

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	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	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	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_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_FS0613	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0614	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0615	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0616	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0618	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0621	20-Oct-22	20-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_FS0218	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0226	27-Feb-23	27-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0230	25-Aug-22	25-Aug-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0231	3-Aug-22	3-Aug-23	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

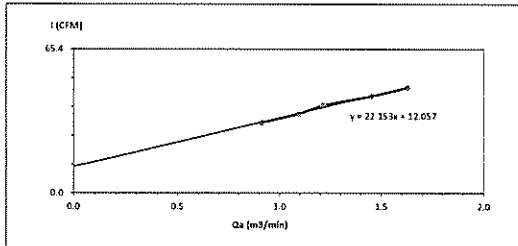
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG_FS0420	3-Apr-23	3-Apr-24	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	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
Rayong Lab	Ammonia Nitrogen	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-23	18
Rayong Lab	Conductivity (On site)	Conductivity meter	RYG_FS0597	19-Jul-22	18-Jul-23	12
Water Lab	Calcium	ICP-OES	BKK_EL0037	2-Mar-23	1-Mar-24	12
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	2-Mar-23	1-Mar-24	12
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	2-Mar-23	1-Mar-24	12
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	2-Mar-23	1-Mar-24	12
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
Water Lab	Chlorite	Ion Chromatography	BKK_EN0130	11-Jan-23	11-Jan-24	12
Water Lab	Organochlorine Pesticide	GC MSMS	BKK_EN0284	25-May-23	25-Nov-24	18



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd.
 Calibrate Location: โรงบรรจุภัณฑ์พลาสติก
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-FS0185
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-FS0185
 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: Jan
 (Mr.) Jaradrawee Sriruksa
 Field Scientist (2)

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

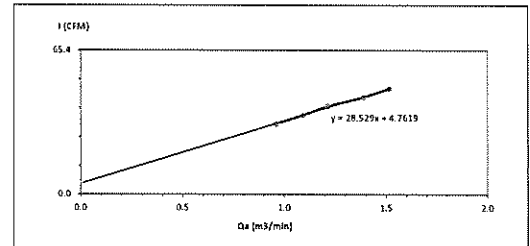
FORM NO. F 06-074 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd.
 Calibrate Location: โรงบรรจุภัณฑ์พลาสติก
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-FS0184
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-FS0184
 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: 28.5296 Intercept: 4.7619 Correlation Coefficient: 0.9902
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: Jan
 (Mr.) Jaradrawee Sriruksa
 Field Scientist (2)

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

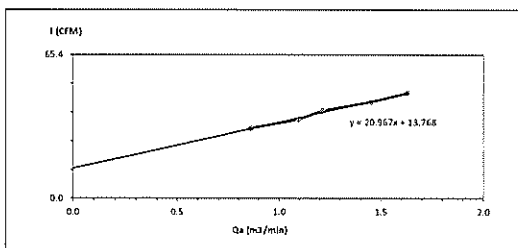
FORM NO. F 06-074 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd.
 Calibrate Location: โรงบรรจุภัณฑ์พลาสติก
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-FS0186
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-FS0186
 High Volume Model: TE-5009X
 High Volume S/N: 4794
 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: 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: Jan
 (Mr.) Jaradrawee Sriruksa
 Field Scientist (2)

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

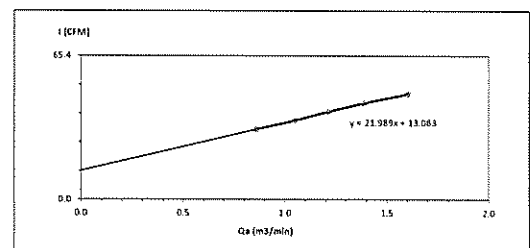
FORM NO. F 06-074 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd.
 Calibrate Location: โรงบรรจุภัณฑ์พลาสติก
 Calibrate Date: 16-May-23
 Calibration Sheet No.: C-160523-RYG-FS0183
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 756
 Temperature (°C): 31
 High Volume ID: RYG-FS0183
 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	1.096	36	
3	3.2	1.214	40	
4	4.2	1.389	44	
5	5.6	1.602	48	



Calibrated by: Jan
 (Mr.) Jaradrawee Sriruksa
 Field Scientist (2)

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

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

Sartorius (Thailand) Co., Ltd.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2943 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS

REVIEW BY: Pratit

APPROVED BY: D. K.

NEXT CAL DATE: 01/03/24

Certificate of Calibration

Model Number: LA130S-F Certificate No.: 23BC10110
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 25409664 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.Pluek Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluek 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:
Capacity: 150 g Readability: 0.0001 g
Ambients Conditions:
Temperature: 24.2 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±
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	C02212585	14-Sep-2023
MHB-362SD	Humidity/Barometer/Temp Lutron 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.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2943 8361-6 Fax: +66 2943-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: LA130S-F Certificate No.: 23BC10110
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 25409664 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 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 OIML R110)	
Nominal Value : (Low Load)	10.0000 g	Nominal value	50 g
Tolerance	0.0001 g	Tolerance	0.0004 g
Nominal Value : (High Load)	100.0000 g		
Tolerance	0.0001 g		
Standard Deviation	0.00009		

Linearity

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

Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00022
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

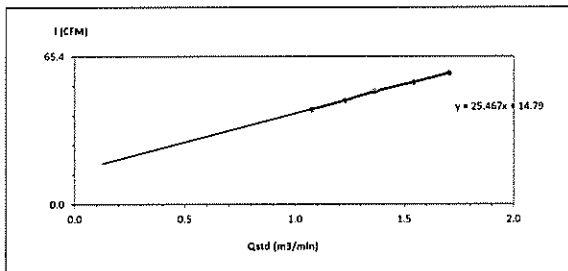
End of Report

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg): 756
Calibrate Location: โรงเรือนปลูกผัก 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	



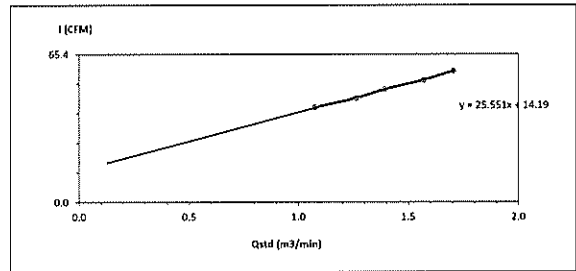
Calibrated by: Jam
(Mr.Jaradrawee Sritruxa)
Field Scientist(2)

Approved by: N. Pongprong Juntaruporn
(Mr. Nopprong Juntaruporn)
Enviro Field Coordinator Scientist (3)

High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg): 756
Calibrate Location: โรงเรือนปลูกผัก 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: Jam
(Mr.Jaradrawee Sritruxa)
Field Scientist(2)

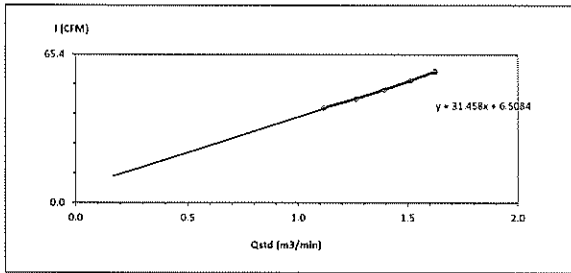
Approved by: N. Pongprong Juntaruporn
(Mr. Nopprong Juntaruporn)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงเรียนปทุมคงคา (บางกอกใหญ่) 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 : 1.59765
 Calibrator S/N : 1166 Calibrator Intercept : -0.02043

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: 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. Hoppeng Juntarupan
 Enviro Field Coordinator Scientist (3)

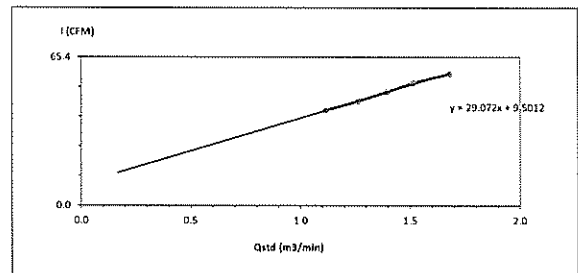
FORM NO. F-06-073 REVISION NO. : ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงเรียนปทุมคงคา 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 : 1.59765
 Calibrator S/N : 1166 Calibrator Intercept : -0.02043

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: 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. Hoppeng Juntarupan
 Enviro Field Coordinator Scientist (3)

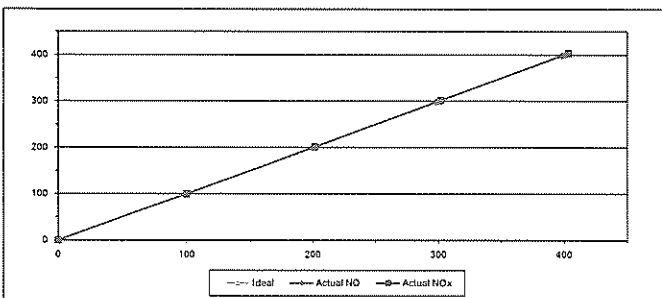
FORM NO. F-06-073 REVISION NO. : ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date : 5-Jan-23 Equipment Name : NOx Analyzer
 Manufacturer : HORIBA Model : APNA-370
 Serial No. : TB5HW41 Equipment ID : RYG_FS0461
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 047
 Std. Gas Concentration (PPM) : 55.88 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expiry Date : 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	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 Jitranont
 Assistant General Manager

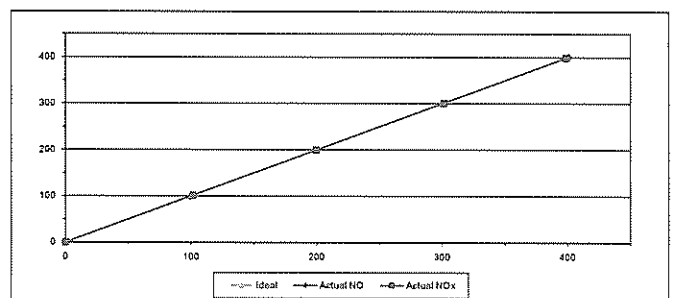
ALS Laboratory Group
 FORM NO. F-06-056 REVISION NO. : ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date : 5-Jan-23 Equipment Name : NOx Analyzer
 Manufacturer : HORIBA Model : APNA-370
 Serial No. : NV0ER3YH Equipment ID : RYG_FS0459
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 047
 Std. Gas Concentration (PPM) : 55.88 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expiry Date : 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.80	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 Jitranont
 Assistant General Manager

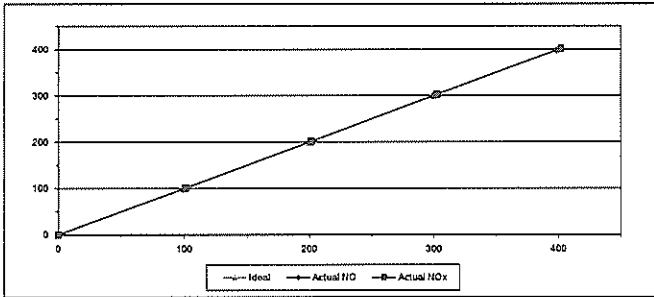
ALS Laboratory Group
 FORM NO. F-06-056 REVISION NO. : ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	RDEK0177	Equipment ID	RYG_FS0483
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	98.50	-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			0.68	



Calibrated By

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

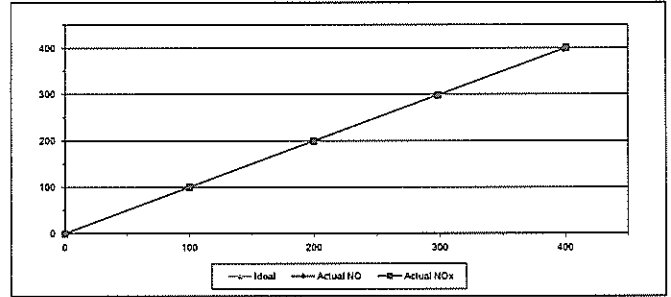
Approved By

(Mr. Sanyuth Jitranont)
Assistant General ManagerALS 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.	T2T8YRL	Equipment ID	RYG_FS0457
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	398.60	-1.40	-0.35	400.70	0.70	0.17	
AVERAGE (%)				-0.74			-0.05	



Calibrated By

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

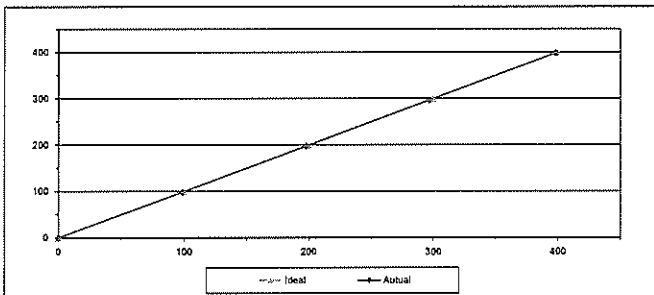
Approved By

(Mr. Sanyuth Jitranont)
Assistant General ManagerALS 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.	VABFSLH	Equipment ID	RYG_FS9480
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	B47		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30
2	200.00	197.80	-2.20	-1.10
3	300.00	296.50	-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)

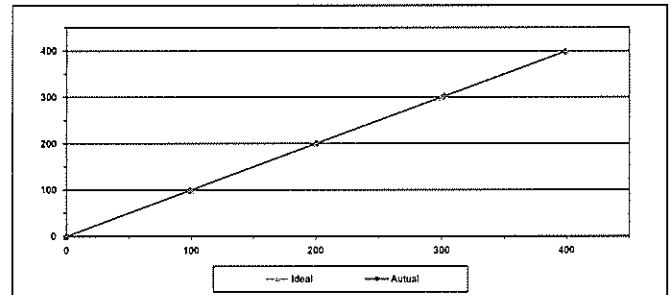
Approved By

(Mr. Sanyuth Jitranont)
Assistant General ManagerALS 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.	PAUY077A	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	201.10	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)

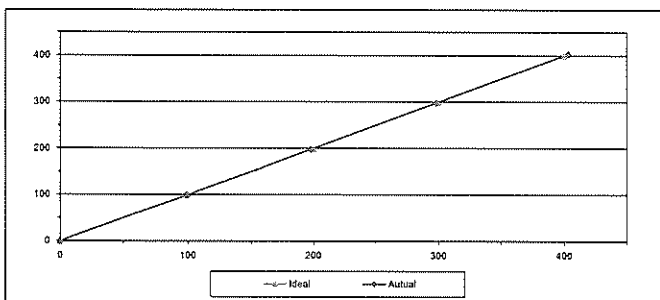
Approved By

(Mr. Sanyuth Jitranont)
Assistant General ManagerALS Laboratory Group
FORM NO. F-06-056 REVISION NO. : ISSUE DATE: 02/04/12



Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HDRIBA	Model	APBA-370
Serial No.	XL28Y85B	Equipment ID	RYG_FSQ482
Calibrating Manufacturer	Teladyns API	Model	700
Serial No.	847		
Sid. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90
2	200.00	198.10	-1.90	-0.95
3	300.00	297.60	-2.40	-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.Sanyuth Jittranont)
Assistant General Manager

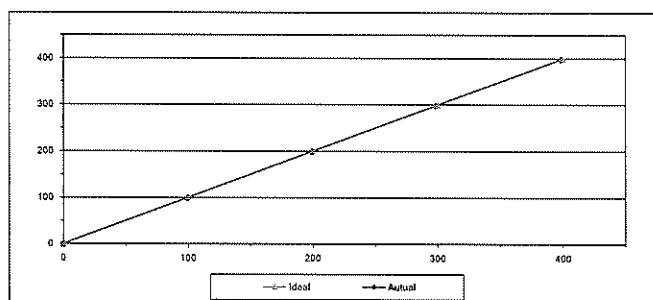
ALS Laboratory Group

FORM NO. F 08-056 REVISION NO. - ISSUE DATE 02/04/12



Calibration Date	4-Jan-23	Equipment Name	SD2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	ROHWYDWW	Equipment ID	RVQ_F80456
Calibrator Manufacturer	Teledyne APi	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Almgas 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. Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By _____

(Mr. Sarayuth Jitranont)
Assistant General Manager

A.I.S. Laboratories Group

FORM NO. E-66-055 REVISION NO. 1 ISSUE DATE 02/04/12



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Web site: www.j.p.sasak.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-7154-PLS 17025
CALIBRATION 0167

Air speed measurement laboratory
Calibration services department.

