

# ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ





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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_F50160	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_F50178	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_F50175	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_F50291	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_E00001	1-Mar-23	1-Mar-24	12
Ambient	Particulate Matter (PM10)	High Volume	RYG_F50900	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RYG_F50797	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RYG_F50798	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RYG_F50169	-	-	On site Calibration
Ambient	Particulate Matter (PM10)	Digital Balance	RYG_E00001	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO Analyzer	BKQ_F50782	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	BKQ_F50797	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	RYG_F50033	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	RYG_F50061	1-Jul-23	1-Jan-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKQ_F50781	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKQ_F50796	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_F50057	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_F50060	2-Jul-23	2-Jan-24	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_F50030	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKQ_F50143	5-Jan-23	5-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_F50013	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_F50089	13-Jul-23	13-Jan-24	6
Stack	Total Suspended Particulate	Console Control Unit	BKQ_F50048	13-Jul-23	13-Jan-24	6
Stack (CEMS)	Dioxide of Nitrogen	Digital Balance	RYG_E00003	1-Mar-23	1-Mar-24	12
Stack (CEMS)	Sulfur Dioxide	Analyzer - System calibration, Start	-	-	-	-
Stack (CEMS)	Leq 24 hrs	Analyzer - System calibration, Start	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RYG_F50013	26-Jan-23	26-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50044	23-Jan-23	23-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50022	23-Jan-23	23-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50030	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_F50013	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50016	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50019	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50033	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50034	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50018	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50020	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50013	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50031	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50033	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50039	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50044	13-Jan-24	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_F50056	19-Oct-23	19-Oct-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50358	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50321	24-Feb-23	24-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50322	24-Feb-23	24-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50217	15-May-23	15-May-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50218	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50219	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_F50221	14-Mar-23	14-Mar-24	12
Illuminance	Illuminance	Lux Meter	RYG_F50036	2-Sep-22	2-Sep-23	12
Illuminance	Illuminance	Lux Meter	RYG_F50038	20-Sep-23	20-Sep-24	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_E00296	3-Jul-23	3-Jul-24	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_E00152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_E00002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_E00010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_E00002	1-Mar-24	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_E00032	20-Oct-22	20-Apr-24	18
Rayong Lab	BOD	DO meter with Sensor	RYG_E00010	29-Jul-23	29-Jul-24	18
Rayong Lab	BOD	Incubator	RYG_E00154	29-Nov-23	29-Nov-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_E00002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_E00006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_E00061	20-Oct-22	20-Apr-24	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_E00184	25-Jan-23	25-Jul-24	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	COD	Spectrophotometer	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	Chloride	pHISE Meter	RYG_E00152	22-Dec-22	22-Dec-23	12
Rayong Lab	Cyanide	SPECTROPHOTOMETER	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	Formaldehyde	SPECTROPHOTOMETER	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	Phenol	SPECTROPHOTOMETER	RYG_E00037	27-Sep-22	27-Mar-24	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RYG_E00184	25-Jan-23	25-Jul-24	18
Rayong Lab	Fluoride	pHISE Meter	RYG_E00152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_E00188	15-Mar-24	15-Mar-24	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_E00152	22-Dec-22	22-Dec-23	12
Water Lab	Calcium	ICP-OES	BKQ_EL00037	2-Mar-23	1-Mar-24	12
Water Lab	Calcium	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Calcium	Chamber (Cold Room)	BKQ_E00167	30-Jan-22	30-Dec-23	18
Water Lab	Magnesium	ICP-OES	BKQ_E00037	2-Mar-23	1-Mar-24	12
Water Lab	Magnesium	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Magnesium	Chamber (Cold Room)	BKQ_E00167	30-Jan-22	30-Dec-23	18
Water Lab	Sodium	ICP-OES	BKQ_EL00037	2-Mar-23	1-Mar-24	12
Water Lab	Sodium	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	SAR	ICP-OES	BKQ_EL00037	2-Mar-23	1-Mar-24	12
Water Lab	SAR	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	SAR	Chamber (Cold Room)	BKQ_E00167	30-Jan-22	30-Dec-23	18
Water Lab	Chloride	Ion Chromatography	BKQ_E00130	11-Jan-23	11-Jan-24	12
Water Lab	Organochlorine Pesticide	GC-MS/MS	BKQ_E00284	25-May-23	25-Nov-24	18
Water Lab	Anionic Surfactant	Spectrophotometer	BKQ_E00018	15-Sep-23	15-Sep-24	12
Water Lab	Anionic Surfactant	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKQ_E00018	15-Sep-23	15-Sep-24	12
Water Lab	Silver	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Silver	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Silver	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Barium	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Barium	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Lead	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Iron	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Iron	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Iron	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Manganese	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18
Water Lab	Copper	ICP-MS	BKQ_EL00026	12-Jun-23	11-Jun-24	12
Water Lab	Copper	Hot Block	BKQ_EL00054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cold Room)	BKQ_E00167	30-Jun-22	30-Dec-23	18





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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Nickel	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Arsenic	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Arsenic	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Selenium	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Cadmium	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Zinc	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Zinc	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Trivalent Chromium	ICP-MS	BKS_EI0026	12-Jun-23	11-Jun-24	12
Water Lab	Trivalent Chromium	Hot Block	BKS_EI0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	Chamber (Cold Room)	BKS_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	DIG-CVAFS / CVAAS	BKS_EI0023	24-May-23	24-May-24	12

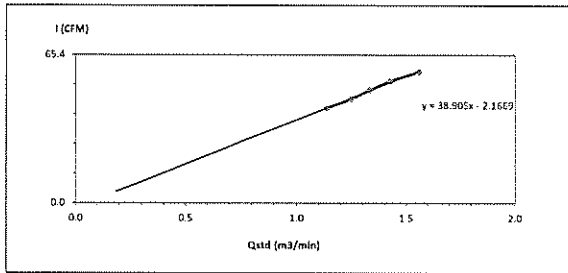


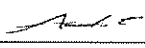


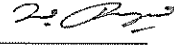
### High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf T33 Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	โรงโม่หินบ้านศรีภักดิ์	Temperature (°C) :	30
Calibrate Date :	23-Nov-23	High Volume ID :	RYG_FS0180
CalibrationSheet No.:	C-231123-RYG_FS0180	High Volume Model :	TE-S170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	1328
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>air</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.9	1.1376	42	Slope : 38.9045 Intercept : -2.1669 Correlation Coefficient : 0.9972
2	3.5	1.2478	46	
3	4.0	1.3325	50	
4	4.6	1.4275	54	
5	5.5	1.5590	58	



Calibrated by   
( Mr. Anurak Tongkhajonsakda )  
Field Scientist(1)

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

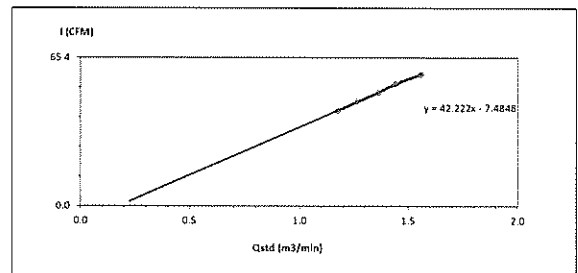
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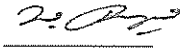
### High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf T33 Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	โรงโม่หินบ้านศรีภักดิ์	Temperature (°C) :	30
Calibrate Date :	23-Nov-23	High Volume ID :	RYG_FS0178
CalibrationSheet No.:	C-231123-RYG_FS0178	High Volume Model :	TE-S170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4804
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>air</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.1	1.1755	42	Slope : 42.2224 Intercept : -7.4848 Correlation Coefficient : 0.9985
2	3.6	1.2652	46	
3	4.2	1.3649	50	
4	4.7	1.4427	54	
5	5.5	1.5590	58	



Calibrated by   
( Mr. Anurak Tongkhajonsakda )  
Field Scientist(1)

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

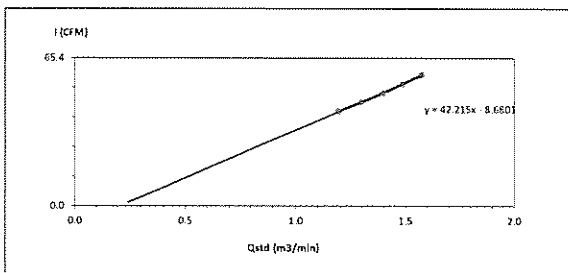
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### High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf T33 Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	โรงโม่หินบ้านศรีภักดิ์	Temperature (°C) :	30
Calibrate Date :	23-Nov-23	High Volume ID :	RYG_FS0175
CalibrationSheet No.:	C-231123-RYG_FS0175	High Volume Model :	TE-S170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4801
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>air</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.2	1.1940	42	Slope : 42.2145 Intercept : -8.6801 Correlation Coefficient : 0.9992
2	3.8	1.2993	46	
3	4.4	1.3966	50	
4	5.0	1.4874	54	
5	5.6	1.5729	58	



Calibrated by   
( Mr. Anurak Tongkhajonsakda )  
Field Scientist(1)

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

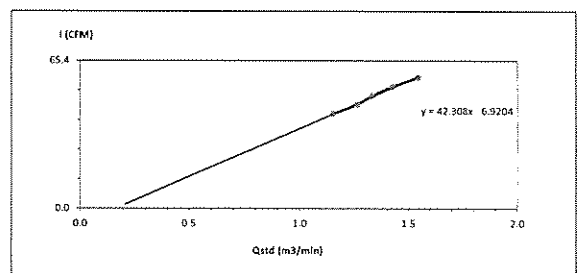
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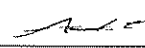



### High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf T33 Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	โรงโม่หินบ้านศรีภักดิ์	Temperature (°C) :	30
Calibrate Date :	23-Nov-23	High Volume ID :	RYG_FS0291
CalibrationSheet No.:	C-231123-RYG_FS0291	High Volume Model :	TE-S170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	5333
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>air</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1567	42	Slope : 42.3079 Intercept : -6.9204 Correlation Coefficient : 0.9964
2	3.6	1.2652	46	
3	4.0	1.3325	50	
4	4.6	1.4275	54	
5	5.4	1.5450	58	



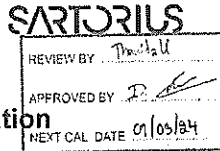
Calibrated by   
( Mr. Anurak Tongkhajonsakda )  
Field Scientist(1)

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

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



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



# Certificate of Calibration

Model Number : LA130S-F Certificate No. : 23BCI0110  
Description : Analytical Balance Issued Date : Friday, March 03, 2023  
Serial Number : 25409564 Reference No. : 204833  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius Page No. : 1 of 2

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

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

Calibrated By : Mr. Chonchai Inthana  
Calibration Date : Wednesday, March 01, 2023  
Calibration Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

Metrological data  
Capacity : 150 g Readability : 0.0001 g  
Ambient Conditions  
Temperature : 24.2 °C ± 5.0 °C  
Humidity : 60.0 % RH ± 10.0 % RH  
Pressure : ±

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

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

## Traceability:

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

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

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.  
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel: +66 2543 8301-6 Fax: +66 2543-8307 e-mail: service.thailand@sartorius.com



# Certificate of Calibration

Model Number : LA130S-F Certificate No. : 23BCI0110  
Description : Analytical Balance Issued Date : Friday, March 03, 2023  
Serial Number : 25409564 Reference No. : 204833  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius Page No. : 2 of 2

## Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the result of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).		
Nominal Value : (Low Load)	10 g	10.0000	Nominal value :	50 g	
Tolerance	0.0001 g	10.0000	Tolerance	0.0004 g	
Nominal Value : (High Load)	100 g	100.0000			
Tolerance	0.0001 g	100.0000			
Standard Deviation	0.00009	0.00006			

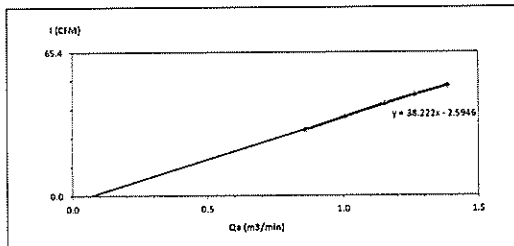
Linearity					
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.					
Tolerance	0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	
0.01	0.0100	0.0100	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	0.00023	
20	20.0000	20.0001	0.0001	0.00023	
100	100.0000	100.0002	0.0002	0.00026	

SOP FM 33 03 February 2022

## High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TSI Co., Ltd.  
Calibrate Location : โรงงานอุตสาหกรรม  
Calibrate Date : 23-Nov-23  
Calibration Sheet No. : C-231123-RYG-FS0400  
Calibrator ID : RYG-FS0205  
Calibrator Model : TE-502RA  
Calibrator S/N : 1166  
Barometric Pressure (mm Hg) : 756  
Temperature (°C) : 30  
High Volume ID : RYG-FS0400  
High Volume Model : TE-5009X  
High Volume S/N : 5691  
Calibrator Slope : 0.94434  
Calibrator Intercept : -0.01292

Test No.	Delta H <sub>2</sub> O (Inch)	Qa (m³/min)	I: Chart (CFM)	Linear Regression
1	1.6	0.861	30	Slope: 38.2217
2	2.2	1.007	36	Intercept: -2.5946
3	2.9	1.155	42	Correlation Coefficient: 0.9999
4	3.5	1.267	46	
5	4.2	1.307	50	



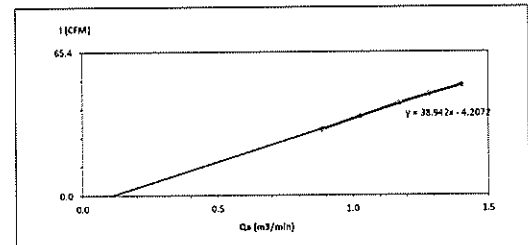
Calibrated by : (Mr. Anurak Tongkhajonsakda) Field Scientist (1)

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

## High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TSI Co., Ltd.  
Calibrate Location : โรงงานอุตสาหกรรม  
Calibrate Date : 23-Nov-23  
Calibration Sheet No. : C-231123-RYG-FS0397  
Calibrator ID : RYG-FS0205  
Calibrator Model : TE-502RA  
Calibrator S/N : 1166  
Barometric Pressure (mm Hg) : 756  
Temperature (°C) : 30  
High Volume ID : RYG-FS0397  
High Volume Model : TE-5009X  
High Volume S/N : 5687  
Calibrator Slope : 0.94434  
Calibrator Intercept : -0.01292

Test No.	Delta H <sub>2</sub> O (Inch)	Qa (m³/min)	I: Chart (CFM)	Linear Regression
1	1.7	0.887	30	Slope: 39.9422
2	2.3	1.030	36	Intercept: -4.2072
3	2.0	1.174	42	Correlation Coefficient: 0.9989
4	3.6	1.285	46	
5	4.3	1.403	50	



Calibrated by : (Mr. Anurak Tongkhajonsakda) Field Scientist (1)

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

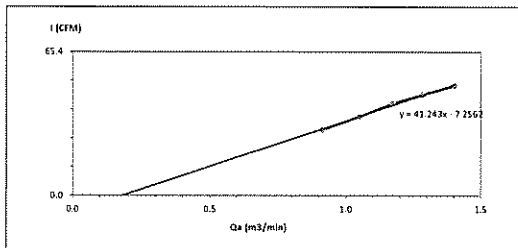




### High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TSI Co., Ltd. Barometric Pressure (mm Hg): 756  
 Calibrate Location: ท่าอากาศยานสุวรรณภูมิ Temperature (°C): 30  
 Calibrate Date: 23-Nov-23 High Volume ID: RYG\_F50198  
 Calibration Sheet No.: C-231123-RYG\_F50398 High Volume Model: TE 5009X  
 Calibrator ID: RYG\_F50205 High Volume S/N: 5684  
 Calibrator Model: TE 5028A Calibrator Slope: 0.94434  
 Calibrator S/N: 1166 Calibrator Intercept: -0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.912	30	Slope: 41.2435 Intercept: -7.2562 Correlation Coefficient: 0.9974
2	2.4	1.051	36	
3	3.0	1.174	42	
4	3.6	1.285	46	
5	4.3	1.403	50	



Calibrated by: [Signature]  
 (Mr. Anurak Tongkajonsakda)  
 Field Scientist (1)

Approved by: [Signature]  
 (Mr. Noppeng Jantarapan)  
 Enviro Field Coordinator Scientist (3)

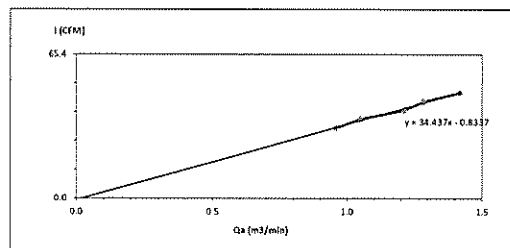
FORM NO. F 06-074 REVISION NO. - ISSUE DATE 14/03/16



### High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TSI Co., Ltd. Barometric Pressure (mm Hg): 756  
 Calibrate Location: ท่าอากาศยานสุวรรณภูมิ Temperature (°C): 30  
 Calibrate Date: 23-Nov-23 High Volume ID: RYG\_F50189  
 Calibration Sheet No.: C-231123-RYG\_F50189 High Volume Model: TE 5009X  
 Calibrator ID: RYG\_F50205 High Volume S/N: 4797  
 Calibrator Model: TE 5028A Calibrator Slope: 0.94434  
 Calibrator S/N: 1166 Calibrator Intercept: -0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.961	32	Slope: 34.4372 Intercept: -0.8337 Correlation Coefficient: 0.9949
2	2.4	1.051	36	
3	3.2	1.212	40	
4	3.6	1.285	44	
5	4.4	1.419	48	



Calibrated by: [Signature]  
 (Mr. Anurak Tongkajonsakda)  
 Field Scientist (1)

Approved by: [Signature]  
 (Mr. Noppeng Jantarapan)  
 Enviro Field Coordinator Scientist (3)

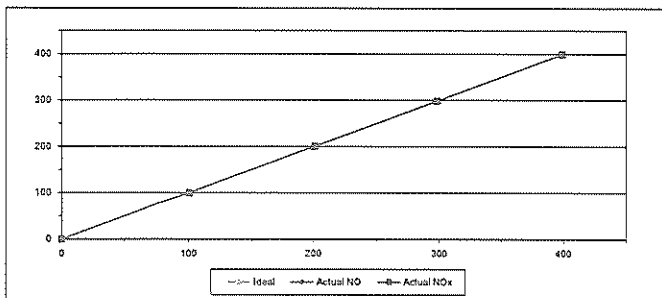
FORM NO. F 06-074 REVISION NO. - ISSUE DATE 14/03/16



### MULTIPOINT CALIBRATION REPORT

Calibration Date: 1-Jul-23 Equipment Name: NOx Analyzer  
 Manufacturer: HORIBA Model: APNA-370  
 Serial No.: WPYDJMWD Equipment ID: BKK\_F50782  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: QN0027222  
 Cylinder Pressure (psi): 1800 Certified By: Airgas Inc.  
 Certified Date: 9-Feb-22 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	100.60	0.60	0.60
2	200.00	199.70	-0.30	-0.15	201.30	1.30	0.65
3	300.00	298.50	-1.50	-0.50	298.30	-1.70	-0.57
4	400.00	398.70	-1.30	-0.33	399.00	-1.00	-0.25
AVERAGE (%)				-0.28			0.11



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

Approved By: [Signature]  
 (Mr. Sarayuth Jitranont)  
 Assistant General Manager

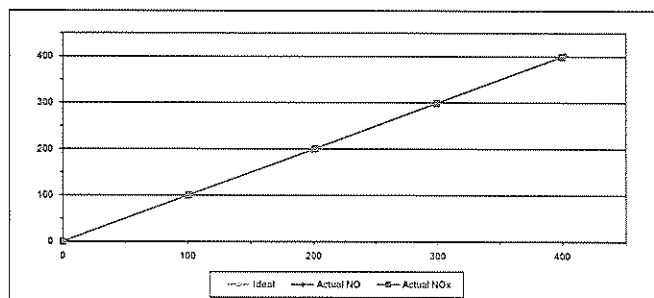
ALS Laboratory Group  
 FORM NO. F 06-055 REVISION NO. - ISSUE DATE 02/04/12



### MULTIPOINT CALIBRATION REPORT

Calibration Date: 1-Jul-23 Equipment Name: NOx Analyzer  
 Manufacturer: HORIBA Model: APNA-370  
 Serial No.: H73KYD1M Equipment ID: BKK\_F80797  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: QN0027222  
 Cylinder Pressure (psi): 1800 Certified By: Airgas Inc.  
 Certified Date: 9-Feb-22 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.70	-0.30	-0.30	101.00	1.00	1.00
2	200.00	198.60	-1.40	-0.70	201.30	1.30	0.65
3	300.00	299.00	-1.00	-0.33	299.20	-0.80	-0.27
4	400.00	402.10	2.10	0.53	399.50	-0.50	-0.13
AVERAGE (%)				-0.14			0.27



