

ภาคผนวก ง

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	RVG_F50160			On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50178			On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50175			On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50291			On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RVG_EK0091	1-Mar-23	1-Mar-24	12
Ambient	Particulate Matter (PM10)	High Volume	RVG_F50400			On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RVG_F50397			On site Calibration
Ambient	Particulate Matter (PM10)	High Volume	RVG_F50396			On site Calibration
Ambient	Particulate Matter (PM10)	Digital Balance	RVG_EK0091	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO Analyzer	BKK_F50782	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	BKK_F50797	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	RVG_F50933	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO Analyzer	RVG_F50941	1-Jul-23	1-Jan-24	6
Ambient	Sulfur Dioxide	SO Analyzer	BKK_F50781	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO Analyzer	BKK_F50796	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO Analyzer	RVG_F50257	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO Analyzer	RVG_F50450	2-Jul-23	2-Jan-24	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50530	19-Jan-23	19-Jan-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_F50143	5-Jun-23	5-Jun-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50059	19-Jan-23	19-Jul-24	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_F50443	13-Jul-23	13-Jan-24	6
Stack (CEMS)	Chloride of Nitrogen	Digital Balance	RVG_EK0093	1-Mar-23	1-Mar-24	12
Stack (CEMS)	Sulfur Dioxide	Analyzer - System calibration, Span				
Noise	Leq 24 hrs	Sound Calibrator	RVG_F50213	26-Jan-23	26-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50431	25-Jan-24	25-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50434	25-Jan-24	25-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50932	23-Jan-24	23-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50630	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RVG_F50213	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50097	13-Jun-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50012	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50018	3-Jan-23	3-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50431	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50919	20-Oct-22	20-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50437	7-Sep-23	7-Sep-24	12
Noise	Leq 8 hrs	Sound Calibrator	RVG_F50213	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50432	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50434	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50437	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50491	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50492	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RVG_F50495	12-Jan-23	12-Jan-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50356	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50359	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50360	03-Feb-23	3-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50520	24-Feb-23	24-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50220	3-Feb-23	3-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50223	3-Feb-23	3-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50224	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50581	20-Jul-23	20-Jul-24	12
Illuminance	Lux Meter	Lux Meter	RVG_F50536	2-Sep-22	2-Sep-23	12
Illuminance	Lux Meter	Lux Meter	RVG_F50538	20-Sep-23	20-Sep-24	12



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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RVG_F50296	3-Jul-23	3-Jul-24	12
Rayong Lab	pH at 25 °C	pH Meter	RVG_EK0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RVG_EK0092	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RVG_EK0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RVG_EK0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RVG_EK0010	20-Oct-22	20-Apr-24	18
Rayong Lab	BOD	DO meter with Sensor Incubator	RVG_EK0184	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	DO meter with Sensor Incubator	RVG_EK0154	29-Nov-23	29-Nov-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RVG_EK0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RVG_EK0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RVG_EK0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RVG_EK0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	COD	Spectrophotometer	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Chloride	pHISE Meter	RVG_EK0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Cyanide	SPECTROPHOTOMETER	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Formaldehyde	SPECTROPHOTOMETER	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Phenol	SPECTROPHOTOMETER	RVG_EK0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RVG_EK0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Fluoride	pHISE Meter	RVG_EK0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RVG_EK0188	15-Mar-23	15-Mar-24	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RVG_EK0152	22-Dec-22	22-Dec-23	12
Water Lab	Calcium	KCP OES	BKK_EL0037	2-Mar-23	1-Mar-24	12
Water Lab	Calcium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Magnesium	KCP OES	BKK_EL0037	2-Mar-23	1-Mar-24	12
Water Lab	Magnesium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Magnesium	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Sodium	KCP OES	BKK_EL0037	2-Mar-23	1-Mar-24	12
Water Lab	Sodium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	SAR	KCP OES	BKK_EL0037	2-Mar-23	1-Mar-24	12
Water Lab	SAR	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	SAR	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Chloride	Ion Chromatography	BKK_EK0150	11-Jan-23	11-Jan-24	12
Water Lab	Organochlorine Pesticide	GC-MS/MS	BKK_EK0264	23-May-23	23-Nov-24	18
Water Lab	Anionic Surfactant	Spectrophotometer	BKK_EK0018	15-Sep-23	15-Sep-24	12
Water Lab	Anionic Surfactant	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Precipitant Chromium	Spectrophotometer	BKK_EK0018	15-Sep-23	15-Sep-24	12
Water Lab	Silver	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Silver	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Silver	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Barium	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Barium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Lead	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Iron	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Iron	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Iron	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cold Room)	BKK_EK0167	30-Jun-22	30-Dec-23	18
Water Lab	Copper	CP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Copper	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cold Room)	BKK_EK0167	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-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Arsenic	ICP-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Arsenic	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Selenium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Cadmium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Zinc	ICP-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Trivalent Chromium	ICP-AES	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	DUOCVAFS / CVAAS	BKK_EL0023	24-May-23	24-May-24	12