Certificate Number

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CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	Cup anemometer
MANUFACTURER	Novaflow
MODEL/TYPE	Sensor WS 02F Data logger WS 250L
SERIAL NUMBER	Sensor - Data logger A2481
ID NUMBER	EKF_150141
CONDITION AS-RECEIVED	Used item
CUSTOMER	ASL Laboratory group (Thailand) Co., Ltd 104 Phatthana-anon Rd, Phatthana-anon Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	28 Dec 2022
DEFAUSULTED DATE	05 Jan 2023
ISSUE DATE	09 Jan 2023
ENVIRONMENTAL CONDITIONS:	
Ambient condition in the laboratory are as follow	
Temperature	21.0 ± 3.0 °C
Relative Humidity	55.0 ± 15.0 %RH
Atmospheric Pressure	1010 ± 10 hPa
PLACE OF CALIBRATION	
Effli-Flow wind tunnel of Javanale Associates Co., Ltd	
CALIBRATION CONDITIONS	
Wind tunnel cross-section area ^a	900 cm ²
Wind direction (digital level) ^b	100 cm ²
Diameter of mounting pipe ^c	mm
Blockage ratio of test object ^d	0.111 [-]
Preconditioning	24 Hours at ambient conditions.
Measurement Condition	The test object was set up in the measurement are 123 °C, 147 ± 1

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

Celebrated by:
 LT Mr. Sarawit Thachakul
 LT Miss Asteaporn Kitisamphol

Remarks:

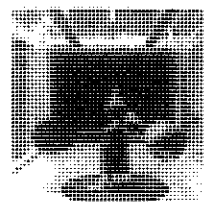
- ¹ Inside cross-section area of the wind tunnel
- ² Projected cross-section area of the tested object include mounting pipe
- ³ Diameter of mounting pipe
- ⁴ Ratio γ to γ_0

Calibration procedure. The cup anemometer was calibrated against standard air velocity transducer model B55-22 and pitot tube with precision differential pressure meter model: DFM2500 in an open test-section of lift/tail wind tunnel with 900 cm² cross test section area. The W-CL-007 based on IEC 61450 12.1. Wind energy generation systems - Part 12.1. Power performance measurements of electricity producing wind turbines. March 2017 was used as a calibration guideline.

Traceability.
This certificate provides a traceability of the measurement to recognized the essential standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: NMIC02-23 and NMIC06-23.

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

Mr. Parvys Houtzboen
Celebration Occasions Manager



Page 2 of 2 Pages

MEASUREMENT RESULTS²

The up-areometer, Unit Under Calibration (UUC) was exercise at 30 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer 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 100 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out during 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_{∞} (m/s)	Temp. wind tunnel ($^{\circ}$ C)	Temp. room ($^{\circ}$ C)	v_{∞} (m/s)	Error (m/s)	$U(x=2)$ (m/s)
0.059	23.82	23.85	0.7	-0.3	0.16
2.011	23.90	23.85	1.7	-0.8	0.16
3.051	24.00	23.85	2.9	-0.2	0.20
4.132	23.84	23.85	3.9	-0.2	0.20
5.00	23.88	23.85	4.9	-0.1	0.24
5.98	23.24	23.85	5.8	-0.2	0.18
7.06	23.82	23.55	6.8	-0.2	0.19
8.17	23.50	23.85	8.0	-0.1	0.22
9.06	23.72	23.85	9.0	-0.1	0.21
10.09	23.85	23.85	9.9	-0.2	0.20
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
14.29	23.70	23.85	14.1	-0.2	0.27
15.26	23.64	23.85	15.0	-0.3	0.23
16.20	23.60	23.85	16.1	-0.2	0.28

Remarks:

^b Calibration results only could be for the tested circumstances and environmental conditions during which calibration took place.^c Velocity of standard

Validity of Host Under Calibration

PHOTO OF CALIBRATION SET-UP

Calibration set-up of the cup anemometer calibration in the wind tunnel of Transient Associates Co. Ltd. The cup anemometer shows a slight difference from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.

End of Certificate of Completion

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

By Mr. Sorawat Thacharad

By Miss Jiraporn Terntanlop

Remarks:

1. Visible cross section area of the wind tunnel

2. Prescribed cross section area of the tested object include mounting pipe

3. Diameter of mounting pipe

4. Ratio 1:1

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: 4040075-0004 P3 5-100 in on close test section of Eiffel type wind tunnel with 500 cm² cross test section area. The WCL 008 based on IEC 61400-12 1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines. March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIM (National Metrology Institute of Thailand) via Certificate number: DA 0343 22

Uncertainty of Measurement:

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

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

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

Remark:

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

Direction of standard

Direction of Unit Under Calibration

End of Certificate of Calibration

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

By Mr. Sorawat Thacharad

By Miss Jiraporn Terntanlop

Remarks:

1. Visible cross section area of the wind tunnel

2. Prescribed cross section area of the tested object include mounting pipe

3. Diameter of mounting pipe

4. Ratio 1:1

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DP41500 in on close test section of Eiffel type wind tunnel with 500 cm² cross test section area. The WCL 007 based on IEC 61400-12 1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines. March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIM (National Metrology Institute of Thailand) via Certificate number: MIV-0052-21 and MIV-0056-22

Uncertainty of Measurement:

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

Page 2 of 2 Pages

MEASUREMENT 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 100 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both ramp and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.989	24.10	24.00	0.7	-0.3	0.18
2.034	23.96	24.00	1.7	-0.3	0.16
3.051	24.06	24.00	2.9	-0.2	0.19
4.138	24.00	24.00	3.9	-0.2	0.19
4.99	24.00	24.00	4.8	-0.3	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
9.05	23.72	24.00	9.1	0.0	0.30
10.09	23.60	24.00	9.9	-0.1	0.24
11.15	23.60	24.00	11.1	-0.1	0.28
12.13	23.60	24.00	12.1	0.0	0.28
13.21	23.50	24.00	13.2	0.0	0.34
14.37	23.18	24.00	14.4	0.1	0.12
15.76	23.88	24.00	15.1	-0.1	0.27
16.32	24.00	24.00	16.4	0.1	0.28

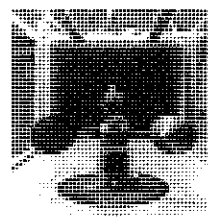
Remark:

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

Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



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

End of Certificate of Calibration

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



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	13 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-130123-BHK_FS0459	Relative Humidity (%) :	55
Digital Temperature ID :	BKK_FS0469	Reference Temperature ID	BKK_FS0609
Serial No. :	1302005	Serial No. :	7680004
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
Oven	140	139	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
Filter	140	139	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
Exit	140	139	-1	±3	Pass
	0	0	0	±3	Pass
	10	9	-1	±3	Pass
Meter	20	19	-1	±3	Pass
	0	0	0	±3	Pass
	25	24	-1	±3	Pass
AUX	50	49	-1	±3	Pass
	0	2	2	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE (Maximum permissible error of measurement) ค่าตามที่กำหนดจะแสดงตามรหัสต่อไปนี้

Calibrated by Saksit Phaisanphut Approved by Nattapon Jangwong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jangwong)
 Field Scientist (4) Specialist (1)

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE 9 Feb 23

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE 30 Jan 22

Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0473 Calibration Date 13 Jan 23
 Lab test duct Number 258-1-13-01 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
		Cp		0.842	0.842

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

$$\text{Average deviation(A or B)} = \frac{\sum_{i=1}^n [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by Saksit Phaisanphut Approved by Nattapon Jangwong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jangwong)
 Field Scientist (4) Specialist (1)

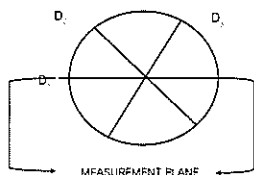
FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE 30 Jan 22



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 Phaisanphut Approved by Nattapon Jangwong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jangwong)
 Field Scientist (4) Field Specialist (1)

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE 30 Jan 22



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mm-Hg) : 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 (%) : 1.0160
 Next Calibration Date : 09/27/23

Calibration No. C-130123-RYG_FS0015
 Dry Gas Meter ID RYG_FS0315
 Serial No. 1706091
 Model No. XC-572-V

ΔH (mm H ₂ O)		Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter				Dry Gas Meter Calibration	
		W (Lbs)		T (°C)		V (Lbs)		T (°C)		Correction Factor (%)	Avg. ΔH (mm H ₂ O)
		Final	Initial	Final	Initial	Final	Initial	Final	Initial		
15	12.16	150.00	0.00	150.00	35.0	1659025.4	1542020.0	34.0	34.0	1.0432	46.1316
25	9.33	150.00	0.00	150.00	35.0	1659215.2	1659070.0	35.0	35.0	1.0471	45.1163
50	6.61	150.00	0.00	150.00	35.0	1659252.2	1659380.0	35.0	35.0	1.0479	45.1435
80	5.20	150.00	0.00	150.00	35.0	1660065.0	1659860.0	35.0	35.0	1.0463	44.7012
120	4.71	150.00	0.00	150.00	37.0	1660164.0	1660070.0	37.0	37.0	1.0462	44.3799
										1.0461	43.9451

Y Ratio of reading of reference to dry gas meter, tolerance for individual values ± 0.07 mm average.

ΔH_{avg} Orifice pressure differential that equates to 21.24 in of air @ 75 °C and 760 mm of mercury, marked tolerance for individual values ± 5.08 mm average.

Procedure: ISO 6460 APP A METH 1 SEC 5.3 & 7

Calibrated by Saksit Phaisanphut Approved by Nattapon Jangwong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jangwong)
 Field Scientist (4) Field Specialist (1)

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE 30 Jan 22



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date	13/01/23	Ambient Temperature (°C)	30
Calibration sheet No.	C-130123-RYG_FS0316	Relative Humidity (%)	55
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	
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 Phaisangphut
Mr Saksit Phaisangphut
Field Scientist (4)

Approved by Nattapon Jengwareewong
Mr Nattapon Jengwareewong
Specialist (1)

FORM NO. P-004/27 REVISON NO. 1 DATE DATE 2/10/22



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

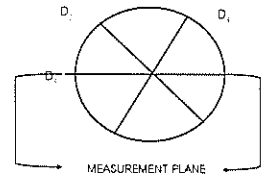
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	D ₁ - D ₂ - D ₃ / 3
	D ₁	D ₂	D ₃		
1	0.300	0.300	0.300	0.000	0.300
2	0.470	0.465	0.465	0.005	0.467
3	0.600	0.600	0.600	0.000	0.600
4	0.770	0.760	0.755	0.015	0.762
5	0.920	0.930	0.930	0.010	0.927
6	1.080	1.080	1.085	0.005	1.082
7	1.240	1.230	1.235	0.010	1.235
8	1.594	1.598	1.597	0.004	1.598

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 Phaisangphut
(Mr Saksit Phaisangphut)
Field Scientist (4)

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

FORM NO. P-004/27 REVISON NO. 1 DATE DATE 2/10/22



Pitot Tube Calibration Data

Pitot Tube Identification Number RYG_FS0320 Calibration Date 13 Jan 23
Lab test duct Number 258-1-13-01 Standard Pitot ID BKK_FS0441
Calibration Sheet No C-130123-RYG_FS0320 Cp Standard 0.99

Type G 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
			Cp	0.842	0.842

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

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

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

FORM NO. P-004/27 REVISON NO. 1 DATE DATE 2/10/22



Pitot Tube Calibration Data

Pitot Tube Identification Number RYG_FS0321 Calibration Date 13 Jan 23
Lab test duct Number 258-1-13-01 Standard Pitot ID BKK_FS0441
Calibration Sheet No C-130123-RYG_FS0321 Cp Standard 0.99

Type G 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
			Cp	0.842	0.842

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

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

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

FORM NO. P-004/27 REVISON NO. 1 DATE DATE 2/10/22

Sartorius (Thailand) Co., Ltd.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-5, e-mail: service.thailand@sartorius.com



SARTORIUS

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

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC10115
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 Inthana
Calibration Date: Wednesday, March 01, 2023
Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (W-003)
Based on UKAS LAB 14 : 2019

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambients Conditions:
Temperature: 23.0 °C ± 5.0 °C
Humidity: 55.0 % RH ± 10.0 % RH
Pressure: ±
Reasons for calibration:
☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance
Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Luron 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)
SARTORIUS
10025 2019

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-5 Fax: +66 2543 4357, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC10115
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 range 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 reading 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 R111).		
Nominal Value: (Low Load)	20.0000 g	200.0000 g	Nominal value:	100 g	
Tolerance	0.0001 g	0.0001 g	Tolerance	0.0004 g	
Nominal Value: (High Load)	200.0000 g	200.0000 g			Difference
Tolerance	0.0001 g	0.0001 g			1 0.0000
					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	0.00014
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. 2345493-1

ANALYZER CALIBRATION DATA

Client: Oulf T83 Co., Ltd. Location: HR80 #11
Date: 17 May 23 Test Operator: Sakat P.