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

Approved By: [Signature]  
 (Mr. Sarayuth Jitranont)  
 Assistant General Manager

ALS Laboratory Group  
 FORM NO. F 06-055 REVISION NO. - ISSUE DATE 02/04/12



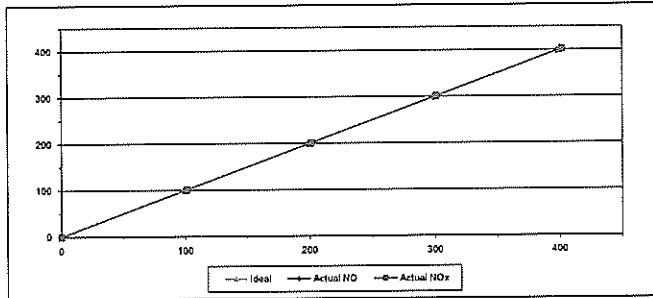


## MULTIPOINT CALIBRATION REPORT

Calibration Date: 1-Jul-23  
 Manufacturer: Teledyne API  
 Serial No.: 7238  
 Calibrator Manufacturer: Teledyne API  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88  
 Cylinder Pressure (psi): 1800  
 Certified Date: 9-Feb-22

Equipment Name: NOx Analyzer  
 Model: T200  
 Equipment ID: RYQ\_F80533  
 Model: 700  
 Cylinder No.: GN0027222  
 Certified By: Airgas Inc.  
 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.10	1.10	1.10
2	200.00	198.70	-1.30	-0.65	201.20	1.20	0.60
3	300.00	298.80	-1.20	-0.40	301.10	1.10	0.37
4	400.00	398.00	-2.00	-0.50	402.00	2.00	0.50
AVERAGE (%)				-0.39			0.53



Calibrated By

Approved By

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

(Mr. Sanyuth Jitranont)  
 Assistant General Manager

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

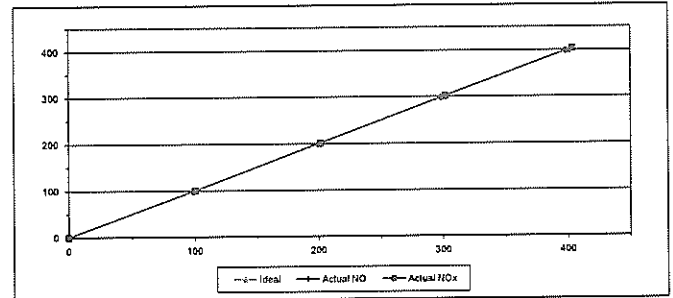


## MULTIPOINT CALIBRATION REPORT

Calibration Date: 1-Jul-23  
 Manufacturer: HORIBA  
 Serial No.: T951WM41  
 Calibrator Manufacturer: Teledyne API  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88  
 Cylinder Pressure (psi): 1800  
 Certified Date: 9-Feb-22

Equipment Name: NOx Analyzer  
 Model: APNA-370  
 Equipment ID: RYQ\_F80481  
 Model: 700  
 Cylinder No.: GN0027222  
 Certified By: Airgas Inc.  
 Expired Date: 9-Feb-30

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



Calibrated By

Approved By

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

(Mr. Sanyuth Jitranont)  
 Assistant General Manager

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

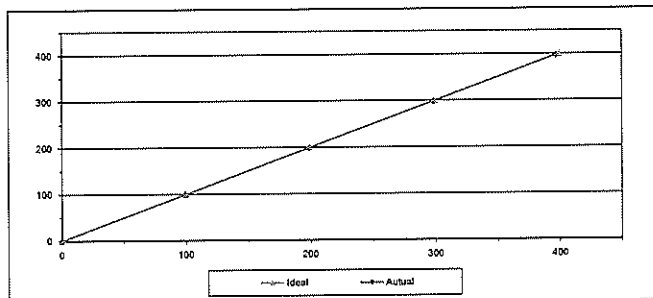


## MULTIPOINT CALIBRATION REPORT

Calibration Date: 2-Jul-23  
 Manufacturer: HORIBA  
 Serial No.: Y53SNSFB  
 Calibrator Manufacturer: Teledyne API  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 58.3  
 Cylinder Pressure (psi): 1800  
 Certified Date: 9-Feb-22

Equipment Name: SO2 Analyzer  
 Model: APSA-370  
 Equipment ID: BKK\_F80781  
 Model: 700  
 Cylinder No.: GN0027222  
 Certified By: Airgas Inc.  
 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	199.20	-0.80	-0.40
3	300.00	298.50	-1.50	-0.50
4	400.00	397.40	-2.60	-0.65
AVERAGE (%)				-0.35



Calibrated By

Approved By

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

(Mr. Sanyuth Jitranont)  
 Assistant General Manager

ALS Laboratory Group  
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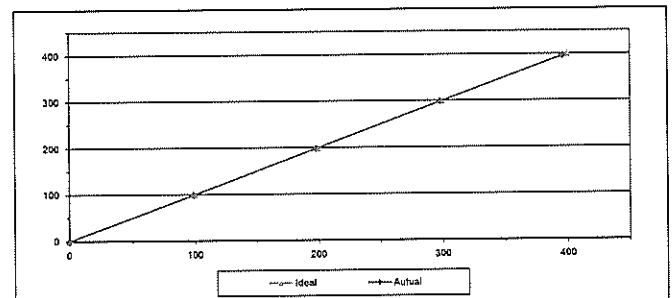


## MULTIPOINT CALIBRATION REPORT

Calibration Date: 2-Jul-23  
 Manufacturer: HORIBA  
 Serial No.: G2CH438B  
 Calibrator Manufacturer: Teledyne API  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 58.3  
 Cylinder Pressure (psi): 1800  
 Certified Date: 9-Feb-22

Equipment Name: SO2 Analyzer  
 Model: APSA-370  
 Equipment ID: BKK\_F80798  
 Model: 700  
 Cylinder No.: GN0027222  
 Certified By: Airgas Inc.  
 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
1	100.00	98.91	-1.09	-1.09
2	200.00	198.10	-1.90	-0.95
3	300.00	298.10	-1.90	-0.63
4	400.00	395.60	-4.40	-1.10
AVERAGE (%)				-0.74



Calibrated By

Approved By

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

(Mr. Sanyuth Jitranont)  
 Assistant General Manager

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

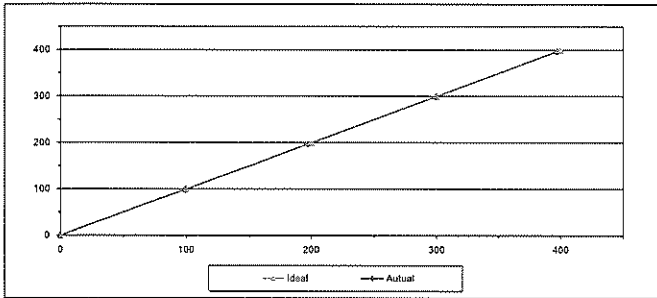




## MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	802 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	24PHOKNA	Equipment ID	RYG_FS0257
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.40	-0.60	-0.60
2	200.00	197.30	-2.70	-1.35
3	300.00	299.50	-0.50	-0.17
4	400.00	397.00	-3.00	-0.75
AVERAGE (%)				-0.55



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

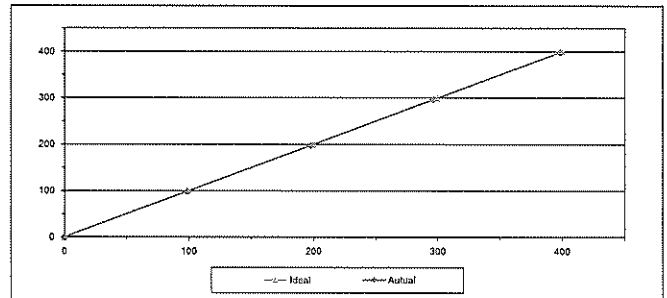
ALS Laboratory Group  
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	802 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	VABF0LSH	Equipment ID	RYG_FS0460
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	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	396.30	-3.70	-0.92
AVERAGE (%)				-0.78



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

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



Accredited calibration laboratory  
ISO/IEC 17025:2017  
NIST 705 Y5.12025  
CALIBRATION D367

Air speed measurement laboratory  
Calibration services department

Certificate Number

CL 012 65

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Wind Direction Sensor  
MANUFACTURER: Novamys  
MODEL/TYPE: Sensor WS-01F  
SERIAL NUMBER: Data logger: 110-WS-2501-D  
10 NUMBER: Sensor: WS0-011  
CONDITION AS RECEIVED: Data logger: AS060  
CUSTOMER: RYG\_FS0330  
Used item: ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanaburi Rd., Phatthanaburi Rd., Khwaeng Suam Luang,  
Khet Suam Luang, Bangkok 10250 Thailand

RECEIVED DATE: 16 Jan 2023  
MEASUREMENT DATE: 19 Jan 2023  
ISSUE DATE: 20 Jan 2023

ENVIRONMENTAL CONDITIONS:  
Ambient condition in the laboratory are as follows:  
Temperature: 23.0 ± 3.0 °C  
Relative Humidity: 55.0 ± 15.0 %RH  
Atmospheric Pressure: 1010 ± 10 hPa

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

CALIBRATION CONDITION: Wind tunnel cross-section area\* 900 cm<sup>2</sup>  
Wind direction frequency\*\* 129 cm<sup>2</sup>  
Diameter of mounting pipe 101 mm  
Blockage ratio of test object† 0.143 ± 1

Preconditioning: 24 hours at ambient conditions.  
Measurement Condition: 16 average values during measurement are (23.7) °C, (44.2) %RH and (1015.2) hPa

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

Calibrated by:  
( ) Mr. Jirawat Sakam  
( ) Mr. Sarayuth Jittrantorn

Approved signature

Mr. Sarayuth Jittrantorn  
Calibration Department Manager

Remarks:  
\* Inside cross-section area of the wind tunnel  
\*\* Projected cross-section area of the tested object include mounting pipe  
† Diameter of mounting pipe  
\* Ratio 1 to 1

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

Certificate Number
CL 012 65

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	42	3	0.74
	90.000	88	2	0.74
	135.000	133	2	0.68
	180.000	179	1	0.74
	225.000	226	1	0.74
	270.000	270	0	0.74
	315.000	316	1	0.74

## Remarks:

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

<sup>2</sup> Direction of standard

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

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



## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM**: Cup anemometer  
**MANUFACTURER**: NovaLink  
**MODEL/TYPE**: Sensor: WS-02F  
Data logger: 110-WS-250L-D  
**SERIAL NUMBER**: Sensor: WSD-011  
Data logger: AS660  
**ID NUMBER**: RYG\_FS0530  
**CONDITION AS-RECEIVED**: Used item  
**CUSTOMER**: ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand

**Calibration procedure:**  
The cup anemometer was calibrated against  
Standard air velocity transducer model: DSA502  
and pitot tube with precision differential pressure  
meter model: DPM1500 in anechoic test chamber of  
Eiffel-type wind tunnel with 300 cm<sup>2</sup> cross test  
section area. The Wi-0402 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 is a realization of the international  
system of units (SI) through the NMIs (National  
Metrology Institute of Thailand) via Certificate  
number: NMV 0057 21 and EIV 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'

**RECEIVED DATE**: 16 Jan 2023  
**MEASUREMENT DATE**: 18 Jan 2023  
**ISSUE DATE**: 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

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

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

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

**Preconditioning**: 24 hours at ambient conditions  
**Measurement Condition**: The average values during measurement are (23.7) °C, (50.2) %RH and (1017.1) hPa

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

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

**Approved signature:** Mr. Parinya Booncharoen  
Calibration Department Manager

**Remarks:**  
1. Nozzle cross-section area of the wind tunnel  
2. Predicted cross-section area of the tested object include mounting pipe  
3. Diameter of mounting pipe  
4. Ratio 1 to 1

Page 2 of 2 Pages

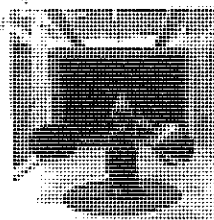
### MEASUREMENT RESULTS<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was checked at 30 m/s for 5 minutes or so to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calibrated by a standard air velocity transducer and above 5 m/s to 30 m/s was calibrated by a pitot tube with precision differential pressure meter which was installed 40 mm and 350 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
0.979	23.56	23.70	0.8	-0.2	0.16
2.025	23.80	23.70	1.8	-0.2	0.16
3.046	23.50	23.70	2.8	-0.2	0.20
4.120	23.64	23.70	3.9	-0.3	0.20
5.01	23.44	23.70	4.8	-0.2	0.18
5.98	23.60	23.70	5.8	-0.2	0.18
7.05	23.28	23.70	6.9	-0.1	0.19
8.17	23.60	23.70	8.0	-0.2	0.19
9.09	23.20	23.70	9.0	0.0	0.22
10.09	23.52	23.70	9.9	-0.2	0.20
11.13	23.20	23.70	10.9	-0.2	0.20
12.19	23.50	23.70	11.9	-0.2	0.21
13.19	23.20	23.70	13.0	0.2	0.22
14.15	23.46	23.70	14.3	0.0	0.24
15.22	23.20	23.70	15.1	-0.1	0.24
16.31	23.30	23.70	16.1	-0.2	0.29

**Remark:**  
1. Calibration results only count for the tested circumstances and environmental conditions during which calibration took place  
2. Velocity of standard  
3. Velocity of Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



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

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

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

## CERTIFICATE OF CALIBRATION

Certificate No.: CL-005-66  
Page 1 of 2

**Equipment Name:** Data Logger with Temperature  
Sensor  
**Manufacturer:** NovaLink  
**Model:** 110 WS-250L-D  
**Serial No.:** AS660  
**ID No.:** RYG\_FS0530

**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:** 16 Jan 2023  
**Calibration date:** 18 Jan 2023  
**Issue date:** 20 Jan 2023

**Reference Used During Calibration:**  
1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682 D9, 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 Signature:** Mr. Parinya Booncharoen  
Calibration Department Manager

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment  
**Calibration Range:** 20 - 40 °C

**Function:**  
This equipment was connected with temperature sensor Model: HMP60 S/N: S4620631.  
**Dimension:** Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.066	19.8	-0.3	0.099
60	25.058	24.6	-0.5	0.14
60	30.052	29.5	-0.6	0.099
60	35.047	34.5	-0.5	0.099
60	40.038	39.4	-0.6	0.099

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

★ End of Certificate ★



## CERTIFICATE OF CALIBRATION

Calibration No.: RH-05012023  
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger  
Manufacturer: Novatynx  
Model/Type: 110-WS-25DL-D  
Serial Number: A6660  
ID No.: RYD\_FSD530  
Customer: ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 4D, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260 Thailand.

Environmental Condition:  
The measurement was carried out in an ambient temperature of (26±3)°C, and relative humidity of (60±10)%.

Measurement Method:  
Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

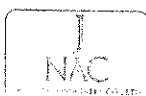
Traceability:  
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101 Due date: Mar 14, 2023

Measurement Date: Jan 18, 2023  
Issued Date: Jan 20, 2023

Measurement Results:  
This equipment was connected with indoor air quality probe and Displayed (UUC) on display. Model: HMP60, Serial number: 54020631  
Calibration was performed in the range of 20%RH to 80%RH  
The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.03	17.8	-2.2	0.66
50	50.28	48.6	-1.7	0.57
80	80.29	79.8	-0.6	0.68

Performed by:  
☐ Mr. Sorawit Thachalad  
☒ Iisa Jitraporn Lertsomphol



Approved Signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

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

Certificate Number

CL 002 65

Page 2 of 2 Pages

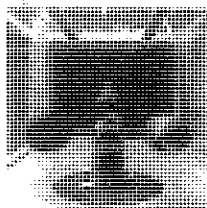
### MEASUREMENT RESULTS<sup>1</sup>

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 pressure difference pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in table below.

V <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>UUC</sub> (m/s)	Error (m/s)	U <sub>k=2</sub> (m/s)
0.505	24.10	24.50	0.7	-0.3	0.18
2.034	23.95	24.00	1.7	-0.3	0.15
3.651	24.06	24.00	2.9	-0.2	0.20
4.138	24.00	24.00	3.0	-0.2	0.19
4.60	24.00	24.00	4.8	-0.3	0.26
5.58	24.00	24.00	5.0	-0.3	0.18
7.05	23.90	24.00	6.9	-0.3	0.21
8.18	23.90	24.00	8.0	-0.2	0.21
9.02	23.72	24.00	9.1	0.0	0.20
10.09	23.80	24.00	9.9	-0.1	0.24
11.16	23.80	24.00	11.1	-0.1	0.28
12.12	23.50	24.00	12.1	0.0	0.26
13.21	23.50	24.00	13.2	0.0	0.34
14.27	23.55	24.00	14.4	0.1	0.22
15.76	23.68	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 better test conditions and environmental conditions during which calibration took place.  
Velocity of standard  
Velocity of test section calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer, calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibration one. The position error on up-down and left-right is less than 1 mm.

End of Certificate of Calibration  
JIRANATEE ASSOCIATES CO., LTD.

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER  
CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novatynx

Sensor: WS-02T

Data logger: WS-25DL

Sensor: Data logger: A4562

SKK, F50149

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 4D, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

28 Dec 2022

05 Jan 2023

03 Jan 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

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

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

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

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

800 cm<sup>2</sup>

100 cm<sup>2</sup>

0.111

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are 24.0°C, (50.4%RH and 1014.5 hPa.

TABULATION OF RESULTS:

The table on next page give the measured values



Approved Signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

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

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

Certificate Number

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Page 2 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novatynx

Sensor: WS-02T

Data logger: WS-25DL

Sensor: Data logger: A4562

SKK, F50149

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 4D, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

28 Dec 2022

05 Jan 2023

03 Jan 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

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

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

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

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

800 cm<sup>2</sup>

120 cm<sup>2</sup>

0.143

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are 24.0°C, (50.4%RH and 1014.5 hPa.

TABULATION OF RESULTS:

The table on next page give the measured values



Approved Signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

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

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



MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>1</sub> Degree (°)	D <sub>2</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
0.000	0	0	0	0.58
45.000	41	4	4	0.74
90.000	87	3	3	0.74
135.000	134	1	1	0.74
180.000	182	2	2	0.74
225.000	228	3	3	0.68
270.000	272	2	2	0.74
315.000	318	3	3	0.74

## Remarks:

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

<sup>2</sup> Direction of standard

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



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

MEASUREMENT RESULTS<sup>1</sup>

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

V <sub>std</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>uuc</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.384	24.10	24.00	0.7	-0.3	0.16
0.629	23.58	24.00	1.8	-0.3	0.16
1.044	23.55	24.00	2.9	-0.2	0.19
4.136	24.20	24.00	3.8	-0.3	0.20
5.00	23.80	24.00	4.8	-0.2	0.21
5.98	24.24	24.00	5.8	-0.2	0.17
7.05	23.50	24.00	6.9	0.2	0.19
8.10	24.24	24.00	8.0	-0.2	0.19
9.00	23.88	24.00	8.9	0.2	0.20
10.09	23.88	24.00	9.6	-0.2	0.19
11.16	23.74	24.00	11.0	-0.2	0.23
12.13	23.81	24.00	12.0	-0.2	0.24
13.19	23.70	24.00	13.0	-0.2	0.22
14.26	23.64	24.00	14.0	-0.3	0.28
15.74	23.64	24.00	14.9	-0.3	0.23
16.30	23.70	24.00	16.0	-0.3	0.23

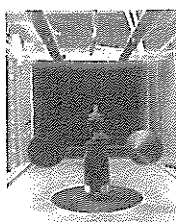
## Remarks:

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

<sup>2</sup> Velocity of standard

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

## PHOTO OF CALIBRATION SET-UP



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



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

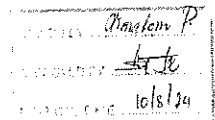
Certificate Number
CL-002-66



Jirarattee Associates Co., Ltd.  
63/14 15 63/15-36  
Petchkasem 7 Th. 15 Wanhathara, Bangkok  
Bangkok 10250 (Thailand)  
Tel: +6623550812  
Mobile: +6623559453  
E-mail: jirarattee@jirarattee.com  
Web site: www.jirarattee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC TH-116 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department



Certificate Number
CL-020-66

## CERTIFICATE OF CALIBRATION

## MEASUREMENT ITEM

## MANUFACTURER

## MODEL/TYPE

## SERIAL NUMBER

## ID NUMBER

## CONDITION AS-RECEIVED

## CUSTOMER

## RECEIVED DATE

## MEASUREMENT DATE

## ISSUE DATE

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

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

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITIONS

Wind tunnel cross section area <sup>1</sup>	900 cm <sup>2</sup>
Win direction frontal area <sup>2</sup>	100 cm <sup>2</sup>
Diameter of mounting pipe <sup>3</sup>	mm
Blockage ratio of test object <sup>4</sup>	0.111 [-]

## Preconditioning

## Measurement Condition

: 24 hours at ambient conditions  
The average values during measurement are (24.0) °C, (41.7) %RH and (1015.0) hPa

## TABULATION OF RESULTS:

The table on next page give the measured values

## Calibrated by:

22 Mr. Sorawat Thachalad  
Miss Intaraporn Jirarattee

## Remarks:

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



Approved signatory:

Calibration Department Manager

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



Jirarattee Associates Co., Ltd.  
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Web site: www.jirarattee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC TH-116 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department

## CERTIFICATE OF CALIBRATION

## MEASUREMENT ITEM

## MANUFACTURER

## MODEL/TYPE

## SERIAL NUMBER

## ID NUMBER

## CONDITION AS-RECEIVED

## CUSTOMER

## RECEIVED DATE

## MEASUREMENT DATE

## ISSUE DATE

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

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

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITION

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

## Preconditioning

## Measurement Condition

: 24 hours at ambient conditions  
The average values during measurement are (23.8) °C, (50.2) %RH and (1012.2) hPa

## TABULATION OF RESULTS:

The table on next page give the measured values

## Calibrated by:

22 Mr. Sorawat Thachalad  
Miss Intaraporn Jirarattee

## Remarks:

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



Approved signatory:

Mr. Parinya Boonchareon  
Calibration Department Manager

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







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

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 notified 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 rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$v_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}$ (m/s)	Error (m/s)	$V(95\%)$ (m/s)
0.583	23.50	23.45	0.8	-0.2	0.17
2.035	23.44	23.45	1.9	-0.1	0.16
3.049	23.50	23.45	2.9	-0.2	0.18
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.2	0.19
9.10	23.25	23.45	9.0	0.1	0.20
10.00	23.44	23.45	9.9	-0.1	0.21
11.15	23.10	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.10	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.3	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

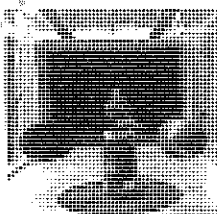
#### Remarks:

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

<sup>2</sup> Velocity of standard.