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756

Calibrate Location : โรงเรียนปทุมคงคา Temperature (°C) : 30

Calibrate Date : 23-Nov-23 High Volume ID : RYG-FS0180

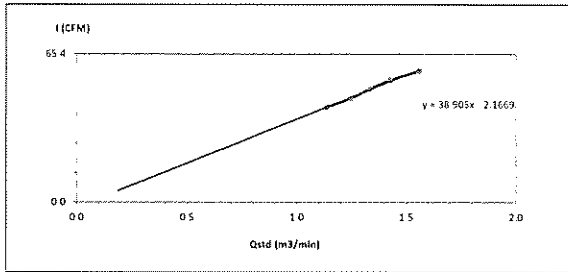
Calibration Sheet No. : C-231123-RYG-FS0180 High Volume Model : TE-5170D

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 ₂ O (inch)	Q _{std} (m ³ /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 [Signature]
(Mr. Anurak Tonghajsakda)
Field Scientist(1)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756

Calibrate Location : โรงเรียนปทุมคงคา Temperature (°C) : 30

Calibrate Date : 23-Nov-23 High Volume ID : RYG-FS0178

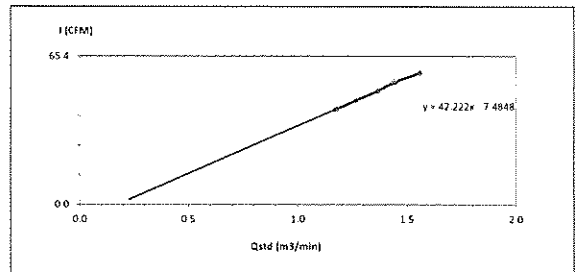
Calibration Sheet No. : C-231123-RYG-FS0178 High Volume Model : TE-5170D

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 ₂ O (inch)	Q _{std} (m ³ /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 [Signature]
(Mr. Anurak Tonghajsakda)
Field Scientist(1)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756

Calibrate Location : โรงเรียนปทุมคงคา Temperature (°C) : 30

Calibrate Date : 23-Nov-23 High Volume ID : RYG-FS0175

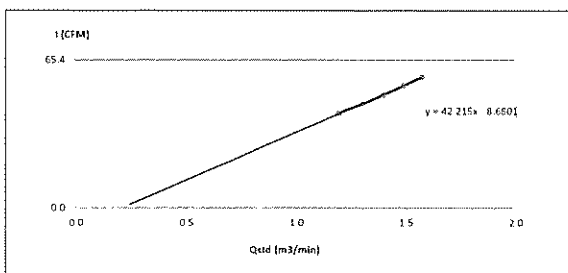
Calibration Sheet No. : C-231123-RYG-FS0175 High Volume Model : TE-5170D

Calibrator ID : RYG-FS0205 High Volume S/N : 4001

Calibrator Model : TE-5028A Calibrator Slope : 1.50765

Calibrator S/N : 1166 Calibrator Intercept : -0.02043

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	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 [Signature]
(Mr. Anurak Tonghajsakda)
Field Scientist(1)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756

Calibrate Location : โรงเรียนปทุมคงคา Temperature (°C) : 30

Calibrate Date : 23-Nov-23 High Volume ID : RYG-FS0291

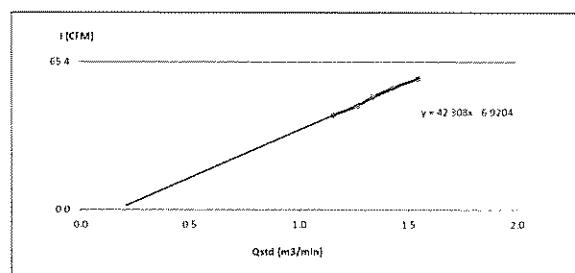
Calibration Sheet No. : C-231123-RYG-FS0291 High Volume Model : TE-5170D

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 ₂ O (inch)	Q _{std} (m ³ /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		

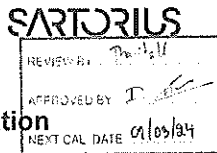


Calibrated by [Signature]
(Mr. Anurak Tonghajsakda)
Field Scientist(1)

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

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

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 6351-6 Fax: +66 2543 6357 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 25409654 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 ☐ Recalibration / 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	C02212585	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Stamp and Signature of Mr. Chonchai Inthana (Technical Manager)