O₂ ANALYZER
Model: 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	7.95	7.94	0.04
Span Gas	16.00	16.02	16.01	0.04

NO₂ ANALYZER
Model: 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	0.10	0.01	0.05
Low-Level Gas	50.41	50.51	50.42	0.04
Span Gas	80.27	80.37	80.28	0.05

SO₂ ANALYZER
Model: 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	-0.06	0.00	0.06
Low-Level Gas	51.61	51.65	51.61	0.05
Span Gas	79.00	79.94	79.00	0.05

CO ANALYZER
Model: TELEDYNE API 300EH Serial No.: 451
Span (ppm): 6000

	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

Sakat P.

(Mr. Sakat Phasamphat)
Environmental Field Scientist (4)



Lot No. 2345493-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: Oulf T83 Co., Ltd. Location: HR80 #11
Date: 17 May 23 Test Operator: Sakat P.

O₂ ANALYZER
Cylinder Conc. (%): 16.00 Span (%): 25

	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	0.02	0.02	0.00	0.01	0.04	0.04
Upscale Gas	16.02	16.02	0.00	16.01	0.04	0.04

NO₂ ANALYZER
Cylinder Conc. (ppm): 80.27 Span (ppm): 200

	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	0.10	0.10	0.00	0.01	0.05	0.05
Upscale Gas	80.37	80.37	0.00	80.25	0.05	0.05

SO₂ ANALYZER
Cylinder Conc. (ppm): 79.00 Span (ppm): 100

	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	-0.06	-0.06	0.00	0.00	0.06	0.06
Upscale Gas	79.94	78.94	0.00	79.00	0.05	0.05

CO ANALYZER
Cylinder Conc. (ppm): 80.53 Span (ppm): 6000

	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	-0.02	-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

Sakat P.

(Mr. Sakat Phasamphat)
Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/26/19
ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	1
Date	17 May 23	Location	HR50 #11
Start Time	13:40	Test Operator	Sakait P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	14:00
NO _x /CO ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:40	13.56	3.91	16.49	0.21	0.62	
13:41	13.57	3.91	16.52	0.21	0.63	
13:42	13.55	3.90	16.54	0.22	0.62	
13:43	13.55	3.91	16.57	0.21	0.65	
13:44	13.57	3.91	16.58	0.22	0.64	
13:45	13.57	3.91	16.62	0.20	0.70	
13:46	13.57	3.91	16.61	0.40	0.64	
13:47	13.57	3.91	16.74	0.40	0.74	
13:48	13.56	3.90	16.67	0.20	0.77	
13:49	13.57	3.91	16.76	0.20	0.68	
13:50	13.57	3.92	16.78	0.21	0.59	
13:51	13.57	3.93	16.86	0.29	0.70	
13:52	14.03	3.88	16.45	0.27	0.67	
13:53	13.57	3.90	16.24	0.30	0.70	
13:54	13.54	3.94	16.69	0.21	0.76	
13:55	13.57	3.93	17.19	0.27	0.89	
13:56	13.58	3.92	16.55	0.20	0.71	
13:57	13.58	3.91	16.74	0.30	0.79	
13:58	13.58	3.91	16.71	0.29	0.77	
13:59	13.58	3.91	16.75	0.29	0.90	
14:00	13.58	3.91	16.79	0.19	0.79	
Average	13.97	3.91	16.87	0.28	0.71	

Sakait P

(Mr. Sakait Phakunphairat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 2007-19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	2
Date	17 May 23	Location	HR50 #11
Start Time	14:01	Test Operator	Sakait P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	14:21
NO _x /CO ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:01	13.58	3.91	16.79	0.19	0.76	
14:02	13.59	3.92	16.72	0.29	0.81	
14:03	13.57	3.91	16.71	0.29	0.72	
14:04	13.57	3.92	16.69	0.29	0.72	
14:05	13.58	3.91	16.74	0.28	0.73	
14:06	13.58	3.91	16.65	0.30	0.85	
14:07	13.56	3.91	16.61	0.24	0.82	
14:08	13.55	3.91	16.67	0.20	0.66	
14:09	13.59	3.90	16.62	0.20	0.82	
14:10	13.59	3.90	16.74	0.19	0.85	
14:11	13.58	3.90	16.85	0.21	0.75	
14:12	13.97	3.91	17.02	0.19	0.79	
14:13	13.98	3.91	17.03	0.19	0.81	
14:14	13.58	3.91	17.04	0.20	0.68	
14:15	13.97	3.91	16.97	0.18	0.74	
14:16	13.59	3.90	16.95	0.18	0.68	
14:17	14.00	3.91	16.76	0.22	0.70	
14:18	13.99	3.91	16.80	0.20	0.66	
14:19	13.58	3.92	17.09	0.20	0.85	
14:20	13.97	3.92	17.15	0.18	0.67	
14:21	13.97	3.92	17.04	0.20	0.71	
Average	13.97	3.91	16.84	0.22	0.76	

Sakait P

(Mr. Sakait Phakunphairat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 2007-19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	3
Date	17 May 23	Location	HR50 #11
Start Time	14:22	Test Operator	Sakait P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	14:42
NO _x /CO ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:22	13.97	3.92	16.75	0.20	0.76	
14:23	13.98	3.92	16.64	0.20	0.79	
14:24	13.96	3.93	16.55	0.19	0.82	
14:25	13.96	3.92	16.49	0.21	0.84	
14:26	14.00	3.89	16.39	0.18	0.76	
14:27	13.96	3.91	16.41	0.19	0.84	
14:28	13.94	3.93	16.64	0.19	0.92	
14:29	13.95	3.93	16.91	0.20	0.81	
14:30	13.97	3.92	16.71	0.19	0.81	
14:31	13.97	3.91	16.98	0.20	0.80	
14:32	13.97	3.92	16.62	0.20	0.87	
14:33	13.96	3.92	16.64	0.19	0.85	
14:34	13.95	3.92	16.72	0.20	0.85	
14:35	13.98	3.91	16.91	0.19	0.85	
14:36	13.97	3.92	17.04	0.20	0.89	
14:37	13.97	3.92	17.09	0.20	0.84	
14:38	13.97	3.91	17.03	0.22	0.85	
14:39	13.95	3.91	16.89	0.22	0.81	
14:40	13.97	3.92	16.69	0.22	0.81	
14:41	13.95	3.92	16.69	0.20	0.84	
14:42	13.97	3.92	17.03	0.21	0.84	
Average	13.98	3.91	16.75	0.20	0.83	

Sakait P

(Mr. Sakait Phakunphairat)

Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 2007-19

ALS Laboratory Group



ANALYZER CALIBRATION DATA

Lot No. 2145495-1

Client	Gulf T&S Co., Ltd.	Location	HR50 #12
Date	17 May 23	Test Operator	Anuvut M.

CO ₂ ANALYZER		Serial No.	
Model	TELEDYNE API 200EH		738
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	7.65	7.88	8.00	0.48
Span Gas	16.04	16.00	15.99	0.04

NO _x ANALYZER		Serial No.	
Model	TELEDYNE API 200EH		738
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	54.54	55.77	55.88	0.11
Span Gas	79.42	80.33	80.00	0.33

SO ₂ ANALYZER		Serial No.	
Model	TELEDYNE API 100EH		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		Serial No.	
Model	TELEDYNE API 300EM		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

Anuvut M

(Mr. Anuvut Moungpaib)

Environmental Field Scientist (2)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 2007-19

ALS Laboratory Group



Lot No 2345495-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Uthair HRSG12
Date : 17 May 23 Test Operator : Anuratt M.

O₂ ANALYZER : 15.04 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	0.18	0.26	0.11	0.00	0.28
Upscale Gas	15.00	15.00	0.00	15.55	0.45	0.45

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

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.09	0.17	0.08	0.11	0.02	0.05
Upscale Gas	80.33	81.00	0.67	81.33	1.00	0.33

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	0.18	0.01	0.16	0.01	0.02
Upscale Gas	80.44	80.77	0.33	79.93	0.51	0.64

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	81.23	1.01	80.68	0.44	0.57

Calibrated by

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 1
Date : 17 May 23 Location : Uthair HRSG12
Start Time : 11:40 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 12:00
NO_x/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
11:40	14.21	4.12	11.22	0.80	1.09	
11:41	14.20	4.09	11.18	0.75	1.05	
11:42	14.19	4.07	11.23	0.75	1.05	
11:43	14.18	4.17	11.24	0.84	1.13	
11:44	14.19	4.14	11.23	0.81	1.10	
11:45	14.23	4.10	11.21	0.77	1.07	
11:46	14.24	4.10	11.20	0.77	1.07	
11:47	14.25	4.09	11.21	0.76	1.06	
11:48	14.27	4.05	11.25	0.73	1.03	
11:49	14.27	4.07	11.22	0.75	1.05	
11:50	14.27	4.10	11.20	0.77	1.07	
11:51	14.28	4.04	11.21	0.72	1.02	
11:52	14.27	4.05	11.25	0.73	1.03	
11:53	14.27	4.10	11.23	0.77	1.07	
11:54	14.25	4.03	11.47	0.71	1.01	
11:55	14.24	4.04	11.23	0.72	1.02	
11:56	14.25	4.08	11.25	0.74	1.04	
11:57	14.24	4.11	11.27	0.78	1.08	
11:58	14.24	4.08	11.24	0.74	1.04	
11:59	14.23	4.05	11.27	0.73	1.03	
12:00	14.23	4.05	11.25	0.76	1.06	
Average	14.24	4.08	11.22	0.78	1.08	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 2
Date : 17 May 23 Location : Uthair HRSG12
Start Time : 12:01 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 12:21
NO_x/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
12:01	14.22	4.11	11.53	0.78	1.08	
12:02	14.22	4.10	11.55	0.77	1.07	
12:03	14.22	4.12	11.56	0.79	1.09	
12:04	14.22	4.07	11.51	0.75	1.05	
12:05	14.22	4.07	11.43	0.75	1.05	
12:06	14.21	4.08	11.44	0.78	1.08	
12:07	14.20	4.13	11.46	0.80	1.09	
12:08	14.22	4.08	11.42	0.74	1.04	
12:09	14.21	4.12	11.35	0.79	1.09	
12:10	14.19	4.14	11.29	0.81	1.10	
12:11	14.19	4.09	11.25	0.76	1.06	
12:12	14.20	4.07	11.18	0.75	1.05	
12:13	14.20	4.16	11.11	0.83	1.12	
12:14	14.20	4.14	11.12	0.81	1.10	
12:15	14.21	4.11	11.18	0.78	1.08	
12:16	14.21	4.07	11.25	0.75	1.05	
12:17	14.21	4.16	11.25	0.82	1.11	
12:18	14.21	4.09	11.29	0.76	1.06	
12:19	14.21	4.17	11.27	0.84	1.13	
12:20	14.21	4.10	11.28	0.77	1.07	
12:21	14.21	4.10	11.22	0.77	1.07	
Average	14.21	4.13	11.33	0.78	1.08	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 3
Date : 17 May 23 Location : Uthair HRSG12
Start Time : 12:22 Test Operator : Anuratt M.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 12:42
NO_x/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
12:22	14.22	4.12	11.25	0.79	1.09	
12:23	14.21	4.13	11.28	0.80	1.09	
12:24	14.22	4.12	11.25	0.79	1.09	
12:25	14.21	4.17	11.24	0.84	1.13	
12:26	14.21	4.08	11.25	0.74	1.04	
12:27	14.21	4.08	11.29	0.74	1.04	
12:28	14.21	4.11	11.25	0.78	1.08	
12:29	14.21	4.12	11.23	0.79	1.09	
12:30	14.21	4.09	11.23	0.76	1.06	
12:31	14.22	4.11	11.19	0.78	1.08	
12:32	14.21	4.13	11.18	0.80	1.09	
12:33	14.22	4.10	11.24	0.77	1.07	
12:34	14.21	4.07	11.29	0.75	1.05	
12:35	14.22	4.07	11.25	0.75	1.05	
12:36	14.22	4.11	11.22	0.78	1.08	
12:37	14.22	4.10	11.21	0.77	1.07	
12:38	14.22	4.10	11.22	0.77	1.07	
12:39	14.22	4.12	11.20	0.79	1.09	
12:40	14.21	4.11	11.25	0.78	1.08	
12:41	14.22	4.13	11.26	0.80	1.09	
12:42	14.22	4.08	11.28	0.74	1.04	
Average	14.22	4.10	11.24	0.78	1.07	

Anuratt M

(Mr. Anuratt Moungpa)

Environmental Field Scientist (2)

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

ALS Laboratory Group

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A0440 Reference Number: 160-401977167-1
Cylinder Number: E01140237 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 650
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 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
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				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010133	KAL004535	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12365	D65025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	E00079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124200859	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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret i550 FTIR AUP2010245 CO	FTIR	Dec 10, 2020
Nicoret i550 FTIR AUP2010245 NO	FTIR	Dec 16, 2020
Nicoret i550 FTIR AUP2010245 NO2	FTIR	Dec 02, 2020
Nicoret i550 FTIR AUP2010245 SO2	FTIR	Dec 02, 2020

Triad Data Available Upon Request

NOTES:
Gross Weight: 27.8 Kg
Net Weight: 4.7 Kg



Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A0440 Reference Number: 82-401123195-1
Cylinder Number: E01140237 Cylinder Volume: 247.2 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: B50216 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 23, 2018

Expiration Date: Feb 23, 2028

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

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

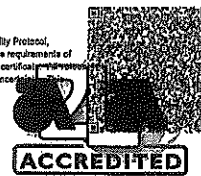
ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.41 PPM	G1	+/- 1.0% NIST Traceable	02/16/2018, 02/25/2018
CARBON MONOXIDE	80.00 PPM	80.31 PPM	G1	+/- 0.7% NIST Traceable	02/16/2018
NITRIC OXIDE	80.00 PPM	80.39 PPM	G1	+/- 1.0% NIST Traceable	02/16/2018, 02/25/2018
SULFUR DIOXIDE	80.00 PPM	81.81 PPM	G1	+/- 1.0% NIST Traceable	02/16/2018, 02/25/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14502755	CC434539	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Feb 23, 2020
PRM	12367	APX1096227	9.83 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 05, 2017
NTRM	18060057	CC445864	80.43 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 07, 2020
GMIS	1018201694	CC235158	4.018 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.4%	Mar 16, 2019
NTRM	16010105	CC472518	49.83 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 07, 2022

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret i550 APVH100281 CO	FTIR	Feb 06, 2018
Nicoret i550 APVH100281 NO	FTIR	Feb 16, 2018
Nicoret i550 APVH100281 NO2	FTIR	Feb 16, 2018
Nicoret i550 APVH100281 SO2	FTIR	Feb 05, 2018

Triad Data Available Upon Request

NOTES:
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, document EPA-600/R-12/031, AE (assay procedures) and measurement conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 368105

Approved for Release

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A0554 Reference Number: 160-401907846-1
Cylinder Number: E01136209 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 650
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 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.64 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	54.64 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	55.00 PPM	54.34 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010133	KAL004535	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12365	D65025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	E00079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124200859	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 23, 2023
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret i550 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicoret i550 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicoret i550 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicoret i550 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg Net Weight: 4.8 Kg