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

#### PHOTO OF CALIBRATION SET-UP



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

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



### CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mm-Hg) : 751  
Relative Humidity (%) : 60.0  
Temperature (°C) : 29.0  
Reference Dry Gas Meter Data  
Reference Dry Gas Meter ID : BKK\_FS1122  
Serial No. : A2000240  
Correction Factor (%) : 1.0160  
Next Calibration Date : 25-Nov-23

$\Delta H$	$\theta$	Reference Dry Gas Meter Calibration										Console Control Drygas Meter										Dry Gas Meter Correction Factor	Dry Gas Meter Calibration Factor	Calibration Factor
		Wt (Liters)						Tr		Vm (Liters)		Tr		Avg Tr		To (°C)	To (°C)	Avg Tr (°C)						
		Final		Initial		Total		Final		Initial		Total		Final					Initial					
15	12.65	150.00	0.00	150.00	0.00	150.00	25.0	241330.0	241175.0	155.00	25.0	26.0	26.0	26.0	26.0	0.9518	48.8413							
25	9.99	150.00	0.00	150.00	0.00	150.00	26.0	241498.0	241343.0	155.00	26.0	26.0	26.0	26.0	26.0	0.9528	48.9033							
50	6.82	150.00	0.00	150.00	0.00	150.00	26.0	241659.0	241504.0	155.00	26.0	26.0	26.0	26.0	26.0	0.9484	47.3656							
100	4.82	150.00	0.00	150.00	0.00	150.00	26.0	241823.0	241668.0	154.00	26.0	26.0	26.0	26.0	26.0	0.9500	47.3171							
150	4.02	150.00	0.00	150.00	0.00	150.00	26.0	241998.0	241844.0	154.00	27.0	27.0	27.0	27.0	27.0	0.9485	49.2959							
																0.9499	48.5300							

Y Ratio of reading of reference to dry gas meter tolerance for individual values  $\pm 0.02$  from average.

ΔH<sub>0</sub> Dry gas pressure differential that equates to 21.24 in of air at 25°C and 760 mm of mercury. mm-H<sub>2</sub>O tolerance for individual values  $\pm 5.08$  from average.

Procedure: 40 CFR 60 APP A METHOD 5E.5.3 & 7

Calibrated by: Saksit Phaisangphosut

(Mr. Saksit Phaisangphosut)

Field Scientist (I)

Approved by:

Nattapon Jangwareewong

(Mr. Nattapon Jangwareewong)

Field Scientist (I)

FORM NO. F-04-028 REVISION NO. 2 ISSUE DATE 30 Jan 22



### Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0472  
Lab test duct Number : 25B-1-13-01  
Calibration Sheet No : C-130723-BKK\_FS0472  
Calibration Date : 13 Jul 23  
Standard Pitot ID : BKK\_FS0441  
Cp Standard : 0.99

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

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

$$| \bar{C}_{p(A)} - \bar{C}_{p(B)} | \text{ must BE } \leq 0.01$$

$$\sum [Cp (s) - Cp(A \text{ or } B)]$$

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

Calibrated by

Saksit Phaisangphosut

(Mr. Saksit Phaisangphosut)

Field Scientist (4)

Approved by

Nattapon Jangwareewong

(Mr. Nattapon Jangwareewong)

Specialist (1)



### Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0473  
Lab test duct Number : 25B-1-13-01  
Calibration Sheet No : C-130723-BKK\_FS0473  
Calibration Date : 13 Jul 23  
Standard Pitot ID : BKK\_FS0441  
Cp Standard : 0.99

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

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

$$| \bar{C}_{p(A)} - \bar{C}_{p(B)} | \text{ must BE } \leq 0.01$$

$$\sum [Cp (s) - Cp(A \text{ or } B)]$$

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

Calibrated by

Saksit Phaisangphosut

(Mr. Saksit Phaisangphosut)

Field Scientist (4)

Approved by

Nattapon Jangwareewong

(Mr. Nattapon Jangwareewong)

Specialist (1)





## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date	13 Jul 23	Ambient Temperature (°C)	29		
Calibration sheet No. :	C-130723-BKK_FS0469	Relative Humidity (%) :	60		
Digital Temperature ID	BKK_FS0469	Reference Temperature ID	BKK_FS1144		
Serial No	1302005	Serial No	201050006013		
Model	XC-572-V	Model	Digicon-CC-VT-MIS		
		Next Calibrate	14 Aug 24		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	300	0	±3	Pass
Probe	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	101	-	±3	-
	120	121	-	±3	-
Filter	140	141	-	±3	-
	100	102	2	±3	Pass
	120	121	1	±3	Pass
Exit	140	141	1	±3	Pass
	0	9	9	±3	Pass
	10	9	-1	±3	Pass
Meter	20	19	-1	±3	Pass
	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
AUX	50	48	-2	±3	Pass
	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่ยอมรับได้

Calibrated by Saksit Phaisanphut Approved by Nattapon Jengwareepong  
(Mr Saksit Phaisanphut) (Mr Nattapon Jengwareepong)  
Field Scientist (4) Specialist (11)

FORM NO F 05-027 REVISION NO 2 ISSUE DATE 16.2.23

RYG\_EN0003

Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel : +66 2843 8351-6 e-mail : service.thailand@sartorius.com



SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCI0115  
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 Plusk Daeng, Rayong 21140, Thailand

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

Calibrated By : Mr Chonchai Inthana Calibration Procedure No. : This calibration was conducted by  
Calibration Date : Wednesday, March 01, 2023 Using in-house calibration procedure number (WI-003)  
Based on UKAS LAD 14 2019

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

## Measurement Method UKAS Publication Ref : Lab 14

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

## Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-80	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barmeter/Temp. Luzon 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)

PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

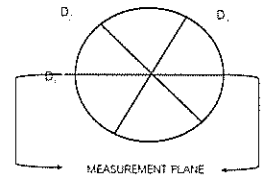
Calibration Date : 13 Jul 23 Nozzle Set ID : BKK\_FS0474  
Calibration Sheet No. : C-130723-BKK\_FS0474 Verner Caliper ID : BKK\_FS1123

Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo ΔD	ID = D <sub>1</sub> - D <sub>2</sub> 3
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>		
1	0.300	0.299	0.300	0.001	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.599	0.602	0.601	0.003	0.601
4	0.763	0.769	0.770	0.007	0.767
5	0.931	0.932	0.932	0.001	0.932
6	1.050	1.092	1.092	0.002	1.091
7	1.264	1.263	1.264	0.001	1.264
8	1.599	1.600	1.599	0.001	1.599

Where

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

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

D<sub>avg</sub> : (D<sub>1</sub> + D<sub>2</sub> + D<sub>3</sub>) 3Calibrated by Saksit Phaisanphut

(Mr Saksit Phaisanphut)

Field Scientist (4)

Approved by Nattapon Jengwareepong

(Mr Nattapon Jengwareepong)

Field Specialist (11)

FORM NO F 05-027 REVISION NO 2 ISSUE DATE 16.2.23


Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel : +66 2843 8351-6 Fax : +66 2843 8357 e-mail : service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCI0115  
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 mass with a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the result of the load + 10 g or 10 g of maximum capacity placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R116).		
Nominal Value (Low Load)	20.0000	200.0000	Nominal value	100	g
20 g	20.0001	200.0000	Tolerance	0.0004	g
Tolerance	20.0000	200.0001			
0.0001 g	20.0000	200.0000			
	20.0000	200.0001			
Nominal Value (High Load)	20.0001	200.0001			
200 g	20.0000	200.0001			
Tolerance	20.0000	200.0000			
0.0001 g	20.0000	200.0001			
	20.0000	200.0001			
Standard Deviation	3.95004	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)	(g)
0.01	0.0100	0.0100	0.0000	0.00003	0.00003
0.05	0.0500	0.0500	0.0000	0.00003	0.00003
0.1	0.1000	0.1000	0.0000	0.00003	0.00003
0.5	0.5000	0.5000	0.0000	0.00003	0.00003
1	1.0000	1.0000	0.0000	0.00003	0.00003
5	5.0000	5.0000	0.0000	0.00003	0.00003
10	10.0000	10.0000	0.0000	0.00003	0.00003
20	20.0000	20.0000	0.0000	0.00003	0.00003
50	50.0000	50.0000	0.0000	0.00003	0.00003
100	100.0000	100.0000	0.0000	0.00003	0.00003
200	200.0000	200.0001	0.0001	0.00003	0.00003

End of Report





Lot No 23125267-1

## ANALYZER CALIBRATION DATA

Client : Gulf T&S Co., Ltd. Location : Ufa HRSG 11  
 Date : 27 Nov 23 Test Operator : Sakat P.

O<sub>2</sub> 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

NO<sub>x</sub> 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	0.04	0.01	0.02
Low-Level Gas	82.39	82.43	82.40	0.02
Span Gas	164.40	164.44	164.41	0.02

SO<sub>2</sub> ANALYZER  
 Model : TELEDYNE API 100EH Serial No. : 437  
 Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.01
Low-Level Gas	78.75	78.73	78.74	0.00
Span Gas	159.50	159.55	159.55	0.00

CO ANALYZER  
 Model : TELEDYNE API 300EM Serial No. : 481  
 Span (ppm) : 500

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	0.00	0.00
Low-Level Gas	79.48	79.46	79.45	0.00
Span Gas	407.40	407.38	407.40	0.00

Calibrated by

*Sakat P*

(Mr. Sakat Phaisangphet)

Environmental Field Scientist (4)

FORM NO. F-06-002 REVISION NO. 3 ISSUE DATE: 2011/03

ALS Laboratory Group



Lot No 23125267-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&S Co., Ltd. Location : Ufa HRSG 11  
 Date : 27 Nov 23 Test Operator : Sakat P.

O<sub>2</sub> ANALYZER  
 Cylinder Conc. (%) : 16.00 Span (%) : 25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.02	0.02	0.00	0.01	0.04	0.04
Upscale Gas	16.02	16.02	0.00	16.01	0.04	0.04

NO<sub>x</sub> ANALYZER  
 Cylinder Conc. (ppm) : 164.40 Span (ppm) : 200

	NO <sub>x</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.04	0.04	0.00	0.01	0.02	0.02
Upscale Gas	164.44	164.44	0.00	164.41	0.02	0.02

SO<sub>2</sub> ANALYZER  
 Cylinder Conc. (ppm) : 159.50 Span (ppm) : 200

	SO <sub>2</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	159.58	159.55	0.00	159.59	0.00	0.00

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

	CO Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	0.00	0.00	0.00
Upscale Gas	407.38	407.38	0.00	407.40	0.00	0.00

Calibrated by

*Sakat P*

(Mr. Sakat Phaisangphet)

Environmental Field Scientist (4)

FORM NO. F-06-003 REVISION NO. 3 ISSUE DATE: 2011/03

ALS Laboratory Group

Page 2 of 5

Page 1 of 5



## EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 1  
 Date : 27 Nov 23 Location : Ufa HRSG 11  
 Start Time : 10:45 Test Operator : Sakat P.  
 Finish Time : 11:05  
 SO<sub>2</sub> Analyzer Model : TELEDYNE API 100EH Serial No. : 437  
 NO<sub>x</sub>/O<sub>2</sub> Analyzer Model : TELEDYNE API 200EH Serial No. : 774  
 CO/CO<sub>2</sub> Analyzer Model : TELEDYNE API 300EM Serial No. : 481

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
10:45	14.34	3.66	16.56	0.30	0.30	
10:46	14.32	3.66	16.54	0.30	0.28	
10:47	14.33	3.65	16.18	0.29	0.16	
10:48	14.23	3.71	16.64	0.30	0.33	
10:49	14.22	3.72	16.55	0.26	0.18	
10:50	14.24	3.70	17.29	0.26	0.21	
10:51	14.24	3.70	17.67	0.26	0.27	
10:52	14.27	3.70	16.66	0.24	0.38	
10:53	14.31	3.67	16.17	0.22	0.35	
10:54	14.23	3.69	16.28	0.21	0.39	
10:55	14.25	3.68	16.20	0.20	0.36	
10:56	14.26	3.68	16.49	0.14	0.25	
10:57	14.25	3.70	16.54	0.23	0.25	
10:58	14.22	3.72	17.35	0.23	0.27	
10:59	14.26	3.69	17.29	0.22	0.29	
11:00	14.23	3.70	17.20	0.24	0.24	
11:01	14.30	3.68	16.64	0.24	0.21	
11:02	14.27	3.68	16.31	0.24	0.19	
11:03	14.31	3.67	15.83	0.25	0.22	
11:04	14.26	3.70	15.98	0.25	0.25	
11:05	14.27	3.70	16.23	0.24	0.22	
Average	14.28	3.68	16.41	0.24	0.27	

*Sakat P*

(Mr. Sakat Phaisangphet)

Environmental Field Scientist (4)

FORM NO. F-06-116 REVISION NO. 0 ISSUE DATE: 2011/03

ALS Laboratory Group

Page 3 of 5



## EMISSION TEST RESULT

Client : Gulf T&S Co., Ltd. Run # : 2  
 Date : 27 Nov 23 Location : Ufa HRSG 11  
 Start Time : 11:08 Test Operator : Sakat P.  
 Finish Time : 11:28  
 SO<sub>2</sub> Analyzer Model : TELEDYNE API 100EH Serial No. : 437  
 NO<sub>x</sub>/O<sub>2</sub> Analyzer Model : TELEDYNE API 200EH Serial No. : 774  
 CO/CO<sub>2</sub> Analyzer Model : TELEDYNE API 300EM Serial No. : 481

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
11:06	14.33	3.67	16.07	0.25	0.21	
11:07	14.36	3.63	14.78	0.28	0.29	
11:08	14.36	3.63	14.08	0.28	0.28	
11:09	14.34	3.64	13.86	0.28	0.24	
11:10	14.30	3.66	14.01	0.29	0.29	
11:11	14.21	3.71	14.83	0.28	0.21	
11:12	14.26	3.70	16.01	0.27	0.22	
11:13	14.33	3.66	16.15	0.28	0.25	
11:14	14.35	3.64	15.92	0.31	0.29	
11:15	14.30	3.66	14.68	0.30	0.25	
11:16	14.31	3.66	14.91	0.31	0.16	
11:17	14.31	3.67	15.05	0.32	0.13	
11:18	14.29	3.67	14.97	0.32	0.14	
11:19	14.30	3.67	15.17	0.33	0.33	
11:20	14.27	3.69	15.51	0.13	0.41	
11:21	14.23	3.72	16.37	0.13	0.42	
11:22	14.23	3.72	16.82	0.14	0.42	
11:23	14.24	3.72	16.79	0.15	0.34	
11:24	14.27	3.70	16.62	0.16	0.27	
11:25	14.27	3.70	16.35	0.17	0.27	
11:26	14.26	3.70	16.26	0.20	0.34	
Average	14.29	3.67	15.44	0.24	0.27	

*Sakat P*

(Mr. Sakat Phaisangphet)

Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	3
Date	27 Nov 23	Location	Ulex HRBG 11
Start Time	11:27	Test Operator	Sakait P.
SO <sub>x</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	11:47
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EH	Serial No.	774
		Dial No.	481

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
11:27	14.23	3.71	15.38	0.28	0.25	
11:28	14.31	3.66	15.00	0.20	0.13	
11:29	14.35	3.64	15.25	0.25	0.13	
11:30	14.30	3.66	14.82	0.24	0.17	
11:31	14.23	3.72	15.27	0.24	0.29	
11:32	14.31	3.69	15.04	0.22	0.24	
11:33	14.35	3.64	15.51	0.21	0.21	
11:34	14.30	3.65	15.01	0.20	0.12	
11:35	14.28	3.67	14.50	0.19	0.12	
11:36	14.15	3.75	15.03	0.18	0.15	
11:37	14.06	3.80	15.38	0.19	0.15	
11:38	14.13	3.79	17.38	0.18	0.24	
11:39	14.21	3.71	18.69	0.18	0.28	
11:40	14.23	3.69	16.15	0.18	0.25	
11:41	14.30	3.68	15.46	0.18	0.19	
11:42	14.31	3.68	14.55	0.18	0.14	
11:43	14.32	3.67	14.20	0.18	0.14	
11:44	14.29	3.66	14.11	0.18	0.12	
11:45	14.31	3.65	14.19	0.19	0.16	
11:46	14.32	3.64	14.19	0.20	0.13	
11:47	14.25	3.71	14.01	0.20	0.13	
Average	14.28	3.68	15.31	0.20	0.18	

*Sakait P.*  
(Mr. Sakait Phaisanphat)

Environmental Field Scientist (4)



Lot No. 23125268-1

## ANALYZER CALIBRATION DATA

Client	Gulf T&S Co., Ltd.	Location	Ulex HRBG 12
Date	27 Nov 23	Test Operator	Sakait P.
O <sub>2</sub> 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	7.53	7.55	7.54	0.04
Span Gas	16.00	16.02	16.01	0.04

NO <sub>x</sub> 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	0.04	0.01	0.02
Low-Level Gas	82.39	82.43	82.40	0.02
Span Gas	164.40	164.44	164.41	0.02

CO <sub>2</sub> ANALYZER			
Model	TELEDYNE API 100EH	Serial No.	437
Span (ppm)	220		

	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	0.01
Low-Level Gas	78.75	78.73	78.74	0.00
Span Gas	159.00	159.88	159.89	0.00

CO ANALYZER			
Model	TELEDYNE API 300EH	Serial No.	481
Span (ppm)	500		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	0.00	0.00
Low-Level Gas	79.45	79.46	79.48	0.00
Span Gas	407.40	407.38	407.40	0.00

Calibrated by

*Sakait P.*

(Mr. Sakait Phaisanphat)  
Environmental Field Scientist (4)

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FORM NO. F 06-002 REVISION NO. 9 ISSUE DATE: 2011/23

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Lot No. 23125268-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	Gulf T&S Co., Ltd.	Location	Ulex HRBG 12
Date	27 Nov 23	Test Operator	Sakait P.