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 6351-6 Fax: +66 2543 6357 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 25409654 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 load conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.		The off-center loading error is yielded by the difference between the reading of the load (e.g. 1/10 of max capacity) placed on 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	Nominal value	50 g
Tolerance	0.0001 g	Tolerance	0.0004 g
Nominal Value (High Load)	100 g		
Tolerance	0.0001 g		
Standard Deviation		Difference	

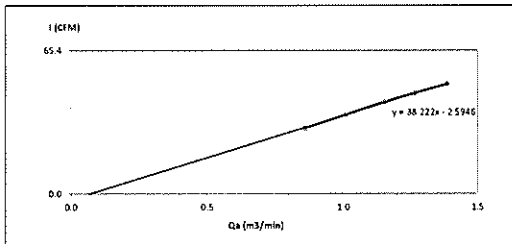
Linearity	
The linearity also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.	
Tolerance	0.0002 g
Nominal Value	Conventional Mass Value
(g)	(g)
0.01	0.0100
0.05	0.0500
0.1	0.1000
0.5	0.5000
1	1.0000
2	2.0000
5	5.0000
10	10.0000
20	20.0000
100	100.0000
End of Report	

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site	Gulf T&E Co., Ltd.	Barometric Pressure (mm Hg)	756
Calibrate Location	โรงเรียนวัดบ้านดง	Temperature (°C)	30
Calibrate Date	25 Nov 23	High Volume ID	RYG_F50400
Calibration Sheet No.	C-231123-RYG_F50400	High Volume Model	TE-5009X
Calibrator ID	RYG_F50205	High Volume S/N	5691
Calibrator Model	TE-5020A	Calibrator Slope	0.94434
Calibrator S/N	1166	Calibrator Intercept	0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /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: 0.9990
4	3.5	1.267	46	
5	4.2	1.387	50	



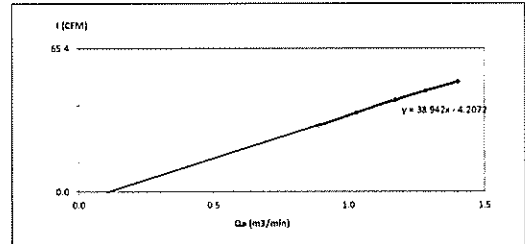
Calibrated by (Mr. Anurak Tongkhajonsakda) Field Scientist(1)

Approved by (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (1)

High Volume Air Sampler Calibration Worksheet

Project Site	Gulf T&E Co., Ltd.	Barometric Pressure (mm Hg)	756
Calibrate Location	โรงเรียนวัดบ้านดง	Temperature (°C)	30
Calibrate Date	25 Nov 23	High Volume ID	RYG_F50497
Calibration Sheet No.	C-231123-RYG_F50397	High Volume Model	TE-5009X
Calibrator ID	RYG_F50205	High Volume S/N	5687
Calibrator Model	TE-5020A	Calibrator Slope	0.94434
Calibrator S/N	1166	Calibrator Intercept	0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I Chart (CFM)	Linear Regression
1	1.7	0.887	30	Slope: 38.9422
2	2.3	1.040	36	Intercept: -4.2072
3	3.0	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)

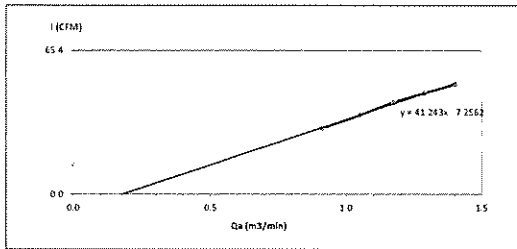
Approved by (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (1)



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงงานทอผ้า/ทอผ้า (ทอผ้า) Temperature (°C) : 30
 Calibrate Date : 24 Nov 23 High Volume ID : RYG-FS0189
 Calibration Sheet No. : C-231123-RYG-FS0398 High Volume Model : TE-5009X
 Calibrator ID : RYG-FS0205 High Volume S/N : 5084
 Calibrator Model : TE-5028A Calibrator Slope : 0.94434
 Calibrator S/N : 1166 Calibrator Intercept : -0.01292

Test No	Delta H ₂ O (inch)	Qa (m ³ /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	48	
5	4.3	1.401	50	



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

Approved by [Signature]
 (Mr. Noppong Juntarapan)
 Enviro Field Coordinator Scientist (3)

