 PM	Audit	Reporting	Session	Report Generated - Certificate

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