O <sub>2</sub> ANALYZER			
Cylinder Conc. (%)	16.00	Span (%)	25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.02	0.02	0.00	0.01	0.04	0.04
Upscale Gas	16.02	16.02	0.00	16.01	0.04	0.04

NO <sub>x</sub> ANALYZER			
Cylinder Conc. (ppm)	164.40	Span (ppm)	200

	NO <sub>x</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.04	0.04	0.00	0.01	0.02	0.02
Upscale Gas	164.44	164.44	0.00	164.41	0.02	0.02

SO <sub>2</sub> ANALYZER			
Cylinder Conc. (ppm)	159.80	Span (ppm)	200

	SO <sub>2</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	159.80	159.80	0.00	159.89	0.00	0.00

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

	CO Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	0.00	0.00	0.00
Upscale Gas	407.38	407.38	0.00	407.40	0.00	0.00

CO <sub>2</sub> ANALYZER			
Cylinder Conc. (%)	16.01	Span (%)	25

	CO <sub>2</sub> Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.01	0.00	0.00	0.04	0.04
Upscale Gas	16.02	16.02	0.00	16.01	0.04	0.04

Calibrated by

*Sakait P.*

(Mr. Sakait Phaisanphat)  
Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	1
Date	27 Nov 23	Location	Ulex HRBG 12
Start Time	12:50	Test Operator	Sakait P.
SO <sub>x</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:10
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EH	Serial No.	774
		Dial No.	481

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:50	14.09	3.60	18.80	0.31	0.32	
12:51	14.02	3.65	18.21	0.33	0.32	
12:52	14.05	3.63	17.77	0.33	0.35	
12:53	14.20	3.74	17.95	0.32	0.27	
12:54	14.24	3.72	16.32	0.33	0.29	
12:55	14.27	3.70	16.67	0.34	0.24	
12:56	14.23	3.71	16.75	0.33	0.27	
12:57	14.19	3.73	18.37	0.33	0.26	
12:58	14.17	3.74	17.73	0.39	0.24	
12:59	14.10	3.81	17.08	0.37	0.25	
13:00	14.21	3.75	15.24	0.34	0.23	
13:01	14.28	3.70	13.57	0.34	0.19	
13:02	14.32	3.66	13.16	0.33	0.16	
13:03	14.30	3.67	14.22	0.35	0.19	
13:04	14.23	3.72	15.87	0.34	0.22	
13:05	14.27	3.71	17.18	0.34	0.21	
13:06	14.29	3.69	17.15	0.34	0.20	
13:07	14.28	3.69	16.83	0.33	0.17	
13:08	14.29	3.69	16.79	0.32	0.16	
13:09	14.30	3.68	16.78	0.32	0.11	
13:10	14.37	3.67	16.83	0.31	0.17	
Average	14.23	3.72	16.82	0.33	0.23	

*Sakait P.*

(Mr. Sakait Phaisanphat)  
Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	2
Date	27 Nov 23	Location	Site HRSG 12
Start Time	13:11	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Serial No.	437
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	774
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EH	Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:11	14.31	3.65	16.81	0.32	0.13	
13:12	14.28	3.61	16.83	0.31	0.15	
13:13	14.28	3.69	16.81	0.30	0.11	
13:14	14.30	3.68	16.87	0.29	0.13	
13:15	14.25	3.63	16.84	0.29	0.15	
13:16	14.15	3.74	17.15	0.28	0.27	
13:17	14.10	3.79	17.35	0.30	0.12	
13:18	14.08	3.81	17.55	0.29	0.30	
13:19	14.09	3.78	17.64	0.28	0.35	
13:20	14.20	3.74	17.69	0.27	0.32	
13:21	14.29	3.69	17.59	0.28	0.33	
13:22	14.32	3.67	17.41	0.28	0.34	
13:23	14.32	3.67	17.14	0.28	0.32	
13:24	14.30	3.67	17.04	0.29	0.30	
13:25	14.29	3.67	17.16	0.29	0.30	
13:26	14.26	3.69	17.15	0.35	0.35	
13:27	14.28	3.70	16.92	0.39	0.32	
13:28	14.25	3.70	16.81	0.41	0.28	
13:29	14.20	3.74	17.14	0.40	0.33	
13:30	14.21	3.74	17.47	0.39	0.27	
13:31	14.23	3.73	17.55	0.39	0.21	
Average	14.23	3.71	17.18	0.31	0.24	

Sakait P.  
(Mr. Sakait Phasaphant)

Environmental Field Scientist (4)



## EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Run #	3
Date	27 Nov 23	Location	Site HRSG 12
Start Time	13:32	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Serial No.	437
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	774
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EH	Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:32	14.21	3.72	17.56	0.39	0.28	
13:33	14.21	3.73	17.60	0.37	0.27	
13:34	14.23	3.73	17.71	0.37	0.27	
13:35	14.25	3.73	17.73	0.35	0.22	
13:36	14.23	3.72	17.70	0.35	0.25	
13:37	14.28	3.70	17.50	0.36	0.17	
13:38	14.30	3.67	17.38	0.36	0.20	
13:39	14.34	3.67	17.23	0.36	0.18	
13:40	14.37	3.65	16.50	0.33	0.10	
13:41	14.38	3.64	15.90	0.34	0.15	
13:42	14.38	3.62	15.69	0.33	0.11	
13:43	14.35	3.63	15.94	0.34	0.21	
13:44	14.31	3.65	16.16	0.32	0.19	
13:45	14.27	3.70	16.55	0.32	0.13	
13:46	14.28	3.71	16.91	0.32	0.18	
13:47	14.32	3.68	16.95	0.31	0.20	
13:48	14.28	3.67	17.06	0.31	0.20	
13:49	14.28	3.70	17.37	0.31	0.21	
13:50	14.28	3.71	17.62	0.29	0.18	
13:51	14.25	3.72	17.51	0.29	0.15	
13:52	14.23	3.72	17.53	0.30	0.13	
Average	14.28	3.68	17.05	0.33	0.19	

Sakait P.  
(Mr. Sakait Phasaphant)

Environmental Field Scientist (4)

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

### CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	AIR LIQUIDE (THAILAND) LTD	Reference Number:	160-402340013-1
Part Number:	E04N189E3HA0002	Cylinder Volume:	247.2 CF
Cylinder Number:	GN0027210	Cylinder Pressure:	2215 PSIG
Laboratory:	124 - Plumsteadville - PA	Valve Outlet:	660
PGVP Number:	A12022	Certification Date:	Feb 11, 2022
Gas Code:	CO,NO,NOX,SO2,BALN		

Expiration Date: Feb 11, 2030

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.39 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/22
CARBON MONOXIDE	80.00 PPM	78.48 PPM	G1	+/- 0.5% NIST Traceable	02/04/2022, 02/11/22
NITRIC OXIDE	80.00 PPM	82.38 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/22
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.5% NIST Traceable	02/04/2022, 02/11/22
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	CC733106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Oct 06, 2026
NTRM	200610-04	CC708044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Oct 05, 2026
GMS	124206869139	CC523707	4.097 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.5 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.5%	Jul 26, 2023

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

Triad Data Available Upon Request

NOTES: Gross Weight: 48.5 Kg  
Net Weight: 8.1 Kg



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

### CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04N189E3HA00026	Reference Number:	62-401257890-1
Cylinder Number:	ND62877	Cylinder Volume:	247.2 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2215 PSIG
PGVP Number:	B52018	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Aug 07, 2018

Expiration Date: Aug 07, 2026

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/05/2018, 08/07/2018
NITRIC OXIDE	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/05/2018, 08/07/2018
SULFUR DIOXIDE	160.0 PPM	158.6 PPM	G1	+/- 1.1% NIST Traceable	07/05/2018, 08/07/2018
CARBON MONOXIDE	400.0 PPM	407.4 PPM	G1	+/- 1.1% NIST Traceable	07/05/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	17009241	BE007087	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	May 11, 2019
PRM	12558	S054119	29.85 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	11010414	KAL004702	99.5 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.5%	Jul 28, 2023
NTRM	15000538	CC433507	491.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 08, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1103391 CO	FTIR	Jul 10, 2018
Nicolet 6700 APW1103391 NO	FTIR	Jul 12, 2018
Nicolet 6700 APW1103391 NO2	FTIR	Aug 03, 2018
Nicolet 6700 APW1103391 SO2	FTIR	Aug 02, 2018

Triad Data Available Upon Request

NOTES:  
Net weight: 8107 grams  
Gross weight: 47090 grams

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Document EPA-600/R-12/031. All testing processes and measurements conform to the requirements of ISO 9001:2008 and relate only to items identified on this document. This document shall not be reproduced in full without written approval of the issuer.

ACCREDITED



TESTING CERT No. 3082.05

Approved for Release

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## CERTIFICATE OF ANALYSIS

<b>Customer Detail:</b> ALS Laboratory Group (Thailand)		<b>Production Order Number:</b> 90132928 <b>Material Number:</b> 478100-J-44 <b>Certification Date:</b> 20-Jan-2016 <b>Expiry Date:</b> 20-Jan-2024	
<b>Cylinder Description:</b> Steel 47 L		The measurement of this reference material is traceable to SI through the change standard which is available to order National Standard of the EPA Traceability Program EPA 400-P-12-034 for the assay and certification of Gases & calibration standards using gravimetric method. The reported uncertainty is based on a standard uncertainty of approximately 0.5%.	
<b>Certificate Number:</b> 4676/15	<b>Analyst:</b>  THIRAWAT LOAYRAT		
<b>Cylinder Number:</b> S50730	<b>Approve:</b>  S. S. S. S. S.		
<b>Nominal Cylinder Content:</b> 6.520 M <sup>3</sup>			
<b>Nominal Pressure:</b> 145.0 Bar			
<b>Valve Outlet:</b> CGA 590 BRASS	<b>To Re-Order Please Quote:</b> 478100-J-44		
<b>Comment:</b> <ul style="list-style-type: none"> <li>It is recommended that this product be not used below 2% of actual contents or should not be used when its gas pressure is below 150psig.</li> <li>Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component.</li> <li>Keep and use in well-ventilated and secure area.</li> </ul>			

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ผู้ให้บริการ (ผู้ให้บริการ) ผู้ให้บริการ (ผู้ให้บริการ)  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

Linde (Thailand) Public Company Limited  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

## CERTIFICATE OF ANALYSIS



Analytical Result					
Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	8.00 %	7.93 %	± 1% relative	(2) I-PB-354	20-Jan-2015
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen in Nitrogen	243625SG	25.00 ± 0.13 %	19-Aug-2017		
Analytical Instruments used in Assay					
Instrument Make/Model	Analytical Principle	Last Minimum Calibration			
Servomex 4100 O2 Analyzer	Paramagnetic	23-Dec-2015			
Method of Analysis: 1. Gas Chromatography 2. Paramagnetic Oxygen Analyzer 3. Electrochemical Oxygen Analyzer 4. Electrochemical Moisture 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	

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ผู้ให้บริการ (ผู้ให้บริการ) ผู้ให้บริการ (ผู้ให้บริการ)  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

Linde (Thailand) Public Company Limited  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

## CERTIFICATE OF ANALYSIS

<b>Customer Detail:</b> ALS Laboratory Group (Thailand)		<b>Production Order Number:</b> 90137389 <b>Material Number:</b> 557200-J-44 <b>Certification Date:</b> 24-Sep-2016 <b>Expiry Date:</b> 24-Sep-2024	
<b>Cylinder Description:</b> STEEL 47 L		The measurement of this reference material is traceable to SI through the change standard which is available to order National Standard of the EPA Traceability Program EPA 400-P-12-034 for the assay and certification of Gases & calibration standards using gravimetric method. The reported uncertainty is based on a standard uncertainty of approximately 0.5%.	
<b>Certificate Number:</b> 2857/16	<b>Analyst:</b>  THIRAWAT LOAYRAT		
<b>Cylinder Number:</b> 363075	<b>Approve:</b>  S. S. S. S. S.		
<b>Nominal Cylinder Content:</b> 6.500 M <sup>3</sup>			
<b>Nominal Pressure:</b> 145.0 Bar			
<b>Valve Outlet:</b> CGA 590 BRASS	<b>To Re-Order Please Quote:</b> 557200-J-44		
<b>Comment:</b> <ul style="list-style-type: none"> <li>It is recommended that this product be not used below 2% of actual contents or should not be used when its gas pressure is below 150psig.</li> <li>Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component.</li> <li>Keep and use in well-ventilated and secure area.</li> </ul>			

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ผู้ให้บริการ (ผู้ให้บริการ) ผู้ให้บริการ (ผู้ให้บริการ)  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

Linde (Thailand) Public Company Limited  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

## 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	25.00 ± 0.13 %	19-Aug-2017		
Analytical Instruments used in Assay					
Instrument Make/Model	Analytical Principle	Last Minimum 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. Total Hydrocarbon Analyzer 6. Other specified					
Cylinder Number: 363075 Production Order Number: 90137389				Certification Date: 24-Sep-2016 Expiration Date: 24-Sep-2024	

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ผู้ให้บริการ (ผู้ให้บริการ) ผู้ให้บริการ (ผู้ให้บริการ)  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114

Linde (Thailand) Public Company Limited  
 15 ถนนสุขุมวิท 111/1 แขวง 14 แขวงสุขุมวิท เขต 15 กรุงเทพฯ  
 โทรศัพท์: 02-554-1111 โทรสาร: 02-554-1112  
 โทรสาร: 02-554-1113 โทรสาร: 02-554-1114



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC13089  
Pages : 1 of 3

## Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No. : 34178121  
ID No. : RYG\_FS0213

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACC23009  
Job No. : VC66AC0031  
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	94.16	0.16	0.14	0.40

#### 2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.2	0.3	0.1	1.0

#### 3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.97	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACC23009  
Job No. : VC66AC0031  
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. 03/0263	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).

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC23080  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamp NH-24  
Serial No. : 00296517 / 135220 / 87527  
ID No. : RYG\_FS0434

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23080  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	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. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 03/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

## Continuation of Calibration Certificate

Cert. No. : ACL23080  
Job No. : VC66AC0031  
Pages : 3 of 8

## Summary of Measurement Result :

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

OF-TS12-04-04-020664

T. Petch.

QF-TS12-04-04-020664

T. Petch.

## Continuation of Calibration Certificate

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

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	14.2
C - weight	19.9
Flat	25.5

## 3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 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	-1.5	-1.4	-1.4	±5.0

## Continuation of Calibration Certificate

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

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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QF-TS12-04-04-020664

T. Petch.



## Continuation of Calibration Certificate

Cert. No. : ACL23080  
Job No. : VC66AC0031  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

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T. Petchur

## Continuation of Calibration Certificate

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

## 11. Overload indication

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

## 12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.9	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

## Continuation of Calibration Certificate

Cert. No. : ACL23080  
Job No. : VC66AC0031  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

## 10. Peak C sound level

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

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

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T. Petchur

451-451/1 Srinthorn Rd., Bangbunru, Bangkok Bangkok 10700 THAILAND.  
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23073  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-52A / Microphone UC-59 / Pre-amplifier NH-25  
Serial No. : 00920831 / 22191 / 22220  
ID No. : -

Condition As Found : GOOD

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

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

Received Date : 06 JANUARY 2023  
Calibration Date : 23-24 JANUARY 2023  
Date of Issue : 25 JANUARY 2023

Calibrated by : Nuhakorn Pisupaisan

Approved by :

T. Petchur  
( Thanakul Petchurai )

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

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T. Petchur

QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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	EP-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EP-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	EP-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. : ACL23073  
Job No. : VC66AC0029  
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	✓	-	0.3	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

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T. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	94.0	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.0

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

Frequency Weighting	Measured value (dB)
A - weight	9.8
C - weight	14.6
Flat	20.3

## 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	0.0	0.0	0.0	± 1.0
1000	0.1	0.1	0.1	± 0.7
8000	-0.3	-0.2	-0.1	+ 1.5, - 2.5

## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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	0.0	0.1	±1.0
125	0.0	0.1	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.1	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

## 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	± 0.1

QF-TS12-04-04-020664

T. Petch.

QF-TS12-04-04-020664

T. Petch.



## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	26.0	0.0	±0.8
25.0	24.9	-0.1	±0.8

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## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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	±0.8

## 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	128.1	0.1	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.7	-0.7	±2.0

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	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23073  
Job No. : VC66AC0029  
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	±0.1

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, Bangkok Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23090  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NI-52A / Microphone UC-59 / Preamplifier NH-25  
Serial No.: 01120939 / 21940 / 22328  
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 : 24 JANUARY 2023  
Calibration Date : 26-30 JANUARY 2023  
Date of Issue : 31 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurui  
( Thanakul Petchurui )

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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-1015-22	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. : ACL23090  
Job No. : VC66AC0030  
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	✓	-	0.3	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

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T. P. P. P.

## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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)	94.0	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	14.9
Flat	20.7

## 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	0.1	0.1	0.1	± 1.0
1000	0.1	0.1	0.1	± 0.7
8000	-0.7	-0.7	-0.7	+ 1.5, - 2.5

## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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	0.0	0.0	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

## 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	± 0.1

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T. P. P. P.



## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.0	0.0	±0.8
25.0	25.0	0.0	±0.8

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## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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	±0.8

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.1	-0.3	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL23090  
Job No. : VC66AC0030  
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	±0.1

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 Srinithorn Rd, Bangbunru, Bangkok 10700 THAILAND  
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23039  
Pages : 1 of 9

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21  
Serial No. : 01133046 / 157226 / 09873  
ID No. : RYG FS0006

Condition As Found : GOOD

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

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

Calibrated by : Nathakorn Pisutpassan

Approved by :

T. Petchur  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL23039  
Job No. : VC66AC0024  
Pages : 2 of 9

Calibration Procedure : CP-AC-02

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Exp. Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	8846A	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. : ACL23039  
Job No. : VC66AC0024  
Pages : 3 of 9

## 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. : ACL23039  
Job No. : VC66AC0024  
Pages : 4 of 9

## 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)
22.0

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

Frequency Weighting	Measured value (dB)
A - weight	21.4
C - weight	21.9
Flat	24.2

## 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	1.7	1.7	1.7	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-5.0	-4.9	-4.9	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL23039  
Job No. : VC66AC0024  
Pages : 5 of 9

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	-0.1	-0.1	-0.1	±1.5
250	-0.1	-0.1	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.1	0.1	0.1	±2.0
4000	0.1	0.1	0.1	±3.0
8000	0.1	0.1	0.2	±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. Bhan

QF-TS12-04-04-020664

T. Bhan



## Continuation of Calibration Certificate

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## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	134.9	-0.1	± 1.1
134.0	133.9	-0.1	± 1.1
133.0	132.9	-0.1	± 1.1
132.0	131.9	-0.1	± 1.1
131.0	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 1.1
119.0	118.9	-0.1	± 1.1
114.0	113.9	-0.1	± 1.1
109.0	108.9	-0.1	± 1.1
104.0	103.9	-0.1	± 1.1
99.0	98.9	-0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	88.9	-0.1	± 1.1
84.0	83.9	-0.1	± 1.1
79.0	78.9	-0.1	± 1.1
74.0	73.9	-0.1	± 1.1
69.0	68.9	-0.1	± 1.1
64.0	63.9	-0.1	± 1.1
59.0	58.9	-0.1	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.7	-0.3	± 1.1

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T. Retan

## Continuation of Calibration Certificate

Cert. No. : ACL23039  
Job No. : VC66AC0024  
Pages : 7 of 9

## 8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

## Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	33.0	0.0	±0.5

## 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	124.0	124.1	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

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## Continuation of Calibration Certificate

Cert. No. : ACL23039  
Job No. : VC66AC0024  
Pages : 8 of 9

## 10. Peak C sound level

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

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

## 11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.1	-0.3	±1.5

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T. Retan

## Continuation of Calibration Certificate

Cert. No. : ACL23039  
Job No. : VC66AC0024  
Pages : 9 of 9

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Retan



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn 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. : ACL23046  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier MH-24  
**Serial No.:** 01122607 / 145554 / 34373  
**ID No.:** RYG\_FS0019

**Condition As Found :** GOOD

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

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

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

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchur )

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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	EE-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAJ	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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)
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	9.9
C-weight	16.5
Flat	22.4

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.6	0.6	0.6	±1.5
1000	0.1	0.1	0.1	±1.0
8000	-2.3	-2.3	-2.3	±5.0

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## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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	-0.1	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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	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	128.1	0.1	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	126.4	126.2	-0.2	±3.0

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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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	104.1	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	24.8	-0.2	±1.1

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## Continuation of Calibration Certificate

Cert. No. : ACL23046  
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	89.7	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. Petch



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL23079  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-32 / Preamplifier JH-24  
Serial No. : 00296516 / 180412 / 88182  
ID No. : RYG\_FS0433

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurai*  
( Thanakul Petchurai )

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QF-TS12-04-04-020664

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

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

### Calibration Method :

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

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

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

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

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
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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# SITHIPORN / SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
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)
14.8

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	17.5
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	0.0	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.4	0.5	0.4	± 5.0

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## Continuation of Calibration Certificate

Cert. No. : ACL23079  
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	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
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, T <sub>b</sub> ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lepeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.8	-0.2	± 1.1
29.0	28.8	-0.2	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
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

QF-TS12-04-04-020664

T. Petch



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinithom Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
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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 Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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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

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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 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-1019-22	24-Feb-23
Measuring Amplifier	NA-42KAJ	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

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# 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)	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

QF-TS12-04-04-020664



## 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

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B.L.A.