Approved for Release

Page 1 of 150-401907846-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A0440 Reference Number: 160-401907847-1
Cylinder Number: E01137377 Cylinder Volume: 144.4 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12020 Valve Outlet: 650
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 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
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				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010133	KAL004535	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12365	D65025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	E00079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124200859	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	07060227	E00079116	100.6 PPM NO/NITROGEN	+/- 1.0%	Jul 23, 2023
NTRM	11010215	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 23, 2023

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicoret i550 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicoret i550 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicoret i550 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicoret i550 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

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



Approved for Release

Page 1 of 150-401907847-1

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N192E3HA0000
Cylinder Number: GN0027033
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: O2,BALN
Reference Number: 150-402340009-1
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 %	7.975 %	G1	+/- 0.4% NIST Traceable	02/10/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010635	K022175	8.987 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-WS-951 - O2	PARAMAGNETIC		Jan 27, 2022		

Triad 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: E02N194E3HA0001
Cylinder Number: GN0027201
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

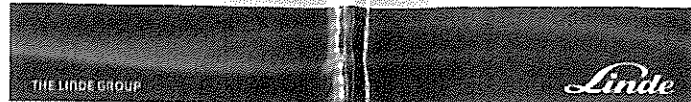
ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.04 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration 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-WS-951 - O2	PARAMAGNETIC		Jan 27, 2022		

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



Approved for Release

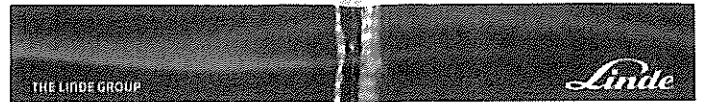
Page 1 of 160-402340010-1



CERTIFICATE OF ANALYSIS

Customer Details:	
ALS Laboratory Group (Thailand)	
Cylinder Description: Steel 47L	
The measurement of this reference material is traceable to SI standards. The assay of this standard has been performed in accordance with the International Union of Pure and Applied Chemistry (IUPAC) standard for the assay of gases. The reported uncertainty is based on a standard uncertainty of approximately 0.5%.	
Certificate Number: 4676/15	Analyst: THIRAT LOYRAT
Cylinder Number: S50730	Approval: SAKANA KANUTHAPAKI
Nominal Cylinder Content: 6.510 M ³	
Nominal Pressure: 145.0 Bar	
Valve Outlet: CGA 590 BRASS	To Re-Order Please Quote: 478100-J-44
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 145psi. 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. 	

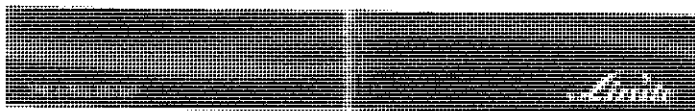
Page 1 of 1



CERTIFICATE OF ANALYSIS

Analytical Result					
Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	8.00 %	7.93 %	+/- 1% relative	(1) 1-PB-354	20-Jan-2015
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen in Nitrogen	243625SG	25.08 ± 0.13 %	19-Aug-2017		
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 Nitrogen Analyzer 5 Total Hydrocarbon Analyzer 6 Other specified					
Cylinder Number: S50730 Production Order Number: 90132928			Certification Date: 20-Jan-2016 Expiration Date: 20-Jan-2024		

Page 2 of 2



CERTIFICATE OF ANALYSIS	
Customer Detail: ALS Laboratory Group (Thailand)	Production Order Number: 90137389 Material Number: 557200-J-44 Certification Date: 24-Sep-2016 Expiry Date: 24-Sep-2024
Cylinder Description: STEEL 47 L	
The measurement of this reference material is traceable to SI through the use of the following standards: The purity of the material is certified by the manufacturer to be 99.99% (mass fraction) and the results are expressed on a multiple basis, unless otherwise specified. The reported concentration is based on a standard material approximately 99%.	
Certificate Number: 285716	Analyst: THIRAT LOYPAT
Cylinder Number: 363075	
Nominal Cylinder Content: 6.500 M ³	Approve: SITHIPORN KAMTHAN
Nominal Pressure: 145.0 Bar	
Valve Outlet: CGA 590 BRASS	To Re-Order Please Quote: 557200-J-44
Comment:	<ul style="list-style-type: none">It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig.Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum major component.Keep and use in well-ventilated and secure area.

Page 1 of 2

บริษัท ออล (ประเทศไทย) จำกัด
15 ซอยสุขุมวิท 2/1 หมู่ 14 แขวงคลองเตย เขต 6 กรุงเทพมหานคร 10110
โทรศัพท์: 02-2334-6100 โทรสาร: 02-2334-6101
แฟกซ์: 02-2334-6102

Linde (Thailand) Public Company Limited
15 ซอยสุขุมวิท 2/1 หมู่ 14 แขวงคลองเตย เขต 6 กรุงเทพมหานคร 10110
โทรศัพท์: 02-2334-6100 โทรสาร: 02-2334-6101
แฟกซ์: 02-2334-6102

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

Cert. No. : ACC23005
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 : 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) %

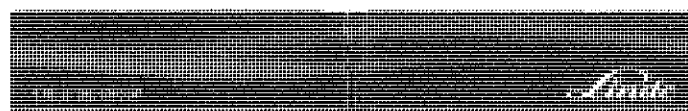
Received Date : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchumai)

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



CERTIFICATE OF ANALYSIS					
Analytical Result					
Component	Request 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	25.08 ± 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 Chromatography 2. Paramagnetic Oxygen Analyzer 3. Electrochemical Oxygen Analyzer 4. Electrochemical Moisture Analyzer 5. Fresh 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

บริษัท ออล (ประเทศไทย) จำกัด
15 ซอยสุขุมวิท 2/1 หมู่ 14 แขวงคลองเตย เขต 6 กรุงเทพมหานคร 10110
โทรศัพท์: 02-2334-6100 โทรสาร: 02-2334-6101
แฟกซ์: 02-2334-6102

Linde (Thailand) Public Company Limited
15 ซอยสุขุมวิท 2/1 หมู่ 14 แขวงคลองเตย เขต 6 กรุงเทพมหานคร 10110
โทรศัพท์: 02-2334-6100 โทรสาร: 02-2334-6101
แฟกซ์: 02-2334-6102

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

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	33511U	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	V744R6069	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).

T. Petchumai

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 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22227
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,
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 : Nuthakorn Pisutpaisan

Approved by :

(Thanakul Petchumai)

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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

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).

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

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

P.L.H.

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

P.L.H.

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

P.L.H.

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
	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

P.L.H.

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

Cert. 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.: RYG_FS0027

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 : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

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

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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-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 unceable 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 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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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
	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, Lepack (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 Srinthorn 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. : 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.: RYG_FS0025

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PIATTHANAKAN 40, PIATTHANAKAN ROAD,
KHWANG PIATTHANAKAN, 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 : Nathakorn Pisulpaisan

Approved by :

T. Petchum
(Thanakul Petchum)

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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-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).

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
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	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

QF-TS12-04-04-020664

T. Retan

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	SIM Display at initial (dB)	SIM 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. Retan

Continuation of Calibration Certificate

Cert. No. : ACL23077
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	104.1	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

QF-TS12-04-04-020664

T. Retan

Continuation of Calibration Certificate

Cert. No. : ACL23077
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	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, L _{peak} (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

QF-TS12-04-04-020664

T. Retan

Continuation of Calibration Certificate

Cert. No. : ACL23077
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	89.7	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 Sirinthorn Rd, Bangbunmu, Bangplud Bangkok 10700 THAILAND.
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Cert. 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 PIATTHANAKAN 40, PIATTHANAKAN ROAD,
KJWAENG PIATTHANAKAN, KJHET 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 : Nuthakorn Pichupaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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QF-TS12-04-04-020664

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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

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd, Bangbunru, Bangkok 10700 THAILAND
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Cert. No. : ACL22228
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623389 / 198636 / 26417
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 Petchurai)

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22228
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. : ACL22228
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.	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-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-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. : ACL22228
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)
14.2

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	16.5
Flat	22.2

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	0.2	0.2	± 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

Continuation of Calibration Certificate

Cert. No. : ACL22228
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	-0.1	±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
Lcq	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. : ACL22228
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, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	135.2	-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. : ACL22228
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	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.1	0.1	±1.1
84.0	84.1	0.1	±1.1
79.0	79.0	0.0	±1.1
74.0	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.1	0.1	±1.1
29.0	29.1	0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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T. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22228
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	89.6	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. Rth.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22229
Pages : 1 of 8

Calibration Certificate

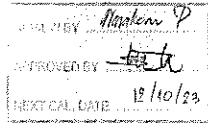
Equipment : SOUND LEVEL METER
Manufacturer : RUON
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623390 / 198637 / 26418
ID No.:

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 : Nathakorn Pisutpaisan

Approved by :

T. Petchumai
(Thanakul Petchumai)

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Continuation of Calibration Certificate

Cert. No. : ACL22229
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).

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Continuation of Calibration Certificate

Cert. No. : ACL22229
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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Continuation of Calibration Certificate

Cert. No. : ACL22229
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)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	17.3
Flat	23.1

3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22229
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	-0.1	±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	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. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22229
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
	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	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. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22229
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	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	74.1	0.1	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	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	29.1	0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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T. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22229
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11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. P. P.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22230
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623391 / 198638 / 26419
ID No.: -

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PIATTHANAKAN 40, PIATTHANAKAN ROAD,
KHWAENG PIATTHANAKAN, 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. Petchurai*
(Thanakul Petchurai)

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22230
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	33511D	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).

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22230
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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22230
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)
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	12.8
C-weight	18.6
Flat	24.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.9	0.9	1.0	± 5.0

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Continuation of Calibration Certificate

Cert. No. : ACL22230
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	0.1	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
Lsq	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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P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL22230
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
	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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.5	-0.9	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL22230
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	137.1	0.1	±1.1
136.0	136.1	0.1	±1.1
135.0	135.1	0.1	±1.1
134.0	134.1	0.1	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.1	0.1	±1.1
114.0	114.1	0.1	±1.1
109.0	109.0	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	30.1	0.1	±1.1
29.0	29.1	0.1	±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	25.2	0.2	±1.1

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P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL22230
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	89.7	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

P.T.A.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22239
Pages : 1 of 8

Calibration Certificate

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

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 Pisulpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22239
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 item 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-3003-22	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. : ACL22239
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. : ACL22239
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)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	11.2
C-weight	17.5
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

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

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Continuation of Calibration Certificate

Cert. No. : ACL22239
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	0.0	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

- B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL22239
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
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	135.6	-0.8	±3.0

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

- P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL22239
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	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	25.0	0.0	±1.1

QF-TS12-04-04-020664

- P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL22239
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

- P.T.A.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22242
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623396 / 198643 / 26424
ID No. :

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PIATTHANAKAN 40, PIATTHANAKAN ROAD,
KHWANG PIATTHANAKAN, 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. Petchuraj
(Thanakul Petchuraj)

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. : ACL22242
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-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).

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22242
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. : ACL22242
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	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)			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	0.2	0.2	0.2	± 1.0

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Continuation of Calibration Certificate

Cert. No. : ACL22242
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	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22242
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	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.1	0.1	±1.1
30.0	30.0	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. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22242
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	136.4	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	135.2	-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. : ACL22242
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	89.8	0.3	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Rth.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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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 : 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 : 17 JANUARY 2023
Calibration Date : 19-20 JANUARY 2023
Date of Issue : 23 JANUARY 2023

Calibrated by : Nathakorn Pisutpaian

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. : 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

SITHIPORN ASSOCIATES CO.,LTD. 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. 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).

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

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Continuation of Calibration Certificate

Cert. No. : ACL23059
Job No. : VC66AC0026
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

7. Rth

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

QF-TS12-04-04-020664

7. Rth

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
	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	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

7. Rth

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

QF-TS12-04-04-020664

7. Rth

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangburum, Banglud Bangkok 10700 THAILAND
Tel.0-2435-8860 Fax.0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22177
Pages : 1 of 8

Calibration Certificate

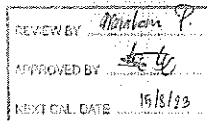
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00658241 / 158767 / 58769
ID No.: BKK_FS0098

Condition As Found : GOOD

Customer : ALS 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 :
(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.

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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-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. : 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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

QF-TS12-04-04-020664

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
Teq	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. Petch

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, 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	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

QF-TS12-04-04-020664

T. Petch

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

QF-TS12-04-04-020664

T. Petch

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

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirdinthon 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. : 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 : Nathakorn Pisupaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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-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. : 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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

QF-TS12-04-04-020664

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

QF-TS12-04-04-020664

T. Petchum

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

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

451-451/1 Sirinhornd Rd, Bangbunru, Bangkok 10700 THAILAND.
Tel: 0-2435-6802 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22253
Pages : 1 of 8

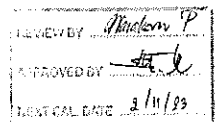
Calibration Certificate

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 PIATTHANAKAN 40, PIATTHANAKAN ROAD,
KIJWAENG PIATTHANAKAN, 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. : ACL22253
Job No. : VC66AC0004
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. : 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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.3	-1.2	-1.1	±5.0

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	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

QF-TS12-04-04-020664

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. Petchur

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
SEL	0.25	1	99.0	98.9	-0.1	1.5; -5.0
	2	8	108.0	108.0	0.0	1.0; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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

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

T. Petchur

451-451/1 Sirinithom Rd., Bangbunmu, Bangkok Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22182
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier N11-24
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. 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

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-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. : 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

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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)	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

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)	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

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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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T. Petchum

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
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	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. Petchum

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

451-451/1 Siindhorn 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. Petchum
(Thanakul Petchum)

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QF-TS12-04-04-020664

T. Petchum

Continuation of Calibration Certificate

Cert. No. : ACL22254
Job No. : VC66AC0004
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 weightings with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	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. : 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

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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

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

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
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

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

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, Th (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	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

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CERTIFICATE OF CALIBRATION

Certificate No. : CL-035-66
Page 1 of 2Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006713
ID No: RYG_FS0218Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khut 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: G67682-08, 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: IT-0034-22. Certificate number: ER-0092-22Calibrated by
☐ Mr. Soravit Thachalee
☒ Miss Jittiporn LettsompholApproved Signatory: 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: 22035270.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.063	20.1	0.0	0.099
60	25.059	25.1	0.0	0.099
60	30.051	30.1	0.0	0.099
60	35.050	35.1	0.1	0.099
60	40.048	40.2	0.2	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015499.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.063	20.3	0.2	0.099
70	25.059	25.1	0.0	0.099
70	30.051	30.0	-0.1	0.099
70	35.051	34.9	-0.2	0.099
70	40.048	39.8	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 22035462.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.063	20.1	0.0	0.099
110	25.059	25.1	0.0	0.099
110	30.051	30.2	0.1	0.099
110	35.051	35.2	0.1	0.099
110	40.048	40.2	0.2	0.099