## 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

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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

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P.T.A.

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
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## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

P.T.A.



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22241  
Pages : 1 of 8

## Calibration Certificate

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

**Condition As Found :** GOOD

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

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

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

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( Thanakul Petchurai )

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QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22241  
Job No. : VC65AC0089  
Pages : 2 of 8

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

### Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.  
For test 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	EELBP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EELBP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EELBP_08/0265	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-2003-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22241  
Job No. : VC65AC0089  
Pages : 3 of 8

### Summary of Measurement Results:

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

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

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
14.2

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

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

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

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

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

QF-TS12-04-04-020664



## Continuation of Calibration Certificate

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

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

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## Continuation of Calibration Certificate

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

## 7. Level linearity on the reference level range

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

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## Continuation of Calibration Certificate

Cert. No. : ACL22241  
Job No. : VC65AC0089  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

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## Continuation of Calibration Certificate

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

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sidinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-6800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23081  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00296518 / 66239 / 34375  
**ID No.:** RYG\_FS0431

**Condition As Found :** GOOD

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

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

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

**Calibrated by :** Nethakorn Pisutpaian

**Approved by :**

*T. Petchur*  
( Thanakul Petchurai )

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
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-42KAI	34560495	AA-2005-22	22-Feb-23

- This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
- This certificate is traceable to the international system of unit maintained at :
  - National Institute of Metrology (Thailand).
  - Thailand Institute of Scientific and Technological Research (TISTR).

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 4 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

### 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)
21.7

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

Frequency Weighting	Measured value (dB)
A-weight	13.1
C-weight	19.0
Flat	24.7

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.4	-0.3	-0.3	± 5.0

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*T. Petchur*

QF-TS12-04-04-020664

*T. Petchur*



## Continuation of Calibration Certificate

Cert. No. : ACL23081  
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)			Acceptance Limits
	Flat	C-weight	A-weight	
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	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. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

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T. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

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T. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
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		
89.6	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.



Cert. No. : ACL23321  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00597168 / 179117 / 87524  
ID No. : RYG\_FS0438

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*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.

QI-TS12-04-04-020664

## Continuation of Calibration Certificate

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

## Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter.

will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

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## Continuation of Calibration Certificate

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

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

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## Continuation of Calibration Certificate

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

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.8
Flat	23.2

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.0	2.1	±5.0

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## Continuation of Calibration Certificate

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

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

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

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

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

## 11. Overload Indication

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

## 12. High level stability

Frequency 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 Sinitthom 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. : ACL23322  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00597169 / 180411 / 88181  
ID No.: RVG\_FS0439

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Petchurai )

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

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T. Petchur



Continuation of Calibration Certificate

Cert. No. : ACL23322  
Job No. : VC67AC0011  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-0030-266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-0029-266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-0031-266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

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

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

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

Continuation of Calibration Certificate

Cert. No. : ACL23322  
Job No. : VC67AC0011  
Pages : 3 of 8

Summary of Measurement Result :

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

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

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*T. Petch...*

Continuation of Calibration Certificate

Cert. No. : ACL23322  
Job No. : VC67AC0011  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.2

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.0	0.0	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.1	2.1	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23322  
Job No. : VC67AC0011  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

*T. Petch...*

QF-TS12-04-04-020664

*T. Petch...*



## Continuation of Calibration Certificate

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

## 7. Level linearity on the reference level range

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

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T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL23322  
Job No. : VC67AC0011  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

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## Continuation of Calibration Certificate

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

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23044  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Pre-amplifier NH-24  
Serial No. : 00900073 / 188466 / 01735  
ID No. : RYG\_FS0494

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Petchur )

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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. 03/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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. : ACL23044  
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)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.7

## 3. Acoustical signal tests of frequency weightings

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

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

## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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	-0.1	-0.1	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.1	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

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## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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	119.1	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	28.0	0.0	± 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. Petchurai

## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

## 10. Peak C sound level

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

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

## Continuation of Calibration Certificate

Cert. No. : ACL23044  
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		
89.5	89.6	0.1	±1.5

## 12. High level stability

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

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn 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. : ACL23325  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01073423 / 169513 / 73684  
ID No.: RVG\_FS0386

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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

QF-TS12-04-04-020664

T. Petchurai



## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 3 of 8

## Summary of Measurement Result :

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

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

QT-TS12-04-04-020664

P.T.A.

## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A-weight	13.1
C-weight	18.8
Flat	24.6

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.6	1.7	1.6	± 5.0

## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

QT-TS12-04-04-020664

P.T.A.

QT-TS12-04-04-020664

P.T.A.



## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	43.9	-0.1	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

QF-TS12-04-04-020664

T. P. H.

## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 8 of 8

## 11. Overload indication

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

## Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.1	-0.3	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
Positive half cycle	135.4	135.2	-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. : ACL23325  
Job No. : VC67AC0011  
Pages : 8 of 8

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Wattthapra, Bangkokhyai, Bangkok 10600 Thailand.

Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiratanee.com



## CERTIFICATE OF CALIBRATION

Certificate No. : CL-014-66  
Page 1 of 2Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 18018313  
ID No: RYS\_F50358Customer  
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 2023Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682-09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date: 22 July 2023Calibration Condition  
Temperature: (23±3)°C  
Relative Humidity: (55±15)%Calibration Procedure  
The temperature calibration was done by In-House  
calibration method as WI-CL-001 according to  
comparison method with standard digital temperature  
indicator and standard temperature probe. The  
temperature scale 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-0082-  
22REVIEW BY: *Alston P.*  
APPROVED BY: *[Signature]*  
NEXT CAL DATE: 2/12/24Calibrated by  
☒ Mr. Sorawit Thacholad  
☐ Miss Jittaporn LertsompholApproved Signatory: *[Signature]*  
Mr. Porliya Boonchareen  
Calibration Department Manager

T. P. H.





63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,  
Wathapra, Bangkhuyai, Bangkok 10600 Thailand.  
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Certificate No.: CL-014-05  
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	25.060	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 ★



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## CERTIFICATE OF CALIBRATION

Certificate No.: CL-043-06  
Page 1 of 2

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 20032241  
ID No: RYG\_FS0521

Customer  
Name: ALS laboratory group (thailand) Co., Ltd.  
Address: 104 Phatthanasai 40, Phatthanasai Rd.,  
Khuang 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.: 657652-09. 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: TI-0034-22, Certificate number: CR-0092  
22

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

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



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Certificate No.: CL-043-06  
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: 21001217  
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.045	20.1	0.1	0.099
60	25.055	25.1	0.0	0.099
60	30.055	30.1	0.0	0.099
60	35.048	35.1	0.1	0.099
60	40.043	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001783.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.045	20.2	0.2	0.099
70	25.055	25.1	0.0	0.099
70	30.055	30.0	0.1	0.099
70	35.048	35.0	0.0	0.099
70	40.043	39.9	0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001242.  
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.045	20.0	0.0	0.099
110	25.055	25.0	0.1	0.099
110	30.055	30.0	0.0	0.14
110	35.048	35.0	0.0	0.099
110	40.043	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-044-06  
Page 1 of 2

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 20032242  
ID No: RYG\_FS0522

Customer  
Name: ALS laboratory group (thailand) Co. Ltd.  
Address: 104 Phatthanasai 40, Phatthanasai Rd.,  
Khuang 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.: 657652-09. 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: TI-0034-22, Certificate number: CR-0092  
22

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate No.: CL-044-66  
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: 21001206.  
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.046	20.0	0.0	0.099
60	25.056	25.0	-0.1	0.099
60	30.055	30.1	0.0	0.099
60	35.048	35.1	0.1	0.099
60	40.043	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001796.  
Dimension: Diameter 14 mm. Length 150 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.046	20.2	0.2	0.099
70	25.055	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	40.044	39.7	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001250.  
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.046	20.0	0.0	0.099
110	25.056	25.0	-0.1	0.099
110	30.055	30.1	0.0	0.099
110	35.048	35.1	0.1	0.099
110	40.043	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-060-66  
Page 1 of 2

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15006711  
ID No: RYG\_FS0217

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

Received date: 11 May 2023  
Calibration date: 15 May 2023  
Issue date: 15 May 2023

Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-100 A500,  
Serial No. 667682-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator Model: DTI-1000 A MK  
II, Serial No.: 671407-00591 Due date: 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-0039-23, Certificate number: ER-0092  
22

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

Calibrated by  
☒ Mr. Sorawit Thacholad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory: Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate No.: CL-060-66  
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: 16008206.  
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	19.997	20.1	0.1	0.099
80	25.000	25.1	0.1	0.099
80	30.004	30.1	0.1	0.099
80	35.005	35.1	0.1	0.099
80	40.003	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17015123.  
Dimension: Diameter 3.3 mm. Length 205 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	19.997	20.1	0.1	0.099
110	25.000	25.1	0.1	0.099
110	30.004	30.1	0.1	0.099
110	35.005	35.2	0.2	0.099
110	40.003	40.2	0.2	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 17003390.  
Dimension: Diameter 14 mm. Length 150 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.068	20.7	0.1	0.099
75	25.060	25.1	0.0	0.099
75	30.050	29.9	-0.1	0.099
75	35.042	34.8	-0.2	0.099
75	40.046	39.7	-0.3	0.099

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



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## CERTIFICATE OF CALIBRATION

Certificate No.: CL-035-66  
Page 1 of 2

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15006713  
ID No: RYG\_FS0218

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

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

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

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

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

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

Calibrated by  
☒ Mr. Sorawit Thacholad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory: Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate No. : CL-036-66  
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: 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

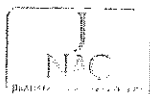
Table 3: This equipment was connected with Globe thermometer probe Model TP3276.2 S/N: 22035462.  
Dimension: Diameter 8 mm, Length 170 mm.

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 ★



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## CERTIFICATE OF CALIBRATION

Certificate No. : CL-036-66  
Page 1 of 2

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15006714  
ID No: RYG\_FS0219

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

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

### Reference Used During Calibration

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

### Calibration Condition

Temperature: (23±1)°C  
Relative Humidity: (65±15)%

### Calibration Procedure

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

### Traceability

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

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory:   
Mr. Panya Booncharoen  
Calibration Department Manager

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Certificate No. : CL-036-66  
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: 22035263  
Dimension: Diameter 14 mm, Length 170 mm.

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

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

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

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

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

UUC\* : Unit Under Calibration

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

★ End of Certificate ★



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## CERTIFICATE OF CALIBRATION

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

Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15006716  
ID No: RYG\_FS0221

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: 01 Mar 2023  
Calibration date: 14 Mar 2023  
Issue date: 15 Mar 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±1) °C  
Relative Humidity: (65±15)%

### Calibration Procedure

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

### Traceability

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

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory:   
Mr. Panya Booncharoen  
Calibration Department Manager

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Certificate No.: CL 057 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: 18000587  
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.068	20.1	0.0	0.099
60	25.060	25.1	0.0	0.14
60	30.050	30.0	0.0	0.099
60	35.041	35.0	0.0	0.099
60	40.045	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015492  
Dimension: Diameter 14 mm. Length 150 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.068	20.3	0.2	0.099
70	25.060	25.1	0.0	0.099
70	30.050	30.0	0.0	0.099
70	35.041	34.9	0.1	0.099
70	40.046	39.8	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15015967  
Dimension: Diameter 8 mm. Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.068	20.0	-0.1	0.099
110	25.061	25.0	0.1	0.099
110	30.050	30.0	0.0	0.099
110	35.041	35.0	0.0	0.099
110	40.046	40.0	0.0	0.099

UUC\* : Unit Under Calibration

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

★ End of Certificate ★



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## Certificate of Calibration

Certificate No.: 22PH447  
Page: 1 of 2

Equipment: Lux Meter  
Manufacturer: PEAK METER  
Model: PM6612L  
Serial No.: H12A-D16324  
ID No.: RYG\_F50536

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Condition As-Received: Used Item  
Received Date: 31 August 2022  
Calibration Date: 02 September 2022

Reference: 2208-1093WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %

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

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

Procedure used: Calibration were conducted using in-house calibration procedure CP-PHD1 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

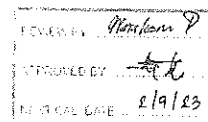
3 Test Equipment: Programmable Voltage/Current Source ( Model: OL83A, S/N: 09220284 )

4 Test Equipment: Illuminance Meter ( Model: 51002, S/N: 080129 )

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

6 This Calibration is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)



Calibrated by: Nimit Nitas  
Issue Date: 06 September 2022

Approved Signatory:

☒ Phulinee Prabpalak  
☒ Chatchawan Khunpluek  
☒ Nuntawat Khamchai

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Cert. No.: 22PH447  
Page: 2 of 2



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## Certificate of Calibration

Certificate No.: 23PH502  
Page: 1 of 2

Result of calibration: ( ) Without adjustment ( \* ) After adjustment  
Function: Illuminance Measurement Range: Autorange

Standard Value	Before Adjust UUC* Reading	After Adjust UUC* Reading	Error	Uncertainty
( lx )	( lx )	( lx )	( lx )	( ± lx )
0	0.00	0.00	0.00	0.080
15	-	14.25	-0.75	0.22
100	-	96.5	-3.5	1.5
500	-	492	-8	7.3
1000	881	992	-8	15
2000	-	1986	-14	30
3000	-	2990	-10	45
4000	-	4026	26	59
5000	4550	5060	60	74

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k=2$ , providing a level of confidence of approximately 95 %

Before adjustment light source factor setting mode:  $L_0 = 1.058$

After adjustment light source factor setting mode:  $L_0 = 1.209$

UUC\* = Unit Under Calibration.

-000-

Equipment: Lux Meter  
Manufacturer: PEAK METER  
Model: PM6612L  
Serial No.: H12A-D16371  
ID No.: RYG\_F50538

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Condition As-Received: Used Item  
Received Date: 15 September 2023  
Calibration Date: 20 September 2023

Reference: 2309-0567WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %

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

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

Procedure used: Calibration were conducted using in-house calibration procedure CP-PHD1 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-0084 22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1472	TP-1039-22	11 Dec 2023

3 Test Equipment: Programmable Voltage/Current Source ( Model: OL83A, S/N: 09220284 )

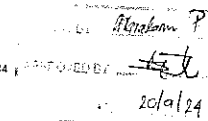
4 Test Equipment: Illuminance Meter ( Model: 51002, S/N: 080129 )

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

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

-National Institute of Metrology Thailand (NIMT)

-National Institute of Metrology (Thailand), NSC-ONS Accredited No. Calibration 0144



Calibrated by: Nimit Nitas  
Issue Date: 21 September 2023

Approved Signatory:

☒ Phulinee Prabpalak  
☒ Chatchawan Khunpluek  
☒ Nuntawat Khamchai

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Cert. No.: 23PH502  
Page.: 2 of 2



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TEL: 0-2717-9900-29 FAX: 0-2719-9564



Cert.No.: 23CH827  
Page.: 1 of 2

Result of calibration: ( ) Without adjustment ( \* ) After adjustment  
Function : Illuminance Measurement Range : Autorange

Standard Value	Before Adjust	After Adjust	Error	Uncertainty
( lx )	UUC* Reading	UUC* Reading	( lx )	( ± lx )
0	0.00	0.00	0.00	0.060
15	-	15.18	0.18	0.20
100	-	100.8	0.8	1.3
500	-	500	0	6.6
1000	970	1000	0	13
2000	-	2016	16	26
3000	-	3000	0	39
4000	-	4030	30	52
5000	4900	5050	50	65

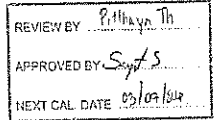
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 %

Before adjustment light source factor setting mode :  $L_0 = 1.227$   
After adjustment light source factor setting mode :  $L_0 = 1.264$   
UUC\* = Unit Under Calibration.

-o0o-

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenGo S2  
Serial No. : B712669291  
ID No. : RYG\_FS0296  
Condition As-Received : Used Item  
Received Date : 30 June 2023  
Calibration Date : 03 July 2023  
Reference : 2305-0984DSC-2  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5, T Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)



Calibrated by : Warakorn Lernagatrakul

Approved by : Approved Signatory

( / ) Malee Buikrua  
( / ) Sathip Meangmai  
( / ) Warakorn Lernagatrakul

Issue Date : 6 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 23CH827  
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Cert. No.: 23LM117  
Page.: 1 of 2

### Condition of this calibration result

- Reference Standard Instrument : -  
Instrument : Serial No. : ID No. : Cert. No. : Due Date :  
1) Document Process Calibrator : 54030049 : 130RC116 : 22E2769 : 24 Aug 2023  
This certification is traceable to the International System of Unit maintained at :  
- Traceable to National Institute of Metrology (Thailand), NIMT
- Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1035

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.986	CPA chem	863833	28 Dec 2023
pH 10.010	CPA chem	863835	28 Dec 2023

- 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 <i>k</i>
			mV	pH		
	pH Meter	4.00	177.48	178	4.00	0.58
S/N: B712669291	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)

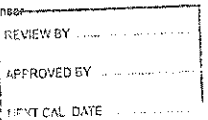
Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading ( mV )	Uncertainty of pH measurement ( ± )	Coverage factor k
pH Electrode	4.008	4.01	188	0.0095	2.05
S/N : 3104144	6.986	7.00	13	0.011	2.00
	10.010	10.01	-165	0.0095	2.00

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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## Certificate of Calibration

Equipment : pH Meter with Sensor  
Manufacturer : Mettler Toledo  
Model : SevenGo S2  
Serial No. : B712669291  
ID No. : RYG\_FS0296  
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 : 30 June 2023  
Calibrated Date : 05 July 2023  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
AC Line Voltage : (220 ± 22) V



Calibrated by : Malee Buikrua

Approved by : Approved Signatory

( / ) Pornthippa Tameyakul  
( / ) Suwit Imjai

Issue Date : 11 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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Malee

a 1169608

A 0056044





Equipment : pH Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2306-0984DSC-3  
Procedure Used :-

Cert. No.: 23LM117  
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90

#### Condition of this result of calibration

##### 1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	2211285	TPA	21 Oct 2023

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

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 3184144

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.007	25.2	0.193	0.16	2.00
30.0	100	30.005	30.2	0.195	0.16	2.00
40.0	100	40.006	40.3	0.294	0.16	2.00
50.0	100	49.997	50.3	0.303	0.16	2.00

UUC\* : Unit Under Calibration

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

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a 1169'00



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TEL. 0 2713-9000-77 FAX 0 2719-9184



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 : 2212-0802DSC-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-CH6 by comparison with standard thermometer

Calibrated by : Warakorn Lergagatrakul

Approved by : Malee  
Approved Signatory

( / ) Malee Bulkruea  
( ) Sathip Meangmai  
( ) Warakorn Lergagatrakul

Issue Date : 26 December 2022

The Uncertainties are for a confidence probability of approximately 95%

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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	4992054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.997	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

#### Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: B834291445	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 (±)	Coverage factor k
pH Electrode S/N.: 1475518	4.008	4.011	185.2	0.0052	2.06
	6.997	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

Function : Temperature Measurement

( \* ) Without adjustment

This equipment was connected with Temperature Probe.

- Model : InLab Expert Pro-ISM

- Serial No. : 1475518

Dimension of probe:

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.001	24.9	-0.101	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1141167

a 1141166









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



Cert. No.: 22TM1517  
Page: 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UFE 500  
Serial No. : GS11 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 Pattanapongsaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
( / ) Maloo Bulkruea  
( ) Suwil Imjai

REVIEW BY   
APPROVED BY   
NEXT CAL DATE 30/09/24

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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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-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard instrument-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

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

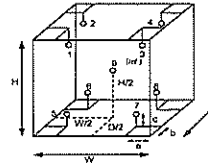
3 This certification is traceable to the International System of Unit.

Result of Calibration : ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL Humid. ( % )	54	59
AC Supply ( Volt )	223	225



Probe Installation Details : Dimension of Chamber :  
a = 50 cm D = 0.40 m  
b = 50 cm W = 0.56 m  
c = 50 cm H = 0.48 m  
Capacity = 0.11 m<sup>3</sup>

Ref. Std. ID No.: @ Calibration Point		
Position :	( 180 ) °C	( 104 ) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

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 )								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.600	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.488	180.361	180.114	180.131	180.243	179.605

Average\* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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

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

UUC\* : Unit Under Calibration

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

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

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a 1132465



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

## Certificate of Testing

Equipment : DO Meter

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102795

ID No. : RYG\_EN0032

Received Date : 21 July 2023

Test Date : 24 July 2023

Reference : 2307-0713DSC-1

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

Rayong Branch  
616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand

Laboratory Condition : Temperature ( 25 ± 5 ) °C

Humidity ( 50 ± 20 ) %

In - house method : CP-CH9

by Comparison Technique with Azido Modification Method

Tested by : Walalak Sirilhean

Approved by :

Approved Signatory

( ) Maloo Bulkruea  
( / ) Sathip Meangmai  
( ) Warakorn Lornagatrakul

Issue Date : 26 July 2023

B 0320211





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

#### Condition of this result of calibration

##### 1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143784	140RC004	22MM50	20 Sep 2023

##### 2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full without written approval of the laboratory

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Signature

a 1172155



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Cert. No.: 23LM125  
Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 25 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
AC Line Voltage : (220 ± 22) V  
Calibrated by : Preecha Hlahib  
Approved by :   
( ) Pornhippa Tamayakul  
( ) Malee Butkruea  
(✓) Suwit Imjai  
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2307-0713DSC-2  
Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

##### 1. Reference standard Instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	2211285	TPA	21 Oct 2023

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

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

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

Result of Calibration :- ( ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N: 1228475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC\* : Unit Under Calibration

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

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Signature

a 1159515



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Cert. No.: 23TM062  
Page : 1 of 3

## Certificate of Calibration

Equipment : Low Temp. Incubator  
Manufacturer : Memmert  
Model : IPP750  
Serial No. : VB18 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 : 29 May 2023  
Calibration Date : 29 May 2023  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Man Pattanasongpaiboon  
Approved by :   
( ) Pornhippa Tamayakul  
( ) Malee Butkruea  
(✓) Suwit Imjai

The Uncertainties are for a confidence probability of approximately 95%

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A 0054967





Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2

Cert. No.: 23TM962  
Page : 2 of 3

#### Procedure Used :-

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

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	MY57013711	22LM93	02 Jul 2023

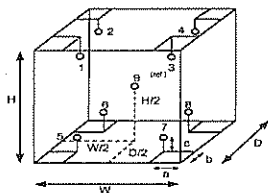
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



#### Probe Installation Details :

#### Dimension of Chamber :

a = 10 cm	D = 0.60 m
b = 10 cm	W = 1.0 m
c = 10 cm	H = 1.2 m
	Capacity = 0.75 m <sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	23	23
REL.Humid. ( % )	54	56
AC Supply ( Volt )	223	222

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

a 1165130

RYG\_EN0006



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM962  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor k
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.116	0.30

Average\* : The average of 30 values in each position.

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

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

UUC\* : Unit Under Calibration

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

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

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a 1165129



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TEL : 6-2717 3000 FAX : 0-2710 9181



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

## Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UM 400

Serial No. : b495.0899

ID No. : RYG\_EN0006

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
618/10 Moo 5, T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140, Thailand

Location : Oven Room

Received Order : 20 October 2022

Calibration Date : 20 October 2022

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Preecha Hlaib

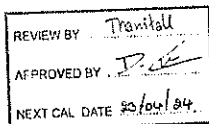
Approved by :   
Approved Signatory

( ) Pornthippa Tanoyakul  
( ✓ ) Malee Buikrua  
( ) Suwit Imjai

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 & Equipment Calibration and Testing Services.



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-1

Cert. No.: 22TM1492  
Page : 2 of 3

#### Procedure Used :-

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

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

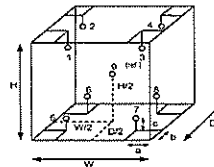
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 :

#### Dimension of Chamber :

a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
	Capacity = 0.053 m <sup>3</sup>

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

Malee

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	70.262	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 %.

-o0o-

Malu.

a 1132472



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
 534 PATTANAKARN ROAD SOI 18, SU ANU UANG, THAILAND BANGKOK, 10250  
 TEL : 0-2717-3660-21 FAX : 0-2716-5484



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. Pluakdaeng,  
 Rayong 21140, Thailand

Location :

Wei Chemistry Lab

Received Order :

20 October 2022

Calibration Date :

20 October 2022

Ambient Temperature :

( 28 ± 10 ) °C

Relative Humidity :

( 50 ± 30 ) %

Calibrated by :

Procha Hahib

Approved by :

Malu.  
 Approved Signatory

( ) Pornthippa Tamoyakul

( ) Malee Butkruea

( ) Suwit Injai

Issue Date :

2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

Placed the instrument to be calibrated calibration in fact, except with the past number  
 Approval of the head of Corporate Services & Equipment Calibration and Testing Services

A 0046906



Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2210-0376OC-4  
 Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1 Reference standard instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

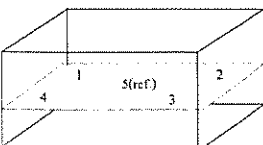
2 This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration : ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730



Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2210-0376OC-4  
 Result of Calibration : ( \* ) Without Adjustment  
 Function of UUC\* : Temperature Source

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

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.590

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 %

-o0o-

Malu.

a 1132471

Malu.

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: +669 9205 6851, +669 9247 2350  
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

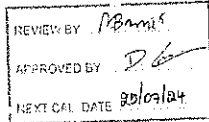


Certificate No. T230116

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber (Cooling Room)  
Manufacturer : MODULAR  
Model : IREVC0HCOO  
Serial No. : C00351459  
Customer Code : RYG\_EN0184  
ID No. : T1939A5  
Customer : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng, Rayong 21140  
Customer Location : Laboratory  
Date of Receipt : 23 January 2023  
Calibrated By : Atiphong Rongrat (Technician)  
Approved By : 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-L14115 31-05-63

Certificate No. T230116

Page 2 of 4

## Calibration Report

Equipment : Chamber (Cooling Room)  
Date of Calibration : 25 January 2023  
Environment : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).  
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

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

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant : 1 Hour  
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

Approved By: Boonchai Suriyawong

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

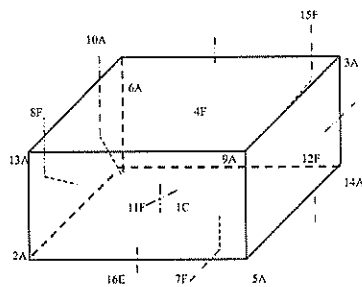
SCI ECO Services Company Limited  
33/2 Moo 3, T. Banpa, A. Kaengkhoh, Saraburi 18110, Thailand



Certificate No. T230116

Page 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	

Certificate No. T230116

Page 4 of 4

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45
	TN151	TN152	TN153	TN154	TN155	TN156				
	3.28	3.22	3.28	3.21						

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min	Max				
3.0	2.8	4.1	3.5	1.20	1.20	1.90

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: Boonchai Suriyawong

Approved By: Boonchai Suriyawong

FM-L15117 15-05-63

FM-L15117 15-05-63





## Certificate of Calibration

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	
418.81	418.4	0.21	0.14	
535.85	535.7	-0.04	0.14	
637.85	638.3	-0.32	0.14	
745.45	745.6	-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	0.563	-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
	0.5005	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0023	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6993	0.672	-0.0027	0.0045
	0.9504	0.934	-0.0056	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
	0.9504	0.982	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-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
	0.5957	0.559	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

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Delivering Growth - In Asia and Beyond.

CALFM-C06-13: 20 Jul 2022

Equipment: SPECTROPHOTOMETER  
Model: DR5000  
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.

Environmental 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. Chetaphon Fothong  
Calibration Date: 27 September 2022  
The Method used: In house method, GAL-WI-24, base on ASTM E 275-09 and ASTM E 387-04  
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Sigma Scientific Limited.

The standard for Wavelength Certificate No. 91418 and 91435  
The standard for Photometric Certificate No. 91441 and 101035  
The standard for Stray light Certificate No. 101041 and 101040  
The standard for Spectral resolution Certificate No. 101037

(Mr. Chetaphon Fothong)  
Person in charge

(Mr. Thaleksoat Pongnangam)  
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.  
This 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 outside in full without approval of DKSH Technology Limited.

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CALFM-C06-13: 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
	0.6609	0.661	-0.0001	0.0064
313 nm	0.0000	0.000	0.0000	0.0080
	0.2895	0.292	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6381	0.630	0.0001	0.0080
Stray Light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)	
260.67 +/- 0.11 nm	260.7	2.1	1.678	
391.94 +/- 0.11 nm	391.9	1.7	1.770	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	DSW
Standard Wavelength (nm)	260.60	266.63	1.39	2.00
UUC: Wavelength (nm)	266.2	266.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.369		

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

The End of Certificate

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CALFM-C06-13: 20 Jul 2022

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม



เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR5000 หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)	
27 Sep 2022		27 Sep 2022	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ
รายการตรวจเช็ค			
General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>
Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	7. ความถูกต้องความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่ตัวอย่าง (Cuvette Module)	<input checked="" type="checkbox"/>
pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>
Turbidity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ว่าง (No Sample)	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.6 ไมล์ 3.0)	<input type="checkbox"/>
Automatic Dilutor			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Borelles	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Flushing and Dosing	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบทำความสะอาดและอุปกรณ์ประกอบ	<input type="checkbox"/>

เงื่อนไขเพิ่มเติม:

Mr. Chetaphon Fothong  
Service Engineer

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Phone: +66 2559 7020 Email: info@dksh.com Website: www.dksh.com

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CALFM-C06-13: 20 Jul 2022

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CALFM-C06-13: 20 Jul 2022



# Certificate of Calibration

Certificate No.: C29230010

Page: 2 of 4

Equipment: Block Digestion Unit  
 Model: KT-200  
 Serial No. (or ID.): 6720210003/5770200073  
 Manufacturer: Gerhardt  
 Condition: In Condition

Certificate No.: C29230010  
 Issued Date: 18 March 2023  
 Job No.: KSPR2304382  
 Page: 1 of 4  
 Digestion Block: 20 holes.

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

Environment Condition: Temperature: 25 °C ± 0.5 °C  
 Humidity: 65 %RH ± 3.7 %RH  
 Voltage: 231 VAC ± 3.1 VAC

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

Calibration By: Mr. Nektarin Ruengro

Calibration Date: 15 March 2023

The Method used: In house method, base on by comparison with standard

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)  
 Certificate No.: TC22/0080

REVIEW BY: *[Signature]*  
 APPROVED BY: *[Signature]*  
 NEXT CAL. DATE: 15/03/24

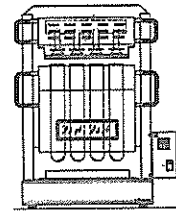
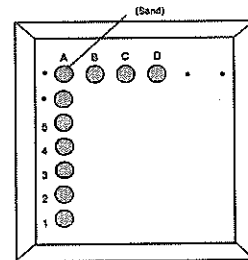


Fig. 1: Front view



Location of standard

Fig. 2: Digestion block

## Definitions

**Indicating Temperature:** The average reading of indicating device which forms the integral part of the Digestion block.

**Measured Temperature:** The average reading of working standard at any positions or location.

(Mr. Nektarin Ruengro)  
 Person in charge

(Mr. Udon Srichana)  
 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 is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
 These results may be affected by deviations from specified conditions. The results relate only to the items tested, examined or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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CAL-FM-C29-07: 20 Jul 2022

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CAL-FM-C29-07: 20 Jul 2022

Certificate No.: C29230010

Page: 3 of 4

## Calibration Results:

### Before adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	380	380	380	375.1	-4.9	1.5
A2				374.3	-5.7	1.5
A3				374.6	-5.4	1.5
A4				378.3	-3.7	1.5
A5				373.2	-6.8	1.5
B1				374.4	-5.6	1.5
B2				374.3	-5.7	1.5
B3				374.6	-5.4	1.5
B4				375.2	-4.8	1.5
B5				375.1	-4.9	1.5
C1				373.6	-6.5	1.5
C2				372.8	-7.2	1.5
C3				372.1	-7.9	1.5
C4				372.2	-7.8	1.5
C5				374.5	-5.5	1.5
D1				374.7	-5.3	1.5
D2				375.3	-4.7	1.5
D3				375.5	-4.5	1.5
D4				375.6	-4.2	1.5
D5				375.1	-4.9	1.5

## Calibration Results:

### After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	360	380	380	378.6	-1.0	1.5
A2				378.7	-1.3	1.5
A3				378.4	-0.6	1.5
A4				378.2	-0.8	1.5
A5				379.2	-0.8	1.5
B1				379.6	-0.2	1.5
B2				379.2	-0.8	1.5
B3				379.5	-0.5	1.5
B4				378.9	-1.1	1.5
B5				379.1	-0.9	1.5
C1				379.1	-0.9	1.5
C2				377.7	-2.3	1.5
C3				378.4	-1.6	1.5
C4				378.2	-1.8	1.5
C5				378.0	-2.0	1.5
D1				378.5	-0.5	1.5
D2				376.7	-1.3	1.5
D3				379.7	-0.3	1.5
D4				378.5	-0.5	1.5
D5				378.4	-0.6	1.5

The End of Certificate





## ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2304362

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

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ตัว)		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
15 Mar 2023			15 Mar 2023		
		Disinfect			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดง Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hold	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพห้ามมือ	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพสิ่งแวดล้อม	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ : \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Mr. Nekarit Ruengro  
Service Engineer

Agilent Technologies (Thailand) Public Co., Ltd.  
 2333 Sukhumvit Road, Bangkok, Thailand 10110  
 Phone: +66 229 7555 Email: info.asia@agilent.com Website: www.agilent.com/thailand  
 Delivering Growth - In Asia and Beyond.



## Agilent CrossLab Start Up Services

### Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY	<i>Manat Z.</i>
APPROVED BY	<i>Sam Z. A.</i>
EFFECTIVE DATE	01/03/23

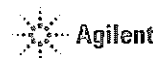
Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

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 G8014-90075  
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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

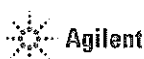


### Important Customer Web Links

- 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

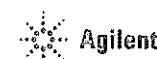
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### Service Engineer's Responsibilities

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

### 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

### Instrument Maintenance

#### System Information

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

Instrument System Name and ID	G8010A ; MY16010005
Instrument System Site and Location	ALS C Bx12

List System Component	Product Numbers	List the Serial Numbers of each Component
1	G8010A	MY16010005
2	G8410A	AU15440964
3	B7142	1095-00159
4	G8455	AU16040115
5		
6		
7		
8		
9		

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

### 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 SRBR	17603.8	146365.1	72,249.2	149,369.5
Mn 257.610 nm SRBR	152,635.2	620,660.3	159,260.0	212,496.1
Al 396.152 nm SBR	29593.5	200,141.2	29,995.9	196,402.0
K 766.491 nm SBR	95616.2	3151,222.8	99,398.4	296,3194.9

\* Axial result is not applicable for G6016AA, G6012AA 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	218.975 VAC	215.155 VAC
Mains Current	0.817 A	0.116 A
Instrument Temperature	24.4 °C	24.5 °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	20.0 °C	23.5 °C
Polychromator Temperature	35.0 °C	35.0 °C
CCD Temperature	-40.0 °C	-40.0 °C
Thermal Stabilizer	34.5 °C	35.0 °C
Argon Supply Pressure	619.70 kPa	541.92 kPa
Purge Gas Supply Pressure*1	609.58 kPa	567.77 kPa
Oxygen 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	1199.9 W
RF Supply Current	No measurement	8.224 A
RF Supply Voltage	No measurement	194.422 V

\*1 If option installed

## Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-G8014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-G8015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	—
Purge Gas Filter	G8010-G8016	All	1
Air Inlet Filter	G8030-G8002	All	1
High Capacity Air Filter	G8010-G8019	Optional	—
Rotor seal for 6-7 port valve for AV56/7	G8454-G8002	G8494A/G8495	—
Rotor seal for 4 port valve for AV54	G8493-G8002	G8493A	—
Rinse solution to rinse station 2 5mm id x 1m	G8410-G8013	SPS 4	1
Barb connector 2 5mm-1 5mm ID	G8410-G8014	SPS 4	1
PVC waste tubing 8mm od x 5mm id, 2m	G8410-G8012	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	3710049000	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: 6005835494 Date Service Completed: 2-May-2023

Service Engineer Name: Durin Ngamvijit Customer Name: Thitiro Banpomy

Service Engineer Signature: Durin Ng. Customer Signature: Thitiro B.

Total number of pages in this document:

## Metrological Center

SCI ECO Services Company Limited

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

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



Certificate No. T231676

Page 1 of 6

## Certificate of Calibration

Equipment : HEATING BLOCK

Manufacturer : Environmental Express

Model : SC 196

Serial No. : 6974CECW3285

Customer Code : BKK\_EL0054

ID No. : T5306A3


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

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

Customer Location : Acid Digestion Lab

Date of Receipt : 13 September 2023

Calibrated By : Sanee Musikawan (Site Calibration Manager)

Approved By :  / Sujjar Naknukred (Site Calibration Manager)

Date of Issue : 26 SEP 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.





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Page 2 of 6

### Calibration Report

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

#### Condition of this results of calibration :

- This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20  
All data show below were final values and the initial data from customer request The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument .

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024
- This certificate is traceable to .  
National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244 )
- Condition of calibrated item : good  
Equipment Description :  
Time Constant 2 Hour 20 Minute At 95 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available
- Adjustment :  
( ) without adjustment ( X ) after adjustment

Approved By.

FM L13 108 30-05-57



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Certificate No T231676

Page 4 of 6

### Calibration Report

Measurement Results		Average Standard Reading at each position (°C)						
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26	
R1 Hole1-Hole6	CAL POINT	Max	95.01	94.41	95.20	95.41	94.51	95.17
		Min	94.57	93.95	94.75	94.92	94.00	94.72
		Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12	CAL POINT	Max	95.36	95.43	95.19	95.16	95.35	94.97
		Min	94.94	94.95	94.72	94.71	94.90	94.47
		Average	95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18	CAL POINT	Max	95.37	95.50	95.21	95.33	95.31	
		Min	94.99	95.09	94.78	94.82	94.88	94.96
		Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24	CAL POINT	Max	95.59	94.42	94.52	94.24	94.63	94.67
		Min	95.21	94.06	94.13	93.88	94.28	94.27
		Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30	CAL POINT	Max	95.19	95.38	92.93	95.30	95.14	95.03
		Min	94.83	95.03	92.56	94.95	94.79	94.70
		Average	95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36	CAL POINT	Max	94.63	94.90	94.77	94.31	94.24	93.87
		Min	94.24	94.55	94.44	93.58	93.92	93.56
		Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42	CAL POINT	Max	94.30	94.44	94.04	93.81	94.89	95.25
		Min	93.95	94.05	93.67	93.48	94.39	94.50
		Average	94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48	CAL POINT	Max	95.99	95.63	95.28	95.29	95.45	94.87
		Min	95.57	95.15	94.82	94.84	94.99	94.48
		Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By.

FM-L13 108 30-05-57



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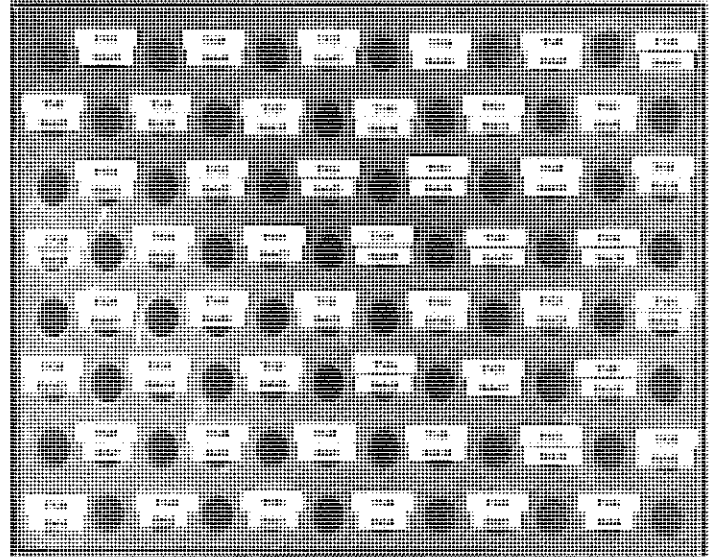
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Page 3 of 6

### Calibration Report



FRONT CONTROL

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FM-L13 108 30-05-57



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Certificate No T231676

Page 5 of 6

### Calibration Report

Measurement Results		Average Standard Reading at each position (°C)						
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26	
R1 Hole1-Hole6	CAL POINT	Max	105.23	104.32	105.43	105.25	104.44	105.27
		Min	104.54	103.95	105.15	105.04	104.11	104.96
		Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12	CAL POINT	Max	105.30	105.12	105.18	105.22	105.12	105.16
		Min	105.11	104.92	104.86	105.00	104.92	104.97
		Average	105.20	105.02	105.07	105.11	105.02	105.06
R3 Hole13-Hole18	CAL POINT	Max	105.37	105.63	105.02	104.80	104.69	105.19
		Min	105.17	105.37	104.75	104.59	104.50	105.00
		Average	105.27	105.50	104.88	104.69	104.60	105.09
R4 Hole19-Hole24	CAL POINT	Max	105.31	104.43	106.41	104.71	105.63	105.82
		Min	105.08	104.22	106.15	104.41	105.37	105.56
		Average	105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30	CAL POINT	Max	104.95	106.26	103.34	105.78	105.59	105.87
		Min	104.67	105.96	103.68	105.56	105.36	105.68
		Average	104.81	106.11	103.51	105.67	105.48	105.77
R6 Hole31-Hole36	CAL POINT	Max	104.75	104.86	104.80	105.20	104.50	104.39
		Min	104.54	104.63	104.59	105.00	104.32	104.18
		Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42	CAL POINT	Max	104.30	104.90	104.85	104.65	104.88	104.85
		Min	104.09	104.72	104.66	104.49	104.63	104.52
		Average	104.19	104.81	104.75	104.57	104.76	104.68
R8 Hole43-Hole48	CAL POINT	Max	105.71	105.85	105.39	105.61	105.42	105.19
		Min	105.45	105.61	105.14	105.27	105.18	104.94
		Average	105.58	105.73	105.27	105.44	105.30	105.07

Approved By.