UUC* : Unit Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Certificate No. : CL-047-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006726
ID No: RYG_FS0226

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

Received date: 21 Feb 2023
Calibration date: 27 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:
Mr. Panyia Booncharoen
Calibration Department Manager

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Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15015841.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.052	20.0	0.1	0.099
60	25.058	25.0	-0.1	0.099
60	30.055	30.0	-0.1	0.099
60	35.049	35.0	0.0	0.099
60	40.041	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015494.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.052	20.2	0.1	0.099
70	25.058	25.0	-0.1	0.099
70	30.055	29.9	-0.2	0.099
70	35.048	34.8	-0.2	0.099
70	40.041	39.7	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20008282
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.052	20.0	-0.1	0.099
110	25.058	25.1	0.0	0.099
110	30.055	30.1	0.0	0.099
110	35.048	35.1	0.1	0.099
110	40.041	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-137-65
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15020734
ID No: RYG_FS0230

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

Received date: 23 Aug 2022
Calibration date: 25 Aug 2022
Issue date: 9 Sep 2022

Reference Used During Calibration

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

Calibration Condition

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

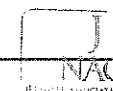
Calibration Procedure

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

Traceability

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

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Panyia Booncharoen
Calibration Department Manager



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Certificate No.: CL-137-65
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: 17015112.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.044	20.0	0.0	0.099
30	25.038	25.0	-0.1	0.14
30	30.032	29.9	-0.1	0.099
30	35.025	34.9	-0.1	0.099
30	40.019	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15033222
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.044	20.2	0.2	0.099
70	25.038	25.0	0.0	0.099
70	30.032	29.8	-0.2	0.099
70	35.025	34.6	-0.4	0.099
70	40.018	39.4	-0.6	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15028482.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.044	20.1	0.1	0.099
110	25.038	25.1	0.1	0.099
110	30.032	30.1	0.1	0.099
110	35.025	35.1	0.1	0.099
110	40.019	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 ★



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CERTIFICATE OF CALIBRATION

Certificate No.: CL 134-65
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 15020735
ID No: RYG_F50231

Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 204 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Received date: 27 Jul 2022
Calibration date: 3 Aug 2022
Issue date: 8 Aug 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No: 667682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No: 671407-00591 Due date: 04 June 2022

Calibration Condition

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

Calibration Procedure

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

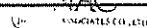
Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number TT-0034-22, Certificate number: ER-0032-21

Signature: *Handwritten Signature*
Date: 3/8/23

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol

Approved Signatory: *Handwritten Signature*
Mr. Pannya Booncharoen
Calibration Department Manager



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Certificate No.: CL 134-65
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: 15035050
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.043	20.1	0.1	0.099
30	25.037	25.1	0.0	0.14
30	30.027	30.0	0.0	0.099
30	35.021	35.0	0.0	0.099
30	40.012	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15033221.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.043	20.1	0.1	0.099
70	25.037	24.9	-0.1	0.099
70	30.028	29.7	-0.3	0.099
70	35.021	34.5	-0.5	0.099
70	40.011	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17023218
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.043	20.1	0.1	0.099
110	25.037	25.1	0.1	0.099
110	30.028	30.1	0.1	0.099
110	35.021	35.1	0.1	0.099
110	40.012	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 042-65
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: H032.2
Serial No: 20032240
ID No: RYG_F50520

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: 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-0032-22

Signature: *Handwritten Signature*
Date: 24/2/24

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol

Approved Signatory: *Handwritten Signature*
Mr. Pannya Booncharoen
Calibration Department Manager



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Certificate No.: CL-042-66
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: 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 ★



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CERTIFICATE OF CALIBRATION

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

Equipment Name: Heat Stress Monitor

Manufacturer: Delta OHM

Model: HD32.2

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: 667662-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023

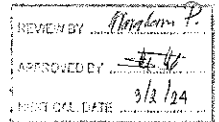
Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%

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. Pannya Booncharoen
Calibration Department Manager

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



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



Certificate No.: CL-016-66
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: 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

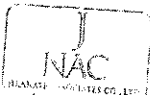
Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020502.
Dimension: Diameter 8 mm. Length 170 mm.

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 ★



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



CERTIFICATE OF CALIBRATION

Certificate No.: CL-014-66
Page 1 of 2

Equipment Name: Heat Stress Monitor

Manufacturer: Delta OHM

Model: HD32.2

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: 667662-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023

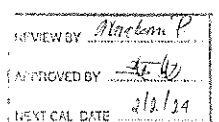
Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%

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. Pannya Booncharoen
Calibration Department Manager

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Certificate No.: CL-014-66
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: 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 ★



Certificate of Calibration

Certificate No.: CL-015-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018314
IO No: RYG_FS0359

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

REVIEW BY	<i>Phanlao P</i>
APPROVED BY	<i>Mr. Panya Booncharon</i>
NEXT CAL DATE	12/24

Calibrated by
☒ Mr. Sawitri Thachalee
☐ Miss Jitraporn Lertsomphol



Approved Signatory
Mr. Panya Booncharon
Calibration Department Manager

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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%.

★ End of Certificate ★



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
554/4 PATTANAKARN ROAD SOI 18, SUAN LUANG, SUAN LUANG, BANGKOK 10250
TEL: 0-2717-3006-24 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.: 19002047
ID No.: RYG_FS0201

Condition As-Received: Used Item
Received Date: 28 September 2022
Calibration Date: 04 October 2022

Reference: 2209-0911WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %

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

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Corporate Services 3: Equipment Calibration and Testing Services.

104 Phatthanakan 40, Phatthanakan Rd
Khwaeng 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-FEL-U	F-1472	TP-1038-21	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 : OL33A, S/N : 09220204)

4. Test Equipment: Illuminance Meter (Model : S1002, S/N : 060129)

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)

REVIEW BY	<i>Phanlao P</i>
APPROVED BY	<i>Mr. Panya Booncharon</i>
NEXT CAL DATE	11/10/23

Calibrated by: Nivat Nilas
Issue Date: 05 October 2022

Approved Signatory:
☐ Phanlao Prapaisai
☐ Chatchavan Khunpluek
☒ Nuntawan Khomchal



Cert. No.: Z2PH515
Page: 2 of 2



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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5944 PATTANAKARN ROAD SOI 16, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 0-2717-2060-21 FAX: 0-2719-0484



Certificate of Calibration

Certificate No.: Z2PH447
Page: 1 of 2

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.

-o0o-

Equipment : Lux Meter
Manufacturer : PEAK METER
Model : PM6912L
Serial No. : H12A-D16324
ID No. : RYG_FS0536
Condition As-Received : Used Item
Received Date : 31 August 2022
Calibration Date : 02 September 2022
Reference : 2209-1093WGC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %

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

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104 Phatthanakan 40, Phatthanakan Rd.,
Khuang 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) High-accuracy Irradiance Standard	OL-FEL-U	F-1471	TP-1037-21	18 Oct 2022
2) Photometry & Encoder	LMguide 9.6 m	120RC003	61-140005-1	30 Apr 2023

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

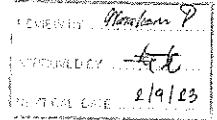
3 Test Equipment : Programmable Voltage/Current Source (Model : OL03A, S/N : 09220264)

4 Test Equipment : Illuminance Meter (Model : 51002, S/N : 060129)

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 Nitas
Issue Date : 08 September 2022

Approved Signatory :
☐ Phatinee Prebpaipat
☐ Chatchawan Khunpikulok
☒ Nuntawat Khamchai

a 1129366

n 0296366



Cert. No.: Z2PH447
Page: 2 of 2



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TEL: 0-2717-2060-21 FAX: 0-2719-0484



Certificate of Calibration

Cert. No.: Z2CH377
Page: 1 of 2

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

Function : Illuminance Measurement	Range : Autorange		
Standard Value	Before Adjust	After Adjust	Uncertainty
UUC* Reading	Error		
(lx)	(lx)	(lx)	(± lx)
0	0.00	0.00	0.060
15	-	14.25	0.22
100	-	96.5	1.5
500	-	492	7.3
1000	881	992	15
2000	-	1986	30
3000	-	2990	45
4000	-	4020	59
5000	4550	5060	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 %

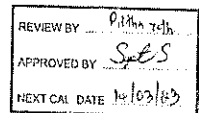
Before adjustment light source factor setting mode : L0 = 1.050

After adjustment light source factor setting mode : L0 = 1.209

UUC* = Unit Under Calibration.

-o0o-

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B531256371
ID No. : RYG_FS0420
Condition As-Received : Used Item
Received Date : 11 March 2022
Calibration Date : 14 March 2022
Reference : 2203-04950SC-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 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method
- CP-CH3 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)



Calibrated by : Warakorn Lemgagrakul

Approved by :
Approved Signatory

☒ Malee Butkrua
☐ Sathip Muangman
☐ Warakorn Lemgagrakul

Issue Date : 17 March 2022

The uncertainties are for a confidence probability of approximately 95 %

By the Technology Promotion Association (Thailand-Japan) Calibration and Testing Services

Approved by: Head of Corporate Services 3: Equipment Calibration and Testing Services

A 0039300

a 1124178



Cert. No.: 22CH377
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	S4030048	130RC116	21E2662	25 Aug 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. AR-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	756620	23 Sep 2023
pH 6.983	CPA chem	756622	04 Sep 2022
pH 10.015	CPA chem	756624	04 Sep 2022

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	mV	pH	mV	pH		
pH Meter S/N : B531256371	4.00	177.48	177	4.00	0.58	2.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00		
	10.00	-177.48	-176	10.00	0.58	2.00		

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N : 1311407	4.008	4.01	181	0.0079	2.00
	6.983	6.98	7	0.0093	2.00
	10.015	10.01	-171	0.0092	2.00

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

-oOo-

a 1100595



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534-4 PATTANAKARN ROAD/5016 SUKUMVIT 11 SUKUMVIT BANGKOK 10250
TEL 0 2712 3400-21 FAX 0 2710 9484



Cert. No.: 22LHM1
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B531256371
ID No. : RYG_FS0420
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Phakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 11 March 2022
Calibrated Date : 15 March 2022
Ambient Temperature : (20 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Malae Butkrues
Approved by :
() Ponthippa Tamayakul
(✓) Suwal Inja
Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the Issuing Laboratory Services & Equipment Calibration and Testing Services

A 0039367



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2203-0495DSC-2

Cert. No.: 22LM41
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	1523	2168080	21H1273	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 : 1311407

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.009	25.4	0.391	0.16	2.00
30.0	100	30.008	30.5	0.492	0.16	2.00
40.0	100	39.997	40.0	0.603	0.16	2.00
50.0	100	49.997	50.0	0.603	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 %

-oOo-

a 1100597



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534-4 PATTANAKARN ROAD/5016 SUKUMVIT 11 SUKUMVIT BANGKOK 10250
TEL 0 2712 3400-21 FAX 0 2710 9484



Cert. No.: 23CH441
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B531256371
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. Phakdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
Calibrated by : Warakorn Lemgagtrakul
Approved by :
() Malae Butkrues
() Sathip Meangmai
() Warakorn Lemgagtrakul
Issue Date : 5 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0052953



Cert. No.: 23CH441
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument
1) Document Process Calibrator
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-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863032	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 (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter	4.00	177.48	177	4.00	0.58	2.00
S/N: B531256371	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 (±)	Coverage factor k
pH Electrode	4.008	4.01	191	0.0071	2.00
S/N: 2465066	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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TEL: 0-2717-5000-27 FAX: 0-2716-9484



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_FS0420
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 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Preecha Hlahib
Approved by :
() Pongthipha Tameyakul
() Melee Bulkruea
() 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 1156433

A 0045967



Equipment : pH Meter with Sensor
Condition As-Received : Used item
Reference : 2303-1133DSC-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
1) Digital Thermometer
This certification is valid only to the item calibrated on date and place of calibration.

2. This certificate 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 (± °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	50.5	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 %.

-00-



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TEL: 0-2717-5000-27 FAX: 0-2716-9484



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 ± 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 :
() Maloo Bulkruea
() Sathip Meangmai
() Warakorn Lernagatrakul
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 1157394

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	22I1306	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
			mV	pH		
pH Meter S/N.: B634291445	4.000	177.48	177.3	4.000	0.058	2.00
	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 (\pm)	Coverage factor k
pH Electrode S/N.: 1475518	4.008	4.011	165.2	0.0052	2.06
	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 ($^{\circ}$ C)	Standard Temperature ($^{\circ}$ C)	UUC* Reading ($^{\circ}$ C)	Error ($^{\circ}$ C)	Uncertainty of measurement (\pm $^{\circ}$ 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 %.

-00-

Maku.

a 1141167

Maku.

a 1141166



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TEL: 0-2717-2000-21 FAX: 0-2719-9181



Certificate of Calibration

Certificate No.: 22E4098
Page: 1 of 2

Equipment : pH Meter

Manufacturer: Mettler Toledo

Model: SevenExcellence

Serial No.: B634291445

ID No.: RYG_EN0152

Condition As-Received: Used Item

Received Date: 21 December 2022

Calibration Date: 23 December 2022

Reference: 2212-06020SC Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch

Ambient Temperature: (23 ± 2) $^{\circ}$ C

Relative Humidity: (50 ± 10) %
616/10 Moo 5, T.Maanam Knu, A.Puakduang,
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: Wutthareporn Wongchulkrann
Issue Date: 26 December 2022

Approved Signatory:
[] Phasinee Prabpai
[] Nuntawat Khamchai
[] Pornthippa Tunyoyakul

0304803



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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a 1140616



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Dokmai Pratek Bangkok 10250
Tel: +66 (0) 2069-9773
www.pentacal.com

Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22103

Certificate No.: PTC/07/22103 Page: 1 of 2
Equipment: Digital Balance Condition: Normal
Manufacturer: Sartorius Serial No: 20267038
Model: MSE224S-100-DU ID No: RYG_EN0002
Type of Balance: Single interval



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

REVIEW BY: *Thantit*
APPROVED BY: *R. K.*
NEXT CAL DATE: 23/03/2023

Environment Condition: Temperature 23.9 °C ± 0.3 °C
Humidity 58.1 %RH ± 4.4 %RH
Air density 1.17 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd.
616/10 Moo 5 T Maenamkoo, A Pluakdaeng,
Rayong 21140, Thailand

The Method used: In house method PTC-WI-07, base on Euramet eg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co., Ltd.
NSC-ONSAC Accreditation No. Calibration 0169

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr Rungroj Metakul



Reviewed by:
(Mr Kiangsak Kalsari)

Approved By: *R. K.*
(Mr Keatsak Kerdo)
Laboratory Manager

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). The effect that the results relate only to the items calibrated.