FM-L13 108 30-05-57





## Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T231676

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### Calibration Report

#### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min, Max	Average		
100.0	100.3, 100.5	100.4	0.26	0.81
107.0	107.0, 107.1	107.1	0.19	0.78

\* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %

Approved By: \_\_\_\_\_

FM-L13 108-30-05-57



## Metrological Center

SCI ECO Services Company Limited

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



Certificate No. T221644

Page 2 of 4

### 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



## Metrological Center

SCI ECO Services Company Limited

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

Saraburi Tel : +66 3627 3095 Fax : +66 3627 3100

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

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

Certificate No. T221644

Page 1 of 4

### Certificate of Calibration

Equipment : Chamber ( Cold Room )

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK\_EN0167

ID No. : T2463A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Environmental Laboratory

Date of Receipt : 27 June 2022

Calibrated By : Sujjar Nakhakred ( Site Calibration Manager )

Approved By : \_\_\_\_\_ / Boonchal Suriyawong (Site Calibration Manager)

Date of Issue : 6 JUL 2022

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L14 117/01-02-64



## Metrological Center

SCI ECO Services Company Limited

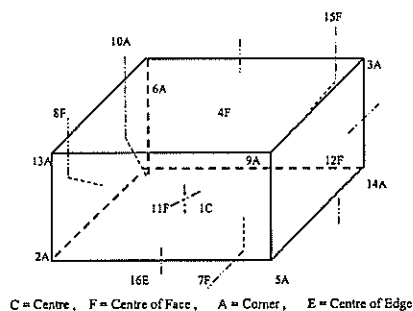
33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.



Certificate No. T221644

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### Calibration Report



1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7F	=	TN167
8F	=	TN168
9A	=	TN169
10A	=	TN170

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By: \_\_\_\_\_

FM-L15 117/15-05-63





Certificate No. T221644

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## Calibration Report

### Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.68	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 117/15-05-63

BKK\_EN0284

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Agilent CrossLab Compliance Services

## Certificate of System Qualification

GC-QQ - GCMS-QQ

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

Date: May 25, 2023 11:05:07 AM  
EQP Name: Agilent/Recommended Agilent/Recommended  
EQP Revision: GC.02.52, GCMS.02.51  
Overall Qualification Status: Pass

REVIEW BY:   
APPROVED BY:   
NEXT CAL DATE: 25 Jun 24

CDS Legon Verification - GC

Legon: SESSIONNAME

Overall CDS Legon 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: MAB

Setpoint Status: Pass

Setpoint: 25.0 psi  
Actual: 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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BKK\_EN0130

REVIEW BY:   
APPROVED BY:   
NEXT CAL DATE: 11 Jun 24



## Certificate of Calibration

ICS-2100: Anion (ID#488)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co., Ltd.

ICS-2100 S/N: 11080010

AS-HV S/N: 5050A23120

For

ALS Laboratory Group (Thailand) Co., Ltd.

Operator Signature:

Date: Jan 11, 2023

(Mr.Nutdanai Laekhwan)

Application Chemist

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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: 230.0 / 230.0 °C  
Temperature: 230.0 / 230.0 °C  
Accuracy: 0.0 °C  
Agilent Recommended: >= -1.0 °C, <= 1.0 °C  
% setpoint in K: (-5.0 °C), (5.0 °C)

Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual: 100.0 / 100.0 °C  
Temperature: 100.0 / 100.0 °C  
Accuracy: 0.0 °C  
Agilent Recommended: >= -1.0 °C, <= 1.0 °C  
% setpoint in K: (-3.7 °C), (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890  
Setpoint Status: Pass  
Setpoint/Average: 100.0 / 100.0333 °C  
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:	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:	7693A			
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:	7693A			
Source:	EI - Extractor			

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

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## Setpoint Status:

## Injection Volume on Column:

## Minimum RSD:

## Agilent Recommended:

## Status:

## Instrument Detection Limit:

## Agilent Recommended:

## Status:

## Overall Instrument Detection Limit Test Status

Pass

## Mass Ratio Precision

## Tested Combination1

	Injection Power	
Name:	7693A	
Source:	EI - Extractor	
Setpoint Status:	Pass	
Injection Volume on Column:	1.0	µL
	Area Mass 1	Mass Ratio
	Abundance's	
RSD:	3.22	%
Agilent Recommended:	≤ 5.00	≤ 5.00
	Pass	Pass

## Overall Mass Ratio Precision Test Status

Pass

Date: May 25, 2023 11:05:07 AM  
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 (µL)	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
Val 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

## Inlet 2

Manufacturer	Agilent Technologies
Name	7690
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

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

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## Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

### Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	TO
Name	7000D
Serial Number	US1826U108
Firmware Revision	G.7000.D85A
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

## MS EI Source 1

Manufacturer	Agilent Technologies
Source Type	Et - Extractor
Number of filaments	2

**Electronic Signature**

### Purpose

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### Details

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

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

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

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User Name: haitapei.hongcharen System id: GM-10  
Host name: ASBKKHYXZ85 Print Date: May 25, 2023 11:05:08 AM

System Id: GM-10  
Print Date: May 25, 2023 15:05:08 AEST

**ALE-GU-12 Transaction log 3**

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:32:30 PM	Audit	Session Deleted	Session	None
May 22, 2023 1:32:30 PM	Start	Configuration	Session	None
May 22, 2023 1:32:30 PM	Audit	Enrollment	Licensing	User is Field Engineer and does not require an unlock code
May 22, 2023 1:37:48 PM	Audit	Exp. loaded	Session	EQP details for primary technique [Gc] - File path: [Presets\Presets\Gc\Configure\Gc\M02_Gc\Gc.02.02.51.exp], EQP File Name: [Gc.02.02.exp], EQP Name: [Agilent\Recommended\Presets\Random (Gc.02.02)] EQP details for hypothesis between [Gc] and [Gc] File path: [Presets\Presets\Gc\Configure\Gc\M02_Gc\Gc.02.02.51.exp], EQP File Name: [Gc.02.02.exp], EQP Name: [Agilent\Recommended\Presets\Random (Gc.02.02)]
May 22, 2023 1:37:52 PM	End	Configuration	Session	None
May 22, 2023 1:37:55 PM	Start	Qualification	Session	OO
May 22, 2023 1:37:55 PM	Start	Execution	EQS Logon Verification - GC - Qualitative test	None
May 22, 2023 2:02:27 PM	Start	Execution	EQS Logon Verification - GC - Qualitative test	None
May 22, 2023 2:02:23 PM	Start	Execution	Instrument Deletion (Link - Injection Tower, Front SIMS, TG) - Source - CI - Extractor - MSD - Cleanup - 12.02% - MSD 1 (Link, Time: ca 1:05)	None

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Date: May 25, 2023 11:05:37 AM  
System ID: GIA-10

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User Name: kartipati.hengcharoen SystemId: 036-10  
 Hostname: AS6KKW265 Print Date: May 25, 2023 11:05:03 AM

SystemId: 056-10  
Print Date: May 25, 2012 11:01:03 AM

ALS\_GN-10 Transaction log:

Time	Transaction Date	Activity Performed	Type of Transaction	Optimal Information
May 22, 2023 2:02:37 PM	Start	Execution	CDG Login Verification - GC - Qualitative test	None
May 22, 2023 2:03:33 PM	End	Execution	CDG Login Verification - GC - Qualitative test	Run Count: 1
May 22, 2023 2:34:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No suspects associated	None
May 22, 2023 2:36:02 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No suspects associated	Run Count: 1
May 22, 2023 2:35:17 PM	Start	Execution	Intel Pressure Accuracy - Front MAM - Pressure Controlled Islet - 8.250 psi - L <= 1.2 psi	None
May 22, 2023 2:36:22 PM	End	Execution	Intel Pressure Accuracy - Front MAM - Pressure Controlled Islet - 8.250 psi - L <= 1.2 psi	Run Count: 1
May 22, 2023 2:36:24 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature Oven - 8.250 °C - L <= +1.0 AHD <= 1.0 % suspect in K	None
May 22, 2023 2:36:48 PM	End	Idle	GC Oven Temperature Accuracy - 7890 - Temperature Oven - 8.250 °C - L <= +1.0 AHD <= 1.0 % suspect in K	Manual Data Entry
May 22, 2023 2:38:34 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature Oven - 8.250 °C - L <= +1.0 AHD <= 1.0 % suspect in K	Run Count: 1

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Date: May 26, 2023 11:06:07 AM  
System ID: GM-10

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User Name: natipat.hengchornen  
Host Name: ASDKNW255  
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 2:38:55 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: ±1.0 AND ±1.0 % setpoint in K	None
May 22, 2023 2:59:09 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	None
May 22, 2023 3:08:09 PM	Start	Execution	Scouting 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): ±12.02% - RSD L (Rel. 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): ±1.00%	None
May 22, 2023 3:17:49 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: ±1.0 AND ±1.0 % setpoint in K	None
May 22, 2023 3:17:56 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: ±1.0 AND ±1.0 % setpoint in K	None
May 22, 2023 3:18:06 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: ±1.0 AND ±1.0 % setpoint in K	Manual Data Entry

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

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User Name: natipat.hengchornen  
Host Name: ASDKNW255  
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 3:18:07 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: ±1.0 AND ±1.0 % setpoint in K	Run Count: 1
May 22, 2023 3:28:07 PM	Start	Execution	Scouting 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): ±12.02% - RSD L (Rel. Time): ±1.00%	None
May 22, 2023 4:02:50 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	None
May 22, 2023 4:13:00 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ±0.5°C	None
May 22, 2023 4:53:57 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ±0.5°C	Manual Data Entry
May 22, 2023 4:53:54 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ±0.5°C	Run Count: 1
May 23, 2023 3:09:15 PM	Audit	AreClosed	Session	None
May 24, 2023 4:53:19 PM	Audit	AreRestarted	Session	None
May 24, 2023 4:14:45 PM	Audit	AreClosed	Session	None
May 25, 2023 10:13:57 AM	Audit	AreRestarted	Session	None
May 25, 2023 10:27:12 AM	Audit	SessionReloaded	Session	None

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

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User Name: natipat.hengchornen  
Host Name: ASDKNW255  
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 10:37:19 AM	Start	Qualification	EO	
May 26, 2023 10:27:16 AM	End	Execution	Tune EI - 70000 TQ - Source: - EI - Extractor Element 1 (Qualitative - No response associated)	None
May 25, 2023 10:37:42 AM	Start	Execution	Tune EI - 70000 TQ - Source: - EI - Extractor Element 1 (Qualitative - No response associated)	None
May 25, 2023 10:37:58 AM	End	Execution	Tune EI - 70000 TQ - Source: - EI - Extractor Element 1 (Qualitative - No response associated)	Run Count: 1
May 25, 2023 10:37:57 AM	Start	Execution	Tune EI - 70000 TQ - Source: - EI - Extractor Element 2 (Qualitative - No response associated)	None
May 25, 2023 10:38:07 AM	End	Execution	Tune EI - 70000 TQ - Source: - EI - Extractor Element 2 (Qualitative - No response associated)	Run Count: 1
May 25, 2023 10:38:08 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source: - EI - Extractor - Part of GCMS System Preparation	None
May 25, 2023 10:38:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	None
May 25, 2023 10:38:20 AM	Start	Execution	Scouting 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: natipat.hengchornen  
Host Name: ASDKNW255  
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	Scouting Run - Injection Tower, Front MM, TQ - Source: - EI - Extractor - Part of GCMS System Preparation	Data File Path: D:\MassSpec\GCMS1\data\AgilentGC_2023\EO_01.D
May 25, 2023 10:29:24 AM	End	Execution	Scouting 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): ±12.02% - RSD L (Rel. Time): ±1.00%	None
May 25, 2023 10:32:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	Data File Path: D:\MassSpec\GCMS1\data\AgilentGC_2023\EO_01.D
May 25, 2023 10:32:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	Data File Path: D:\MassSpec\GCMS1\data\AgilentGC_2023\EO_02.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	Data File Path: D:\MassSpec\GCMS1\data\AgilentGC_2023\EO_03.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source: - EI - Extractor - RSD L (Area): ±12.02% - RSD L (Rel. Time): ±1.00%	Data File Path: D:\MassSpec\GCMS1\data\AgilentGC_2023\EO_04.D

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

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User Name: natlapathengcharoen  
Host Name: ASBKKWX205

System Id: G35-10  
Print Date: May 25, 2023 11:08:08 AM

ALS GM-12 Transaction (pg 2)

Time	Transaction State	Action Performed	Type of Transaction	Optional Information
May 29, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230529_069.D
May 28, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230528_068.D
May 28, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230528_067.D
May 28, 2023 11:20:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 11.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230528_066.D
May 28, 2023 10:20:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230528_065.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230525_064.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230525_063.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path : D:\Master\Audit\GCMS\Hdata\WagnerGC_20230525_062.D
May 25, 2023 10:30:00 AM	End	Execution	Instrument Detection Unit - Injection Tower, Front MMA, TQ - Source: -EI -Extractor -RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	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: rattapatt.hongcharoen  
Hostname: A5BKVYX283

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 28, 2023 10:30:22 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	None
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_01_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: CI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_02_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_03_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_04_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_05_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_06_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_07_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_08_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_09_00
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path : D:\MassHunter\GCMS\MetaSamples\MagnetIQ_0023MHP_10_00
May 28, 2023 10:31:02 AM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMU, TG - Source: EI - Extractor - L (RSD) <= 5.00%	Run Count : 1
May 28, 2023 10:31:02 AM	End	Qualification	Creation	OQ

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

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User Name: nattapat.hengcharoen  
Hostname: ASDR00W0285

Print Date: May 25, 2023 11:03:06 AM


ALB QM-10 Transaction log =

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 28, 2023 10:31:02 AM	Start	Reporting	Session	None
May 28, 2023 11:04:34 AM	Audit	Tapeup	Session	Report Generated: Card Rate

P439919

Date: May 26, 2023 11:04:07 AM  
System ID: GM-10

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 **Bara Scientific Co., Ltd.**  
808 U Chu Liang Building Floor 7 Rama4 Road  
Siam Bangkok Thailand 10500  
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[www.barscientific.com](http://www.barscientific.com)



# Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No.	BSCC-UV-39723
Equipment	UV/Vis Spectrophotometer
Model	UV-1800
Manufacturer	Shimadzu
Serial No.	A11454908533CD
ID No.	BKK_EN0018
Date of receipt	15 September 2023
Date of calibration	15 September 2023
Date of issue	22 September 2023

REVIEW BY Sislok P.  
APPROVED BY LL AL  
NEXT CAL DATE 15/9/2024

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

Temperature	(23.4 - 24.7) °C (On site)
Humidity	(55.5 - 61.2) %RH (On site)

Equipment condition      Good Operation

Calibration Location      Organic Prod

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

Traceability	Wavelength Accuracy is traceable to certificate No 05917 and 05918
	Photometric Accuracy is traceable to certificate No 05937 and 05924
	Sray Light is traceable to certificate No 05908
	The above certificate are traceable to SI unit through Starna Scientific Ltd
	(UKAS accredited calibration laboratory NO 0659)

Calibrated by Mr Warchana Janjoev

Approved by \_\_\_\_\_

Mr.Kanchit Choothep  
Technical Manager

[illegible]





Bara Scientific Co., Ltd.  
908 U Chu Liang Building Floor 7 Ramak Road  
Siam Bangkok Bangkok Thailand 10100  
Tel: 02-6321300 Fax: 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Pages(s)

2 of 3

### Calibration Results:

#### 1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.90	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

#### 2. Photometric Accuracy (UV)

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

\*CNR = Customer not request

The above results are valid exclusively for the calibrated items as mentioned in this report. Certificate and publicity of the results are prohibited and also the report may be reproduced except in full without written approval of the Bara Scientific Co., Ltd.

FM-UV-708-02 Rev 01 (23/01/13)

BSCC-110016



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## Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Pages(s)

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### Calibration Results:

#### 3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5793	0.0010	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.0206	1.0216	0.0010	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5625	0.0004	0.0042
	0.7455	0.7462	-0.0003	0.0042
	0.9385	0.9389	0.0004	0.0042
463.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.9487	0.9486	-0.0001	0.0042
540.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9568	0.9564	-0.0004	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7253	0.7236	-0.0017	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5016	0.5012	-0.0004	0.0042
	0.6927	0.6909	-0.0018	0.0042
	1.0881	1.0866	-0.0015	0.0042

\*CNR = Customer not request

#### 4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC) Wavelength (nm)	Transmission (1/T)	Absorbance (A)
200 BG-0.1nm	200.55	0.9770	2.0104

The Stray light transmission reference is less than 1.0% and Stray light absorbance reference is greater than 2.00A  
\*Stray Light not NSC-DHSC Accredited.

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

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

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FM-UV-708-02 Rev 01 (23/01/13)

### 7700 Series ICP-MS Preventive Maintenance Checklist - Standard



Agilent Preventive Maintenance provides factory recommended service for your analytical systems 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 everything you need to reduce unplanned downtime and keep your systems operating at their peak.

For more information about Agilent Technologies services please visit our web site using the following URL: <http://www.chem.agilent.com/en-us/products/services/naocs/default.aspx>

#### 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.
- 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 additional or special procedures and/or parts for the instrument service, then these must be ordered separately and charged as a repair, which may incur additional costs.

#### Service Engineer's Responsibilities

- Only complete/printout 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 a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

REVIEW BY Sunthorn H.  
APPROVED BY Sunthorn H.  
NEXT CAL DATE 11/01/2014

Issued: 7-Feb-2014, Revision: 1.2

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### 7700 Series ICP-MS Preventive Maintenance Checklist - Standard



#### System Information

Instrument system name and ID	7700x ICP-MS
Instrument system site and location	ALS Laboratory Group (Thailand) b.c.l.h
List system component product numbers	List the serial numbers of each component
1 63291A	1 7P 1209 4612
2 63291A	2 4N 1220 700
3 83X 700	3 05 021295A 516
4	4
5	5
6	6
7	7

ICP-MS configuration table	Circle the type or write in the type if other
Nebulizer	<u>Micro</u> Mist   Micro Flow   Ultra Mist   other
Spray Chamber	<u>Quartz</u>   PFA   other
Torch	<u>Quartz</u>   Demountable   other
Sampling Cone	<u>SP</u>   Pt   other
Skimmer Cone	<u>SP</u>   Pt   Ni plated   other

#### Preparation

- ☒ Discuss any specific issues with the customer prior to starting.
- ☒ Review the instrument logbook.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform general inspection of system for cleanliness.
- ☒ Check for proper installation of safety-related parts, assemblies, sensors etc.
- ☒ Check for required firmware updates and verify with customers if they would like it installed.
- ☒ Begin system vent.

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7700 Series ICP-MS  
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**Inspect and clean system while venting**

- ✓ Perform a general inspection of the system.
- ✓ Look for any obvious external damage or problems.
- ✓ Check mechanical pumps for evidence of excessive fluid leaks.
- ✓ Inspect vacuum hoses, pump exhaust tubes and power cord for excessive wear.
- ✓ Inspect Shield plate contacts. Clean if needed.
- ✓ Inspect the tape lining on the peristaltic pump clamp; replace the tape if worn (5043-0030).
- ✓ Check electronics for dust accumulation, clean if necessary.

**Mechanical vacuum pumps**

- ✓ Drain and replace mechanical pump fluid.
- ✓ Verify proper oil recycling function of mechanical pumps; the gas ballast valve must be open.
- ✓ Replace the oil mist filter.
- ✓ Inspect and clean or replace the inlet filter (P/N 5190-0145 for E2M18, P/N SR03700237 for DS402).
- ✓ Verify proper oil recycling function of mechanical pumps; the gas ballast valve must be open when connected to an Edwards E2M18.

**Cooling water system**

- ✓ Drain cooling fluid.
- ✓ Remove, clean and reinstall metal mesh filter.
- ✓ Re fill Polyclear cooling fluid (G3292-80010).
- ✓ Clean the Air filter and the Condenser by compressed air or vacuum cleaner.

**Ion lens cleaning**

- ✓ Remove extraction/omega lenses and clean all lenses.
- ✓ Remove ORS cell, plate bias and deflect lens, clean all lenses.
- ✓ Replace octopole. Reinstall all lenses and the ORS cell and close analyzer.

**Auto Sampler ASX500 Series**

- ✓ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns.
- ✓ Z-Axis Inspection: Inspect the Z-axis PEEK drive cable for kinks or slight bends. Power off the autosampler and manually move the Z-drive up and down using the rotor on the rear of the instrument. Inspect the Z-axis drive cable for kinks or slight bends. If the movement is rough and hard to move then replace Z-axis drive cable (P/N G3286-80331) or Z-axis drive assembly (P/N G3286-80330).

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7700 Series ICP-MS  
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- ✓ 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.
- ✓ QC Testing  
Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and ensure that the probe is centered in the vial.
- ✓ Final Inspection  
Check that all components are tight.

**Auto Sampler I-AS**

- ✓ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns.
- ✓ 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.
- ✓ QC Testing  
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.

**ISIS**

- ✓ Replace ISIS valve seal (P/N G3138-65117).
- ✓ Inspect the tape lining on the peristaltic pump clamp; replace the tape if worn (5043-0030).
- ✓ QC test  
Verify the function of valve and Peripump. Make sure that there is no leak from the valve and pump tubing connections.

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**Restore Instrument**

- ✓ Pump system down.
- ✓ Perform the system post check.
  - ✓ Check quadrupole matching.
  - ✓ Perform octopole matching.
  - ✓ Verify good gas control function by changing the flow and observing the meter readings, perform an automatic offset adjustment for the MFC's.
- ✓ Verify in Tune (using the customer's last tune) that changes in lens voltage result in the expected sensitivity change.
- ✓ Perform Startup including performance report and an Autotune. Print the Autotune report and attach it to this checklist.
- ✓ Check the instrument status and record the measurements in the status table. (Use "Record Log" in "Maintenance LogBook" with G7200B software. Use Performance report with G7201A/B software).
- ✓ Record the EM and discriminator Voltages in the results table.
- ✓ Run 10 minute stability test with tune solution. Check the result of RSD is below 4%.

**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.
- ✓ Make an entry in the MassHunter Maintenance Log Book recording the PM activities.
- ✓ 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 below if there are additional comments.
- ✓ Review the service and any test results with the customer.
- ✓ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

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**7700 Series ICP-MS Status Results Table**

- ✓ Check this box if you have run a performance report to record the meter readings. Print out the report and attach it to this checklist, instead of completing the table.

Measurement	Standby Mode	Analysis Mode No Gas Mode	Analysis Mode H <sub>2</sub> Gas @ 4ml/min	Analysis Mode He Gas @ 4ml/min
IP: Bk Pyrex	2.65 Pa	2.62 Pa	- Pa	2.62 Pa
TMP Revolution	100 %	100 %	- %	100 %
Analyzer Press	1.54x10 <sup>-3</sup> Pa	2.95x10 <sup>-4</sup> Pa	- Pa	6.15x10 <sup>-4</sup> Pa
Water RF WC-4F	0	1.50 L/min		
Water Temperature		22.1 °C		
Inlet Temp	24.0 °C	24.4 °C		
Internal Temp	18.0 °C	16.0 °C		
RF Power		1531 Watts		
RF Reflect		5 Watts		
Plasma Freq		267.8 MHz		
Carrier Gas (BP)		4.41 kPaG		
Ar Gas Tank Press		5.01 kPaG		
Carrier Gas		1.00 L/min		
MU: Dil Gas		0.10 L/min		
Plasma Gas		14.0 L/min		
Aux Gas		3.40 L/min		
S-C Temperature		2.0 °C		
OP Gas Tank Press: I	- kPaG	- kPaG		
Optional Gas *1		- %		

0 Do not fill in the shaded cells in the table. There are no measurements for these combinations.

Notes:

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# 7700 Series ICP-MS Preventive Maintenance Checklist - Standard

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## 7700 Series ICP-MS Test Results Table

Test Description	Expected Test Result	Actual Test Result
Analog HV Voltage	Not applicable	1761 V
Pulse HV Voltage	Not applicable	1446 V
Discriminator Voltage	Not applicable	4.5 mV

## 7700 Series ICP-MS Parts List Table

Part Description	Part Number	Product/Model # where used	Quantity Consumed
1L Rough Pump Oil	6040-0834	7700 ICP-MS	2
Oil Mist Filter Kit for E2M18	1162-1050	7700 ICP-MS	1
Oil Mist Filter for DS402	9499342M002	7700 ICP-MS	-
Graphite Gasket for Sample Cone (3pk)	G3280-67009	7700 ICP-MS	1
7700 Octopole	G3280-67045	7700 ICP-MS	1
Polyclear cooling fluid	G3282-80010	G1879B/G3292A	1
Rinse / Drain tubing	G3286-80117	ASX-500	1
Tubing / connection kit for drain	G3286-80118	ASX-500	1
Peristaltic pump tubing set	G3160-66326	I-AS	-
Drain tubing to rinse bottle and drain bottle	G3160-66328	I-AS	-
Motor seal for Valve (ISIS)	G3138-65117	ISIS	1
Additional parts may be required from engineers stock:			
Inlet Filter E2M18	5190-0145	7700 ICP-MS	-
Inlet Filter DS402	SR03700237	7700 ICP-MS	-
Peristaltic pump tape (30m roll)	5043-0630	7700 ICP-MS	-
Polishing Paper Kit (#400/#1200, 5 sheets each)	G1833-05404	7700 ICP-MS	-
Cotton Swabs, ultra-fine conical bud shape at both ends (100/pk)	9300-2574	7700 ICP-MS	-
Alumina Powder	8660-0701	7700 ICP-MS	-
Lint-free paper	05080-60051	7700 ICP-MS	-
Z-Axis Drive PEEK Cable (Anti-Kink)	G3286-80331	ASX-500	-
Z-Axis Drive Assembly (PEEK, Anti-Kink)	G3286-80330	ASX-500	-

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# 7700 Series ICP-MS Preventive Maintenance Checklist - Standard

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## Service Engineer Comments (optional)

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

## Other Important Customer Web Links

- How to get information on your product: Literature Library - <http://www.agilent.com/chem/library>
- Need to know more? - [www.agilent.com/chem/education](http://www.agilent.com/chem/education)
- Need technical support, FAQs? - [www.agilent.com/chem/techsupport](http://www.agilent.com/chem/techsupport)
- Need supplies? - [www.agilent.com/chem/supplies](http://www.agilent.com/chem/supplies)

## Service Completion

Service request number W0 6146623 Date service completed 12 June 2023  
 Agilent signature [Signature] Customer signature [Signature]  
 Document part number G3280-90078

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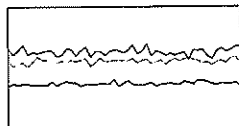
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## Tune Report

Operator Name Supakorn Mak  
 Acq/Data Batch C:\Agilent\CPM\H1\H1User\Tune.b  
 Acq. Date-Time 6/12/2023 4:05:12 PM  
 Report Comment PM 12 June 2023  
 Instrument Name G3281A.JP12091612

[No Gas]

Sensitivity



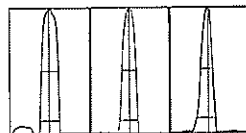
Mass	Range	Count	RSD%	Background
7	15000	6340	4.494	2.100
89	50000	27817	1.328	2.600
205	50000	18566	3.537	9.600

Sampling Period (sec) 0.311  
 Integration Time (sec) 0.1

### Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.492 %  
 Doubly Charged 70 / 140 1.508 %

### Resolution/Axis



Mass	Peak Height	Axis	W-50%	W-10%
7	6337.66	7.60	0.64	0.730
89	27561.94	89.06	0.55	0.710
205	19218.73	205.00	0.46	0.728

Integration Time (sec) 0.1  
 Acquisition Time (sec) 22.74  
 Y Axis Linear

### Tune Parameters

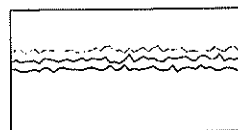
Plasma Parameters			
Plasma Mode	—	Nebulizer Gas	1.00 L/min
RF Power	1550 W	Option Gas	—
RF Matching	1.80 V	Nebulizer Pump	0.10 rpm
Sample Depth	8.0 mm	S/C Temp	2 °C
Lens Parameters			
Extract 1	0.0 V	Omega Lens	6.4 V
Extract 2	-145.0 V	Cell Entrance	-30 V
Omega Bias	-90 V	Cell Exit	-50 V
Cell Parameters			
Use Gas	No	3rd Gas Flow	—
He Flow	0.0 mL/min	OctP Bias	-8.0 V
Energy Discrimination 5.0 V			

## Tune Report

H2 Flow — OctP RF 190 V  
 QP Parameters  
 Mass Gain 145 Axis Gain 1.0021 QP Bias -3.0 V  
 Mass Offset 124 Axis Offset 0.12  
 Hardware Settings  
 Torch  
 Torch H -0.4 mm Torch V 0.0 mm  
 EM  
 Discriminator 4.5 mV Analog HV 1748 V Pulse HV 1496 V

[No Gas]

Sensitivity



Mass	Range	Count	RSD%	Background
59	25000	11826	2.752	7.200
89	20000	15157	2.527	5.800
205	50000	25871	2.706	13.300

Sampling Period (sec) 0.31  
 Integration Time (sec) 0.1

### Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.156 %  
 Doubly Charged 70 / 140 1.508 %

### Tune Parameters

Plasma Parameters			
Plasma Mode	—	Nebulizer Gas	1.00 L/min
RF Power	1550 W	Option Gas	—
RF Matching	1.80 V	Nebulizer Pump	0.10 rpm
Sample Depth	8.0 mm	S/C Temp	2 °C
Lens Parameters			
Extract 1	0.0 V	Omega Lens	7.4 V
Extract 2	-200.0 V	Cell Entrance	-90 V
Omega Bias	-90 V	Cell Exit	-70 V
Cell Parameters			
Use Gas	Yes	3rd Gas Flow	—
He Flow	4.5 mL/min	OctP Bias	-21.0 V
H2 Flow	—	OctP RF	200 V
QP Parameters			
Mass Gain	145	Axis Gain	1.0021
Mass Offset	124	Axis Offset	0.12
QP Bias -18.0 V			
Energy Discrimination 3.0 V			
Hardware Settings			
Torch		Torch V	0.0 mm
Torch H	-0.4 mm		







Device parameter	nominal value	actual value
<b>Analytical parameters Fluorescence cell</b>		
Conditions.: max.conc.: 10µg/L PMT-voltage: ...360.....V		
Blank-solution		Int. 0.00024...
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int. 0.00172... RSD 0.45 %
Conditions.: max.conc. 1.7µg/L PMT-voltage: ...352.....V		
Blank-solution		Int. 0.00370...
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int. 0.01059... RSD 2.39 %
Fok.- factor ( Int <sub>2</sub> / Int <sub>1</sub> )	> 3.5	6.16
<b>Analytical parameters Absorption cell</b>		
Blank-solution		Ext. 0.00093...
without enrichment / FBR 100 ng/L	Ext > 0.0012 RSD < 5 %	Ext. 0.00449... RSD 2.58 %
<b>Comments</b>		

Orawan T  
Signature Customer

24 May 2023  
Place, Date (DD/MM/YYYY)

[illegible]

Remarks  
Food,water

[illegible]

### Method parameters

Method Without enrichment / FBR 30ng/L\_PM24052023  
Created on 5/24/2023 Time 12:27  
Program ---

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr time	30 s
PMT	360 V		
AZ time	5 s	Peak smoothing	8/5
Delay	0 s		
	---		
Working mode	w/o enrich	System cleaning	Acid
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 NL/h
Autosampler			
Autosampler	AS51S/F	Tray type	87/139
Workline mode	continuous		

### Dilution



## QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std. 1 no.	1(30.000 ng/L)	QC std. 2 no.	1(30.000 ng/L)
QC std. 1 limit	± 50.00%	QC std. 2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100 ± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal factor	Off

## Calibration settings

Calib. meth	Standard calib	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep	Premixed
		Blank correct	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat	Mean	Meas. cycles	3
		Blank cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blank cycles	1
Grubbs stat.	---		

## Calibration standards

No.	Name	State	Pos.	Conc. / ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	79	0.000	H: 0.000249 A: 0.004274	0.000132 0.001698	53.13 39.72
2	Cal-Std1	(--)	80	30.000	H: 0.001720 A: 0.02172	0.000007 0.000023	0.459 0.107

Hg

## Calibration function 1

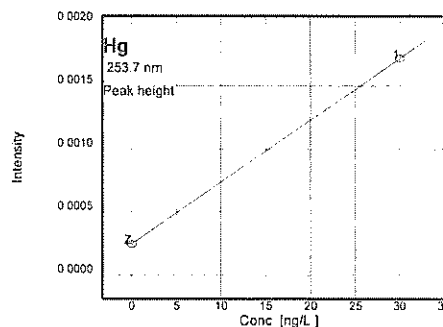
5/24/2023 12:44 Calibration (Peak height)

Ints=k1+k2\*conc

k1=0.000249 k2=0.000049

Recal. factor ---

Slope	0.00005 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

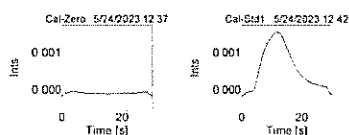
Hg ID	Without enrichment / FBR 30ng/L_PM 24052023					5/24/2023 12:35
	Conc.	Ints	BG	SD	RSD/%	Int. type Time
Cal-Zero		0.000143				PkH 12:37
		0.000397				12:38
		0.000207				12:40
	0ng/L	0.000249		0.0001324	53.13	12:40
Cal-Std1		0.001720				PkH 12:42
		0.001712				12:43
		0.001728				12:44
	30.00ng/L	0.001720		0.000007887	0.459	12:44
Calibration	Calibration function 01					12:44

Mercur

Mercur

## Peak plots

Hg



## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro\_033  
 Program version: 4.7.10.0 Printed on: 5/24/2023 14:01  
 Recording started on: 5/24/2023 13:37 GMT+7:0  
 Operator: PSU.OTA  
 Laboratory: ALS-BKK  
 Code: II\_Hg095\_2023

Remarks  
 Food water

## Method parameters

Hg

Method: Enrichment / FBR 30ng/L\_PM\_24052023  
 Created on: 5/24/2023 Time: 13:36  
 Program: ---

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V		
AZ time	5 s	Peak smoothing	12/11
Delay	0 s		
Working mode	Enr. w/o reload		
FBR technique	off	System cleaning	Off
Pump speed	3	Wash time acid	10 s
Sample load time	10 s	Soaking time	20 s
Reaction time	10 s	Gas load time	10 NL/h
Waiting time AZ	10 s	Gas AZ wait	10 NL/h
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	20 s		
Heat time coil 1	20 s	Cool time coil 1	30 s

Mercur

Mercur



## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	off	Reaction	flag + continue
Rep. measurement	1(30.000 ng/L)	QC std. 2 no.	1(30.000 ng/L)
QC std. 1 no.	± 50.00%	QC std. 2 limit	± 50.00%
QC std. 1 limit	flag + continue	Reaction	flag + continue
QC std. act	0.0100 ± 0.0100	Reaction	off
Expect. blank abs.	off	QC Recal. factor	Off
QC precision			

## Calibration settings

Calib. meth.	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

No.	Name	State	Pos.	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	##	0.000	H: 0.003700 A: 0.02531	0.000081 0.000153	2.192 0.607
2	Cal-Std1	(-)	##	30.000	H: 0.01060 A: 0.05669	0.000253 0.002786	2.366 4.136

Hg

## Calibration function 1

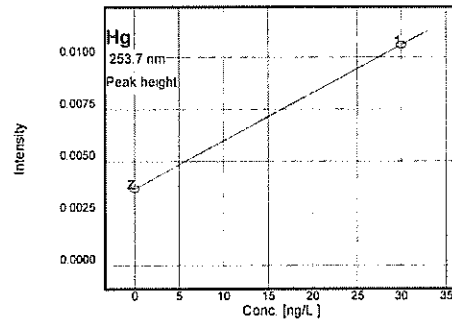
5/24/2023 14:00 Calibration (Peak height)

Ints=k1+k2\*conc

k1=0.003700 k2=0.000230

Recal. factor ---

Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

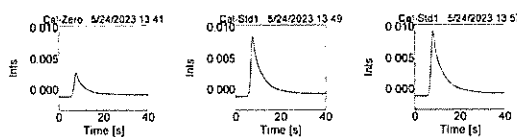
Hg	Enrichment / FER 30ng/L_PM_24052023	5/24/2023	13:37
ID	Conc.	Ints	BG
Cal-Zero		0.003792	
		0.003666	
		0.003640	
	0ng/L	0.003700	0.000081080 2.192
Cal-Std1		0.009498	
		0.008333	
		0.008961	
	30.00ng/L	0.008931	0.0005630 6.528
Cal-Std1		0.01031	
		0.01074	
		0.01076	
	30.00ng/L	0.01060	0.0002530 2.366
Calibration	Calibration function 01		14:00

Mercur

Mercur

## Peak plots

Hg



Mercur

Mercur

## Mercur

Report file	C:\WinAAS\TMP\2023\May\Pro_034
Program version	4.7.10.0
Printed on	5/24/2023 14:33
Recording started on	5/24/2023 14:19 GMT+7.0
Operator	PSU,OTA
Laboratory	ALS-BKK
Code	II_Hg095_2023
Remarks	
Food,water	

## Method parameters

Hg

Method	Without enrichment / Abs / FBR 100ng/L_PM 24052023
Created on	5/24/2023 Time 14:18
Program	---

## Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	225 V		
AZ time	5 s	Peak smoothing	2/5
Delay	8 s		
	---		
Working mode	w/b enrich	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	6 s	Gas load time	5 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Delay	10 s		
Purge time1	50 s		
Purge time2	10 s	Gas wash time2	10 NL/h



## QC parameters

QC type	Conc. check	QC check samp 2	---
QC check samp 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	off	Reaction	flag + continue
Rep. measurement	1(100.00 ng/L)	QC std 2 no	1(100.00 ng/L)
QC std 1 no.	± 50.00%	QC std 2 limit	± 0.00%
QC std 1 limit	flag + continue	Reaction	flag + continue
QC std. act.	0.0100± 0.0100	Reaction	off
Expect. blank abs	off	QC Recal. factor	Off
QC precision			

## Calibration settings

Calib. meth.	Standard calib	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

No.	Name	State	Pos.	Conc. / ng/L	Abs.	SD	RSD/%
1	Cal-Zero	(--)	##	0.00	H 0.000932 A 0.035926	0.000138 0.005209	14.88 17.28
2	Cal-Std1	(--)	##	100.00	H 0.004494 A 0.061266	0.000116 0.001275	2.586 2.062

Hg

## Calibration function 1

5/24/2023 14:33 Calibration (Peak height)

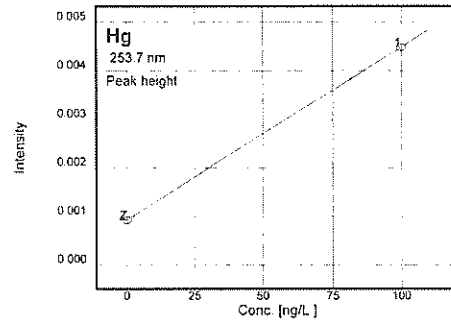
$$Abs = k_1 + k_2 \cdot Conc$$

$$k_1 = 0.000932 \quad k_2 = 0.000036$$

Recal. factor

---

Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110 ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

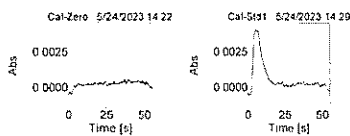
Hg	Without enrichment / Abs / FBR 100ng/L_PM 24052023					5/24/2023	14 19
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0 001039				PkH	14 22
		0 000775					14 23
		0 000981					14 25
	0ng/L	0 000932		0 00013872	14 88		14 25
Cal-Std1		0 004528				PkH	14 29
		0 004384					14 31
		0 004589					14 33
	100.ng/L	0 004494		0 00011623	2 586		14 33
Calibration	Calibration function: 01						14 33

Mercur

Mercur

## Peak plots

Hg



Mercur