This calibration certificate is valid not be reproduced except in full only without written approval from Penta Calibration Co., Ltd.

RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8301-6, e-mail: service.thailand@sartorius.com



SARTORIUS

REVIEW BY: *Thantit*
APPROVED BY: *R. K.*
NEXT CAL DATE: 01/03/24

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BCI0112
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)
615/10 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: 2010

Metrollogical data: Capacity: 220 g Readability: 0.0001 g
Ambients Conditions: Temperature: 23.6 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration: ☐ New Installation ☐ Service / Repaired ☒ 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/Barometer/Temp. Lutron MHB-382SD	DKSH	C16220444	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)



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Dokmai Pratek Bangkok 10250
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Represent to Certificate of Calibration ,PTC/07/22103

Certificate No.: PTC/07/22103

Page: 2 of 2

Measurement Results:

Without Adjustment:

Function Calibration: Non Adjustment

Eccentric Error Weight to be 1/3 1/2 or of Maximum capacity

Eccentricity test		100 (g)				
		Position (g)				
		1	2	3	4	5
		0.0000	0.0000	-0.0002	0.0002	0.0002
		Maximum deviation				
		0.0002				

Repeatability Test Weight to be 1/2 ≤ L ≤ Maximum capacity

Determination of the standard deviation of weighing balance, Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
200	0.00003

Error of indication from nominal value, Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.000086	2.16
0.01	0.01000	0.0100	0.0000	0.00010	2.06
0.1	0.10000	0.1000	0.0000	0.00010	2.06
1	1.00000	1.0000	0.0000	0.00010	2.06
2	2.00000	1.9999	0.0001	0.00010	2.06
5	5.00001	5.0000	0.0000	0.00010	2.06
10	10.00000	10.0000	0.0000	0.00010	2.06
20	20.00003	19.9999	0.0001	0.00011	2.06
50	50.00004	49.9999	0.0001	0.00012	2.00
100	100.00004	100.0001	-0.0001	0.00017	2.00
200	200.00011	200.0000	0.0001	0.00027	2.00

Note: Weight of adjust (g)

The End of Certificate

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8301-6 Fax: +66 2543-8387, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BCI0112
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

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 range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.

Nominal Value : (Low Load)	20.0000	199.9999
20 g	20.0000	200.0000
Tolerance	0.0001 g	200.0000
	20.0000	199.9999
Nominal Value : (High Load)	20.0000	199.9999
200 g	19.9999	200.0000
Tolerance	0.0001 g	200.0000
	20.0000	199.9999
	20.0000	200.0000
Standard Deviation	0.00003	0.00005

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R118).

Nominal value	100	g
Tolerance	0.0004	g
		Difference
	1	-
	2	-0.0001
	3	-0.0001
	4	0.0001
	5	0.0002
	6	-

Linearity

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

Tolerance	0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	
0.01	0.0100	0.0100	0.0000	0.00014	
0.05	0.0500	0.0500	0.0000	0.00014	
0.1	0.1000	0.1000	0.0000	0.00014	
0.5	0.5000	0.5000	0.0000	0.00014	
1	1.0000	1.0000	0.0000	0.00014	
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



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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 Pattanapongpailoon
Approved by : Man
() Pornthippa Tameyakul
(✓) Maloe Buikrua
() Suwit Imjai

REVIEW BY Thanthall
APPROVED BY D. S.
NEXT CAL. DATE 30/04/24

Issue Date : 2 November 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 0046908



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-0T02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY49023832	22LM97	29 Jul 2023

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

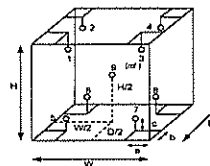
3. This certificate is traceable to the International System of Unit.

Result of Calibration :- () Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL Humid. (%)	54	58
AC Supply (Volt)	223	225



Probe Installation Details : Dimension of Chamber :
a = 50 cm D = 0.40 m
b = 50 cm W = 0.55 m
c = 50 cm H = 0.48 m
Capacity = 0.11 m³

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	22-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

Man.

a 1132466



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-03760C-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 k
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.68	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	179.489	180.351	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 %.

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Man.

a 1132465



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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 Azida Modification Method
Tested by : Walalak Sirithean
Approved by : Saithip
Approved Signatory
() Maloe Buikrua
(✓) Saithip Meangmai
() Warakorn Lerngagtrakul

REVIEW BY N. Bannas
APPROVED BY D. S.
NEXT CAL. DATE 15/8/23

Issue Date : 18 February 2022

B 0281285



Cert.No.: 22TW34
Page: 2 of 2



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TEL: 0-2717-3000-27 FAX: 0-2719-9484



Cert. No.: 22LM12
Page: 1 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.

-000-

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102786
IO 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 Promprat
Approved by : Malee
Approved Signatory
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai
Issue Date : 21 February 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 & Equipment Calibration and Testing Services

Saithip

a 1094744

A 0038008



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2202-0404D5C-5
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	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 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-27 FAX: 0-2719-9484



Cert. No.: 22TM317
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V618.0084
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location : BOD Room
Received Order : 22 April 2022
Calibration Date : 22 April 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpaiboon
Approved by : Malee
Approved Signatory
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai
Issue Date : 3 May 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 & Equipment Calibration and Testing Services

Malee

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

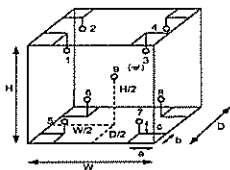
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 :

a = 10 cm
b = 10 cm
c = 10 cm
Dimension of Chamber :
D = 0.60 m
W = 1.0 m
H = 1.2 m
Capacity = 0.75 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
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM317
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
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Calibration Point (°C)	Measured Temperature (°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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Make .

a 1106485

RYG_EN0006

Make .

a 1106484



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 14 SUKHVITANG, SUKHVITANG BANGKOK, 10250
TEL : 0-2717 3001-7 FAX : 0-2719 5481



Cert. No.: 22TM1492
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Mommert

Model : UM 400

Serial No. : b495.0899

ID No. : RYG_EN0006

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Phakdaeng,
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 : Preecha Hishib

Approved by :
Approved Signatory

() Pornthippa Tamoyakul
() Malee Butkruea
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced or altered in any way without the prior written

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



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

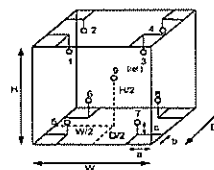
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This 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 :

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)	28	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	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

Make .

A 0046905

a 1132473



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								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.252	69.995	70.079	70.177	70.664	70.039	70.688	70.149	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 sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
 544/4 PATTANAKARN ROAD SOI 18, SUKHVITANG, SUKHAEWANG, BANGKOK 10250
 TEL. 0 2712 8844-27 FAX 0 2712 8844



Cert. No.: 22TM1491
 Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath
 Manufacturer : Memmert
 Model : WNB22
 Serial No. : L513.0648
 ID No. : RYG_EN0061
 Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
 616/10 Moo 5, T. Maenam Khu,
 A. Phukdaeng,
 Rayong 21140, Thailand
 Location : Wet Chemistry Lab
 Received Order : 20 October 2022
 Calibration Date : 20 October 2022
 Ambient Temperature : (26 ± 10) °C
 Relative Humidity : (50 ± 30) %
 Calibrated by : Preecha Hiahb
 Approved by :
 Approved Signatory
 () Pornthippa Tanayakul
 (/) Maloo Butkrus
 () Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95 %

This certificate may not be reproduced without prior written consent of the Association of Calibration and Testing Services.

a 1132472

A 0046905



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

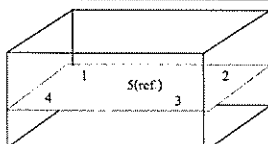
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 (Volt)
	(°C)	(%R.H.)	
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.)
			04.527	04.563	04.628	04.516	04.580

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
85.0	0.12	0.081	0.16	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 %.

-000-

a 1132471

a 1132470



Metrological Center

SCI ECO Services Company Limited

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

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851, +669 8247 2360

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



Metrological Center

SCI ECO Services Company Limited

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



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. : TI939A5

Customer : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)

616/10 Moo 5 T.Maenam Khu,

A.Pluakdaeng, Rayong 21140

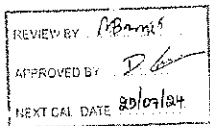
Customer Location : Laboratory

Date of Receipt : 23 January 2023

Calibrated By : Atiphong Rongrat (Technician)

Approved By : Bun Chan / Boonchai 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.

FM-L14118-31-08-64

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	TI50	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 : Bun Chan

FM-L15117-15-05-63



Metrological Center

SCI ECO Services Company Limited

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



Metrological Center

SCI ECO Services Company Limited

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



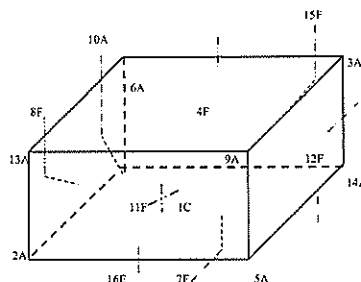
Certificate No. T230116

Page 4 of 4

Certificate No. T230116

Page 3 of 4

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	

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)														
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152	TN153	TN154	TN155
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	3.28	3.22	3.28

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	3.3	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 : Bun Chan

Approved By : Bun Chan

FM-L15117-15-05-63

FM-L15117-15-05-63



Certificate of Calibration

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

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

Environment Condition: Temperature 23.1 °C ±
Humidity 65.4 %RH ±

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

Calibration By: Mr. Chaturaphon Fothong
Calibration Date: 27 September 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 397-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.

The standard for Wavelength Certificate No. 91418 and 91435
The standard for Photometric Certificate No. 91441 and 101089
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

(Mr. Chaturaphon Fothong)
Person in charge

(Mr. Tholemgkeat Pongungem)
Authorized signatory

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

DKSH Technology Limited
2523 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10250
2523 Sukhumvit Road, Bangkok, Phraeklong, Bangkok 10250
Phone: +66 2859 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CALFM-C08-13: 20 Jul 2022



Certificate No.: C06220464 Page 3 of 3

Calibration Results: Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0060
	0.8000	0.861	-0.0001	0.0064
313 nm	0.0000	0.000	0.0000	0.0060
	0.2895	0.292	-0.0025	0.0060
350 nm	0.0000	0.000	0.0000	0.0060
	0.6381	0.639	0.0001	0.0060
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)	
260.67 +/- 0.11 nm	260.7	2.1	1.678	
391.84 +/- 0.11 nm	391.9	1.7	1.770	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SDW
Standard Wavelength (nm)	268.63	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	268.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.208		

* Calibration Marked * Not TICI Accredited * In this Certificate have been included for completeness.

The End of Certificate

DKSH Technology Limited
2523 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10250
2523 Sukhumvit Road, Bangkok, Phraeklong, Bangkok 10250
Phone: +66 2859 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CALFM-C08-13: 20 Jul 2022



Certificate No.: C06220464 Page 2 of 3

Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.4	0.21	0.14	
586.86	586.7	-0.04	0.14	
637.06	636.3	-0.32	0.14	
746.48	746.8	-0.32	0.14	
807.03	807.4	-0.37	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5005	0.503	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
485 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6693	0.672	-0.0027	0.0045
	0.9904	0.994	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
580 nm	0.0000	0.000	0.0000	0.0045
	0.5625	0.564	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.536	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

DKSH Technology Limited
2523 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10250
2523 Sukhumvit Road, Bangkok, Phraeklong, Bangkok 10250
Phone: +66 2859 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CALFM-C08-13: 20 Jul 2022



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER		รุ่น: DR6000	หมายเลขเครื่อง: 1627845	
ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)	
27 Sep 2022			27 Sep 2022	
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ
		General		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Spectrophotometer		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.5 VDC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7. หัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		pH Meter and Conductivity Meter		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	14. ฝาปิดกันปลาน Electrode (Dust Protection Hood)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Turbidimeter		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	16. ค่าความชื้นที่ใส่ชุด (Mo Sample)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	17. ระดับการเชื่อมสว่านของชุด (>= 2.5 ไม่นเกิน 3.0)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Automatic Dilutor		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	18. สภาพ Piston Burettes	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	19. Function Rinsing and Dosing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	20. ระบบท่อสายนำและอุปกรณ์ประกอบ	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

ผู้ตรวจสอบหน้า:

Mr. Chaturaphon Fothong
Service Engineer

DKSH Technology Limited
2523 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10250
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Delivering Growth - In Asia and Beyond.

CALFM-R31-05: 20 Jul 2022

Mettler-Toledo (Thailand) Limited

METTLER TOLEDO

Performance Test

Attachment to Certificate No. CPH-0158-22

Conductivity Sensor

Type InLab 742-ISM SN 5821410228

Certified standards used

Standard 1:	Type	Cond. Standard	Manufacturer	METTLER TOLEDO	Exp. date	Apr-23
		Measured value: (25.00 °C)	83.92	uS/cm	Lot No.	GS947201
Standard 2:	Type	Cond. Standard	Manufacturer	METTLER TOLEDO	Exp. date	-
		Measured value: (- °C)	-	uS/cm	Lot No.	-

Cell Constant Adjustment

Nominal	Old (cm ⁻¹)	New (cm ⁻¹)
84 uS/cm	0.100927	0.096312

Measurements (Reference Temperature 25 °C and Temperature correction is 2.00 % / °C)

Before adjustment				After adjustment			
Buffer Values	Measured	Difference		Buffer Values	Measured	Difference	
83.92 uS/cm	25.2 °C	90.11	6.19	83.91 uS/cm	25.2 °C	84.15	0.23

Note The difference result of calibrated electrode should be within $\pm 2.5\%$

Remarks

Place Chemical room Performance Date July 19, 2022

Service Specialist Sookpal Srisawat Signature *Sookpal*

REVIEW BY *Tanapong*

APPROVED BY *S/S*

NEXT CAL DATE 15 July 2023

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Rev'dn. Version: 16 Jul 2022

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Certificate Number CPH-0158-22

Calibration Certificate
Seven2Go™ pro Conductivity S7

Customer

Company ALS LABORATORY GROUP (THAILAND) CO., LTD

Address 616/10 Moo 9, T. Maengmoo, A. Phrasang

RAYONG 21140

Customer ID number 301856073

Customer representative

Instrument

Type Seven2Go™ pro Conductivity S7 Instrument Serial Number C229260218

Internal Identification Firmware version 1.02.01

Technical specifications

Measuring Range 0.01 uS/cm 1000 mS/cm

Resolution 0.001 1 (auto range)

Limit of Error $\pm 0.5\%$

Temperature range ATC -5 105 °C

Resolution 0.1 °C

Limit of Error ± 0.1 °C

Procedure Statement

METTLER TOLEDO Seven2Go Service Manual Section 8 (Doc. No. 30232219) will be used as referring documentation to adjust and verify the instrument indicated in the "Type" and "Serial number" section. The measurement results of this certificate were obtained at ambient conditions.

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METTLER TOLEDO

METTLER TOLEDO

Certificate Number CPH-0158-22

Certification Tools

Certified Conductivity Resistors Manufacturer METTLER TOLEDO

Type 8322881

Serial number 8207

Certificate number 83872

Date of Certification April 27, 2022

Designation	Nominal value	Certified value
Conductivity 10 Ω	10.000 Ω	9.99437 Ω
Conductivity 150 Ω	150.00 Ω	150.1142 Ω
Conductivity 1.5 kΩ	1.5000 kΩ	1.499422 kΩ
Conductivity 15 kΩ	15.0000 kΩ	15.00491 kΩ
Conductivity 150 kΩ	150.00 kΩ	150.0491 kΩ
Conductivity 1.5 MΩ	1.5000 MΩ	1.500363 MΩ

Certified Temperature Resistors Manufacturer METTLER TOLEDO

Type 8326450

Serial number A827

Certificate number 83871

Date of Certification April 27, 2022

Designation	Nominal value	Certified value
NTC 30 kΩ, 0 °C	84.980 kΩ	84.9814 kΩ
NTC 30 kΩ, 25 °C	20.000 kΩ	20.0022 kΩ
NTC 30 kΩ, 50 °C	10.069 kΩ	10.06530 kΩ
NTC 30 kΩ, 75 °C	4.528 kΩ	4.52584 kΩ
NTC 30 kΩ, 100 °C	2.070 kΩ	2.06920 kΩ

Certificate Number CPH-0158-22

Certification Measurements

Conductivity Sensor Input (Resistance)	Designation	Certified value	Measured value	Max. Tolerance	Passed / Failed
	10 Ω	9.994 Ω	9.99 Ω	0.5 %	Passed
	150 Ω	150.114 Ω	150.2 Ω	0.5 %	Passed
	1.5 kΩ	1.499 kΩ	1.499 kΩ	0.5 %	Passed
	15 kΩ	15.003 kΩ	15.01 kΩ	0.5 %	Passed
	150 kΩ	150.049 kΩ	150.1 kΩ	0.5 %	Passed
	1.5 MΩ	1.500 kΩ	1.501 kΩ	0.5 %	Passed

Conductivity Sensor Input (Temperature)	Designation	Nominal value	Measured value	Max. Tolerance	Passed / Failed
	NTC 30 kΩ, 0 °C	0.0 °C	-0.1 °C	0.1 °C	Passed
	NTC 30 kΩ, 25 °C	25.0 °C	25.0 °C	0.1 °C	Passed
	NTC 30 kΩ, 50 °C	50.0 °C	50.0 °C	0.1 °C	Passed
	NTC 30 kΩ, 75 °C	75.0 °C	75.0 °C	0.1 °C	Passed
	NTC 30 kΩ, 100 °C	100.0 °C	100.0 °C	0.1 °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 Sookpal Srisawat Function Service Technician

Company METTLER TOLEDO

Date July 19, 2022 Signature *Sookpal*

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Certificate of System Qualification

ES-OQ

System ID: MY16010005
 Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
 Organization Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

Date: September 13, 2021 5:49:11 PM
 EQP Name: Agilent Recommended
 EQP Revision: ES.02.50
 Overall Qualification Status: Pass

Preparation

Pass

Instrument Tests

Pass

Autosampler Operation

Pass

REVIEW BY	Thitima B.
APPROVED BY	Srinuan N.
NEXT CAL DATE	12 Mar 23

Date: September 13, 2021 5:49:11 PM
 System ID: MY16010005

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES
Preventive Maintenance

REVIEW BY	Charatt T.
APPROVED BY	Srinuan N.
NEXT CAL DATE	01/03/24

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

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

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

Revision A.02 Issued 21 January 2022
 Document Number G0914-90075
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Page ___ of ___



Agilent 5100 5110 Preventive Maintenance Checklist



Introduction

Customer Information

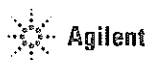
- Customers should provide all necessary operating supplies upon request of the engineer
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service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

Agilent 5100 5110 Preventive Maintenance Checklist



Important Customer Web Links

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



Service Engineer's Responsibilities

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

Instrument Maintenance

System Information

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

Instrument System Name and ID	G9010A ; M416010005
Instrument System Site and Location	ALS C Bldg

List System Component Product Numbers	List the Serial Numbers of each Component
1 G9010A	M416010005
2 G9440A	AU16440964
3 G9711L	ED06-00169
4 G9485	AU16040115
5	
6	
7	
8	
9	

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

Preparation

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

Preventive Maintenance Procedures

Record Pre-PM instrument performance

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

Clean and inspect ICP-OES system

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

Agilent Water Recirculator

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

SPS 3 Auto Sampler

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

SPS 4 Auto sampler

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

AVS 4, 6, 7 Advanced Valve System

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

ICP-OES adjustment

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

Record Post-PM instrument performance

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

Restore Instrument

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

Service Review

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

Test Results

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SBR	33603.8	144365.1	39,348.9	164,359.5
Mn 257.610 nm SBR	153692.2	698560.3	159,250.0	313,496.1
Al 396.152 nm SBR	28583.5	200,141.7	28,945.9	196,607.0
K 766.491 nm SBR	99,116.7	3,181,823.8	99,899.4	2,968,954.9

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

Instrument Test Results Table

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

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

ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	218.578	VAC	215.435	VAC
Mains Current	0.217	A	0.116	A
Instrument Temperature	24.4	°C	24.3	°C
RF Air Flow (sensor speed)	16.0	Hz	20.0	Hz
Plasma Exhaust Temperature	No measurement		47.3	°C
Water Flow Oscillator	No measurement		1.20	L/min
Water Flow Detector	1.12	L/min	1.09	L/min
Water Inlet Temperature	25.0	°C	23.5	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-40.0	°C	-40.0	°C
Thermal Stabilizer	34.8	°C	35.0	°C
Argon Supply Pressure	513.73	kPa	541.92	kPa
Purge Gas Supply Pressure*1	609.38	kPa	567.77	kPa
Option Gas Supply Pressure*1	—	kPa	—	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		255.76	kPa
Plasma Gas Flow	No measurement		11.98	L/min
Auxiliary Gas Flow	No measurement		1.0	L/min
RF Power	No measurement		1195.9	W
RF Supply Current	No measurement		0.727	A
RF Supply Voltage	No measurement		194.472	V

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-60104	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-60105	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	—
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8030-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	—
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	—
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	—
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	1
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	1
PVC waste tubing 6mm od x 5mm id, 2m	G8410-80122	SPS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	—
Z axis drive belt	5410047400	SPS 3	—
Peristaltic pump tubing, PVC SolvaFlex 3 bridged,	3710040000	SPS 4	—

Consumed Parts Reference

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

☐ Section Not Applicable

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

Signature Page

Service Engineer Comments (optional)

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

- During PM found water tubing in instrument broken then water leaking inside instrument.
- Replace all water tube inside instrument, after replace found water flow sensor water leak also.
- Replace water module and continue PM without deviation.

Service Verification

Service Request Number: 6005835474 Date Service Completed: 2 - May - 2023

Service Engineer Name: Burin Ngamvijit Customer Name: Thitiro Sangtong

Service Engineer Signature: Burin Ng. Customer Signature: Thitiro S.

Total number of pages in this document:



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhaoi, Sarabun 18110

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

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

Certificate No. 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. : TS5306A3

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

 104 Phatthanakan 40, Phatthanakan Rd., Kitiwong Phatthanakan,
 Khet Suan Luang, Bangkok 10250

Customer Location : Acid Digestion Lab

Date of Receipt : 30 March 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By : /Suffar Naknakred (Site Calibration Manager)

Date of Issue : 12 APR 2022

REVIEW BY	Tattaporn C.
APPROVED BY	Sangtong
NEXT CAL DATE	7/10/23

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

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Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.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



Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. 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 W1-T20.
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instruments	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

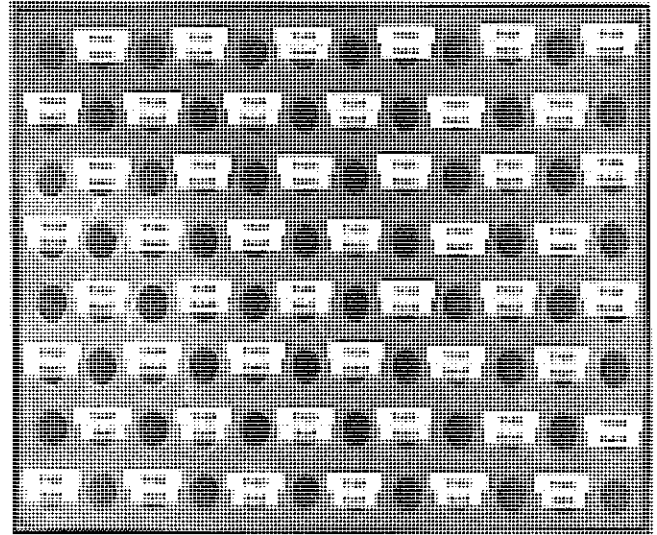
Approved By.

FM-L13 108.30-05-57

Certificate No. T220730

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By.

FM-L13 108.30-05-57



Metrological Center

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

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

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

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

Certificate No. 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
	Min	93.07	93.26	93.51	93.66	93.82
	Average	93.33	93.54	93.78	93.93	94.09
R2 Hole7-Hole12	TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82
	Min	94.05	94.25	94.08	93.97	94.26
	Average	94.32	94.52	94.36	94.26	94.54
R3 Hole13-Hole18	TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06
	Min	94.46	93.98	94.20	94.28	94.49
	Average	94.74	94.26	94.49	94.56	94.78
R4 Hole19-Hole24	TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73
	Min	94.33	94.26	95.51	95.62	95.51
	Average	94.61	94.54	95.62	95.73	95.62
R5 Hole25-Hole30	TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.39	96.37	96.54	96.04
	Min	96.01	96.10	96.02	96.20	95.89
	Average	96.15	96.24	96.20	96.37	95.98
R6 Hole31-Hole36	TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33
	Min	96.53	96.65	96.71	96.08	95.98
	Average	96.68	96.81	96.87	96.28	96.16
R7 Hole37-Hole42	TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95
	Min	96.13	95.84	95.85	95.72	96.64
	Average	96.30	95.99	96.02	95.90	96.80
R8 Hole43-Hole48	TN237	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34
	Min	96.55	96.21	95.80	95.87	96.03
	Average	96.73	96.40	95.96	96.03	96.18

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
	Min	104.15	104.27	104.45	104.98	105.14
	Average	104.31	104.46	104.62	105.15	105.31
R2 Hole7-Hole12	TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.55	105.73	105.65	105.84	105.97
	Min	105.28	105.43	105.35	105.52	105.68
	Average	105.42	105.59	105.50	105.68	105.82
R3 Hole13-Hole18	TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.14	106.06	105.81	106.03	105.81
	Min	105.85	105.81	105.55	105.62	105.53
	Average	106.00	105.94	105.68	105.82	105.67
R4 Hole19-Hole24	TN239	TN240	TN221	TN222	TN223	TN224
	Max	105.86	105.60	104.44	104.51	104.28
	Min	105.61	105.37	104.27	104.35	104.12
	Average	105.74	105.48	104.35	104.43	104.20
R5 Hole25-Hole30	TN225	TN226	TN227	TN228	TN229	TN230
	Max	104.94	104.93	104.97	105.08	104.68
	Min	104.77	104.75	104.76	104.90	104.51
	Average	104.85	104.84	104.85	104.99	104.60
R6 Hole31-Hole36	TN231	TN232	TN233	TN234	TN235	TN236
	Max	105.44	105.45	105.61	104.95	104.84
	Min	105.27	105.27	105.44	104.76	104.66
	Average	105.36	105.36	105.53	104.85	104.75
R7 Hole37-Hole42	TN237	TN238	TN239	TN240	TN221	TN222
	Max	105.17	104.70	104.59	104.51	105.22
	Min	105.00	104.53	104.41	104.35	105.04
	Average	105.08	104.62	104.50	104.43	105.13
R8 Hole43-Hole48	TN223	TN224	TN225	TN226	TN227	TN228
	Max	105.61	105.45	105.10	104.77	104.87
	Min	105.44	105.23	104.92	104.60	104.70
	Average	105.53	105.37	105.01	104.69	104.93

Approved By.

FM-L13 108.30-05-57

Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)	Uncertainty (± °C)
	Min, Max	Average		
100.0	100.0, 100.4	100.1	0.29	0.83
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=2 which for a t-distribution, providing a level of confidence of approximately 95 %

Approved By: _____

FM-L13 108/30-05-57

Calibration Report

Equipment : Chamber (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 0244)

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

Approved By: _____

FM-L15 117/15-05-63

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 Nakhakred (Site Calibration Manager)

Approved By : _____ / Boonchai Suriyawong (Site Calibration Manager)

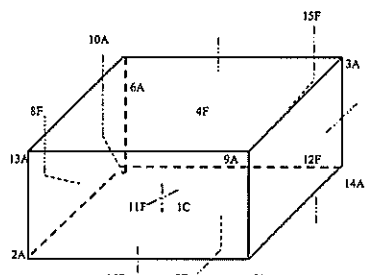
Date of Issue : 04 JUL 2022

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

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FM-L14 117/01-02-64

Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C = TN161	11F = TN171
2A = TN162	12F = TN172
3A = TN163	13A = TN173
4F = TN164	14A = TN174
5A = TN165	15F = TN175
6A = TN166	16E = TN176
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	

Approved By: _____

FM-L15 117/15-05-63

Certificate No. T221644

Page 4 of 4

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.69	3.02	2.96	3.03	2.85
	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	Average					
3.0	2.9, 4.0	3.2	2.99	1.05	1.30	1.66	2.00

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.


The result of test was found accurate as shown on date and place of test only.


The reported expanded uncertainty is based on 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 11/15-05-63

REVIEW BY: Autichayawon S.
APPROVED BY: Serana M.
NEXT CAL DATE: 11 Jan 24


ARCHEMICA

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:  Date: Jan 11, 2023
(Mr.Nutdanai Laekhwan)
Application Chemist

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Certificate of System Qualification

GC-QG + GCMS-QG

REVIEW BY: Autichayawon S.
APPROVED BY: Serana M.
CAL DATE: 11/15/23System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn Rd., Kwang Suan Luang, Khet Suan Luang, Bangkok 10250Date: November 23, 2021 1:12:35 PM
EDP Name: Agilent Recommended, Agilent Recommended
EQP Revision: GC 02.52, GCMS 02.51
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Nanihawadee Sombon

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: <= 1.2Date: 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 °C (-5.0 °C)
<= 1.0 °C (5.0 °C)
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 100.0 99.8 °C
Accuracy: -0.2 °C
Agilent Recommended: >= -1.0 °C (-3.7 °C)
<= 1.0 °C (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:	7693D			
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:	Injection Tower			
Source:	EI - Extractor			
Setpoint Status:	Completed			
Injection Volume on Column:	1.0 µL			

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	EI - Extractor			

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

Page 3 / 15

Setpoint Status:	Pass	
Injection Volume on Column:	1.0 µL	
Area	5.79 %	Retention Time: 0.05 %
Minimum RSD:	<= 12.00	<= 1.00
Agilent Recommended:	Pass	Pass
Status:	Pass	
Instrument Detection Limit:	1.94800 fg	
Agilent Recommended:	<= 4.03800	
Status:	Pass	

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	EI - Extractor			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0 µL			
Area Mass 1	4.07 %		Mass Ratio: 2.06 %	
Abundance's	<= 5.00		<= 5.00	
RSD:	Pass		Pass	
Agilent Recommended:	Pass		Pass	

Overall Mass Ratio Precision Test Status

Pass

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

Page 4 / 15

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	GM-10
Manufacturer	Agilent Technologies
Name	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	CN18170137
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	US1626U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN 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

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User Name: jaruwat.channarong

Hostname: ASBKRWX205

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 10:13:05 AM	Audit	Session Created	Session	None
November 23, 2021 10:13:05 AM	Start	Configuration	Session	None
November 23, 2021 10:13:35 AM	Audit	Exit/Event	Licensing	User is Field Engineer and does not require an unlock code
November 23, 2021 10:20:27 AM	Audit	Eq Loaded	Session	EQP details for primary technique [D1] File path: [ProtocolRack\GC\Config\analinst\02_52\02_52_exp]. EQP File Name: [GC:02_52_exp]. EQP Name: [AgilentRecommended] EQP details for hyphenated technique [G1M]. File path: [ProtocolRack\GC\Config\analinst\02_51\02_51_exp]. EQP File Name: [GC:02_51_exp]. 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 10:21:02 AM	Start	Qualification	Session	OQ
November 23, 2021 10:21:54 AM	Start	Execution	CDS Legon Verification - GC Quantitative test	None
November 23, 2021 10:26:40 AM	End	Execution	CDS Legon Verification - GC Quantitative test	Run Count: 1

Page 1 / 7

User Name: jaruwat.channarong

Hostname: ASBKRWX205

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 10:26:42 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 10:29:56 AM	Start	Execution	Inlet Pressure Accuracy - Front MM: - 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 MM: - 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: 250.0°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: 250.0°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: 250.0°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: 100.0°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: 100.0°C; L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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User Name: janwetachannarong

Hostname: ASDXW205

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 10:27:45 AM	End	Execution	GC Oven Temperature Accuracy - 7850 - Temperature	Run Count: 1
November 23, 2021 10:28:26 AM	Start	Execution	GC Oven Temperature Stability - None	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 1.0 AND <= 1.0 % setpoint in R
November 23, 2021 10:35:24 AM	Start	Execution	GC Oven Temperature Stability - None	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
November 23, 2021 10:35:29 AM	Start	Execution	GC Oven Temperature Stability - None	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
November 23, 2021 10:37:44 AM	Start	Execution	GC Oven Temperature Stability - None	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
November 23, 2021 10:39:20 AM	Audit	Data	GC Oven Temperature Stability - Manual Data Entry	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
November 23, 2021 10:39:23 AM	End	Execution	GC Oven Temperature Stability - Run Count: 1	- 7850 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
November 23, 2021 10:39:26 AM	Start	Execution	Tune EI - 70000 TQ - Source - None	EI - Extractor Filament 1 (Qualitative - No setpoints associated)
November 23, 2021 10:41:10 AM	End	Execution	Tune EI - 70000 TQ - Source - Run Count: 1	EI - Extractor Filament 1 (Qualitative - No setpoints associated)

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User Name: janwetachannarong

Hostname: ASDKXW205

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 10:41:13 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
November 23, 2021 10:41:34 AM	End	Execution	Tune EI - 70000 TQ - Source - Run Count: 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
November 23, 2021 10:43:47 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\Agilent002021V01_001.D
November 23, 2021 10:45:10 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 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_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\Agilent002021V01_001.D

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: janwetachannarong

Hostname: ASDKXW205

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 10:45:39 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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_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\Agilent002021V01_001.D

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User Name: janwetachannarong Hostname: ASDKXW205			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 10:45:39 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\Agilent002021V01_010.D
November 23, 2021 10:45:50 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) <= 5.00%	None
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_001.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_002.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_003.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_004.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS1\data\Agilent002021V01_005.D

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System ID: GM-10

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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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User Name: Janwatachananong

Hostname: ASDHOW2055

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 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ - Source: EI - Extractor - L (RSD): <= 5.00%	Data Files Path: D:\MassHanta\GCMS\data Agilent002021MRP 605.D
November 23, 2021 10:48:02 AM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMI, 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	AccClosed	Session	None
November 23, 2021 1:03:30 PM	Audit	AccRestarted	Session	None
November 23, 2021 1:03:32 PM	Audit	SessionReleased	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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Date: November 23, 2021 1:12:35 PM
System ID: GM-10

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Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn 40, Pathanakarn Rd., Kwang Suan Luang, Khel Suan Luang, Bangkok 10250

Date: May 25, 2023 11:05:07 AM
EOP Name: AgilentRecommended, AgilentRecommended
EOP Revision: GC.02.52, GCMS.02.51
Overall Qualification Status: Pass

REVIEW BY: Suchada T.
APPROVED BY: Nant Sath
CRITICAL DATE: 25 Nov 19

CDS Logon Verification - GC

Logon: SESSIONNAME

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 MMI

Setpoint Status: Pass

	Setpoint	Actual
Inlet Pressure:	25.0 psi	24.9 psi

Accuracy: 0.1 psi

Agilent Recommended: <= 1.2

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 230.0 230.0 °C
Accuracy: 0.0 °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: 100.0 100.0 °C
Accuracy: 0.0 °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: 100.0 100.0333 °C
Stability: 0.1 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	7000D			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	7693A			
	EI - Extractor			
Setpoint Status:	Completed			
Injection Volume on Column:	1.0			µL

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	7693A			
	EI - Extractor			

Date: May 25, 2023 11:05:07 AM
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Setpoint Status:	Pass
Injection Volume on Column:	1.0 μ L
Minimum RSD:	10.98 %
Agilent Recommended:	\leq 12.00 %
Status:	Pass
Instrument Detection Limit:	3.69552 fg
Agilent Recommended:	\leq 4.03803 fg
Status:	Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	7693A			
Setpoint Status:	EI - Extractor			
Injection Volume on Column:	1.0 μ L			
RSD:	3.22 %	Area Mass 1	Mass Ratio	14.08 %
Agilent Recommended:	\leq 5.00 %	Abundance's		\leq 5.00 %
	Pass			Pass

Overall Mass Ratio Precision Test Status

Pass

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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.11.02
Usage	Sample Injection
Location	Front
Syringe Volume (μ L)	10

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Sampler 2	
Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN18170137
Firmware Revision	A.11.03
Vial Heater	Not Installed
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN18153080
Firmware Revision	B.02.05
Oven Type	Standard
Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	TQ
Name	70000
Serial Number	US1826U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer: Natlapat Hengcharoen
Logged On User Name: natlapat.hengcharoen@agilent.com
Signature Creation Date: May 25, 2023
Reason for Signature: Executed protocol and published this original version of document

Regulatory Disclaimer

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natlapat.hengcharoen
Host Name: ASDKXW265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:32:33 PM	Audit	Session Created	Session	None
May 22, 2023 1:32:33 PM	Start	Configuration	Session	None
May 22, 2023 1:32:33 PM	Audit	Entitlement	Licensing	User is Field Engineer and does not require an unlock code
May 22, 2023 1:37:48 PM	Audit	File Loaded	Session	EOP details for primary technique [0c] - File path: [ProtocolPath\GCMs\Configurations\02_GM-02.02.02.ecp]. EOP File Name: [GCM02.02.ecp], EOP Name: [AgilentRecommended]Protocol Revision [GCM02.02] EOP details for hyperlinked technique [GCM02] - File path: [ProtocolPath\GCMs\Configurations\02.01\GCM02.01.ecp]. EOP File Name: [GCM02.01.ecp], EOP Name: [AgilentRecommended]
May 22, 2023 1:37:52 PM	End	Configuration	Session	None
May 22, 2023 1:37:55 PM	Start	Qualification	Session	QC
May 22, 2023 1:37:58 PM	Start	Execution	QC Logon Verification - QC - Qualitative test	None
May 22, 2023 2:02:37 PM	Start	Execution	QC Logon Verification - QC - Qualitative test	None
May 22, 2023 2:02:33 PM	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

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natlapat.hengcharoen
Host Name: ASDKXW265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:02:37 PM	Start	Execution	QC Logon Verification - QC - Qualitative test	None
May 22, 2023 2:03:33 PM	End	Execution	QC Logon Verification - QC - Qualitative test	Run Count: 1
May 22, 2023 2:34:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - T800 - Qualitative Test - No actions associated	None
May 22, 2023 2:35:02 PM	End	Execution	System Inspection and Basic Safety and Operation - T800 - Qualitative Test - No actions associated	Run Count: 1
May 22, 2023 2:35:17 PM	Start	Execution	Init Pressure Accuracy - Front MM, - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
May 22, 2023 2:35:22 PM	End	Execution	Init Pressure Accuracy - Front MM, - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
May 22, 2023 2:35:24 PM	Start	Execution	GC Oven Temperature Accuracy - T800 - Temperature Oven - S: 220.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:35:48 PM	Audit	Data	Manual Data Entry	
May 22, 2023 2:35:54 PM	End	Execution	GC Oven Temperature Accuracy - T800 - Temperature Oven - S: 220.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natlapat.hengcharoen
Host Name: ASDKXW265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:35:55 PM	Start	Execution	GC Oven Temperature Accuracy - T800 - Temperature Oven - S: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:50:09 PM	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
May 22, 2023 3:08:09 PM	Start	Execution	Scanning Run - Injection Tower, Front MM, TQ - Source: EI - Extractor - Part of GCMs System Preparation	None
May 22, 2023 3:10:34 PM	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
May 22, 2023 3:12:01 PM	Start	Execution	Mass Ratio Prediction - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD): <= 8.00%	None
May 22, 2023 3:17:49 PM	Start	Execution	GC Oven Temperature Accuracy - T800 - Temperature Oven - S: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:17:50 PM	Start	Execution	GC Oven Temperature Accuracy - T800 - Temperature Oven - S: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:18:05 PM	Audit	Data	Manual Data Entry	

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nallapat.hengcharoen
Hostname: ASBKWV265

System ID: GM-10
Print Date: May 25, 2023 11:05:58 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 3:18:07 PM	End	Execution	GC Oven Temperature Accuracy - 780°C - Temperature : Oven - S: 109.0°C - L: +/- 1.0 AND +/- 1.0% setpoint in K	Run Count: 1
May 22, 2023 3:39:07 PM	Start	Execution	Soaking Run - Injection Tower, Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	None
May 22, 2023 3:39:10 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 4:02:59 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 4:03:58 PM	Start	Execution	GC Oven Temperature Stability - 780°C - Temperature : Oven - S: 109.0°C - L: +/- 0.5°C	None
May 22, 2023 4:03:52 PM	Audit	Data	GC Oven Temperature Stability - 780°C - Temperature : Oven - S: 109.0°C - L: +/- 0.5°C	Manual Data Entry
May 22, 2023 4:03:54 PM	End	Execution	GC Oven Temperature Stability - 780°C - Temperature : Oven - S: 109.0°C - L: +/- 0.5°C	Run Count: 1
May 23, 2023 3:08:15 PM	Audit	AccClosed	Session	None
May 24, 2023 4:03:19 PM	Audit	AccRestarted	Session	None
May 24, 2023 4:14:45 PM	Audit	AccClosed	Session	None
May 23, 2023 10:15:57 AM	Audit	AccRestarted	Session	None
May 23, 2023 10:27:12 AM	Audit	SessionRelocated	Session	None

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nallapat.hengcharoen
Hostname: ASBKWV265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:27:13 AM	Start	Qualification	Session	QC
May 25, 2023 10:27:16 AM	Start	Execution	Tune EI - 70000 TQ - Source: None EI - Extractor Filament 1 (Qualitative - No separate associated)	None
May 25, 2023 10:27:42 AM	Start	Execution	Tune EI - 70000 TQ - Source: None EI - Extractor Filament 1 (Qualitative - No separate associated)	None
May 25, 2023 10:27:56 AM	End	Execution	Tune EI - 70000 TQ - Source: Run Count: 1 EI - Extractor Filament 1 (Qualitative - No separate associated)	None
May 25, 2023 12:27:57 AM	Start	Execution	Tune EI - 70000 TQ - Source: None EI - Extractor Filament 2 (Qualitative - No separate associated)	None
May 25, 2023 10:28:07 AM	End	Execution	Tune EI - 70000 TQ - Source: Run Count: 1 EI - Extractor Filament 2 (Qualitative - No separate associated)	None
May 25, 2023 10:28:08 AM	Start	Execution	Soaking Run - Injection Tower, Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	None
May 25, 2023 10:28:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 10:28:29 AM	Start	Execution	Soaking Run - Injection Tower, Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	None

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nallapat.hengcharoen
Hostname: ASBKWV265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:28:59 AM	Audit	Data	Soaking Run - Injection Tower, Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:29:24 AM	End	Execution	Soaking Run - Injection Tower, Front MM, TQ - Source: EI - Extractor: Part of GCMS System Preparation	Run Count: 1
May 25, 2023 10:29:25 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:30 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nallapat.hengcharoen
Hostname: ASBKWV265

System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D
May 25, 2023 10:30:50 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: EI - Extractor: RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data\AgilentGC_20230501.D

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: naitapatharngcharoen
Hostname: AS2HQO0285
System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:22 AM	Start	Execution	Mass Ratio Precision - Injection	None Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 25, 2023 10:30:48 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_01.D ≤ 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_02.D ≤ 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_03.D ≤ 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_04.D ≤ 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_05.D ≤ 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\MassHunter\GCMS\1\data Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): Agilent\GC_2023\MRP_06.D ≤ 5.00%
May 25, 2023 10:30:57 AM	End	Execution	Mass Ratio Precision - Injection	Run Count: 1 Tower: Front MMU, TQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 25, 2023 10:31:02 AM	End	Qualification	Session	OD

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: naitapatharngcharoen
Hostname: AS2HQO0285
System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:31:02 AM	Start	Reporting	Session	None
May 25, 2023 11:04:34 AM	Audit	Reporting	Session	Report Generated: C:\G\cde

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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