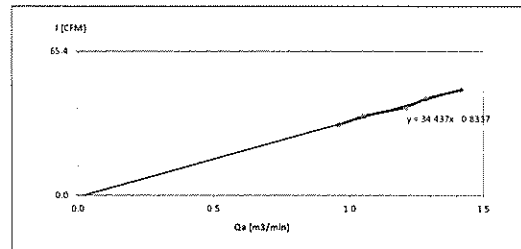
FORM NO. F-06-074 REVISION NO. ISSUE DATE 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 756
 Calibrate Location : โรงงานทอผ้า/ทอผ้า (ทอผ้า) Temperature (°C) : 30
 Calibrate Date : 24 Nov 23 High Volume ID : RYG-FS0189
 Calibration Sheet No. : C-231123-RYG-FS0189 High Volume Model : TE-5009X
 Calibrator ID : RYG-FS0205 High Volume S/N : 4792
 Calibrator Model : TE-5028A Calibrator Slope : 0.94434
 Calibrator S/N : 1166 Calibrator Intercept : -0.01292

Test No	Delta H ₂ O (inch)	Qa (m ³ /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 Tengkhajonsakda)
 Field Scientist (1)

Approved by [Signature]
 (Mr. Noppong Juntarapan)
 Enviro Field Coordinator Scientist (3)

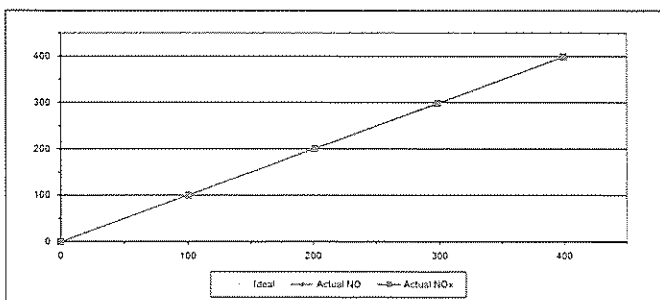
FORM NO. F-06-074 REVISION NO. ISSUE DATE 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date : 1-Jul-23 Equipment Name : NOx Analyzer
 Manufacturer : HORIBA Model : APNA-370
 Serial No. : WPY0UMVD Equipment ID : BKK_FS0782
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 947
 Std. Gas Concentration (PPM) : 55.88 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expired Date : 9-Feb-30

Point	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. Jirawat Sakam)
 Field Environmental Scientist (3)

Approved By [Signature]
 (Mr. Saranyuth Jitnont)
 Assistant General Manager

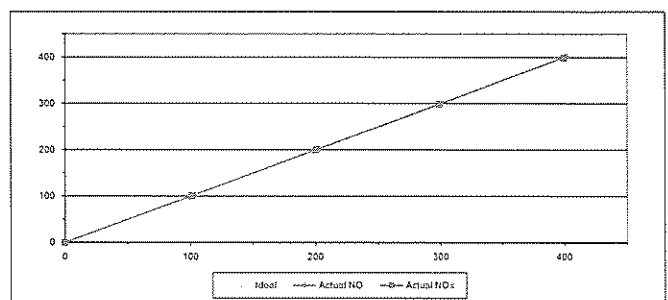
ALS Laboratory Group
 FORM NO. F-06-058 REVISION NO. ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date : 1-Jul-23 Equipment Name : NOx Analyzer
 Manufacturer : HORIBA Model : APNA-370
 Serial No. : H73KYD1M Equipment ID : BKK_FS0787
 Calibrator Manufacturer : Teledyne API Model : 700
 Serial No. : 947
 Std. Gas Concentration (PPM) : 55.88 Cylinder No. : GN0027222
 Cylinder Pressure (psi) : 1800 Certified By : Airgas Inc.
 Certified Date : 9-Feb-22 Expired Date : 9-Feb-30

Point	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. Jirawat Sakam)
 Field Environmental Scientist (3)

Approved By [Signature]
 (Mr. Saranyuth Jitnont)
 Assistant General Manager

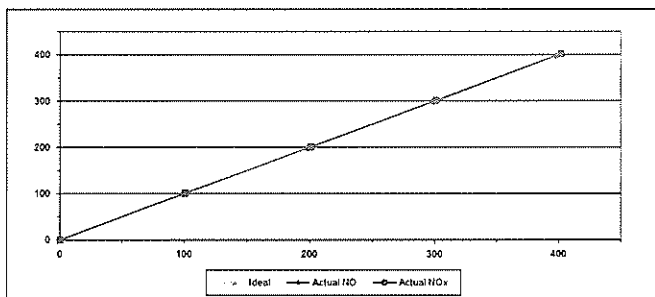
ALS Laboratory Group
 FORM NO. F-06-058 REVISION NO. ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	7238	Equipment ID	RYG_FS0533
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae 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	99.50	-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. Sarayuth Jitranont)
Assistant General Manager

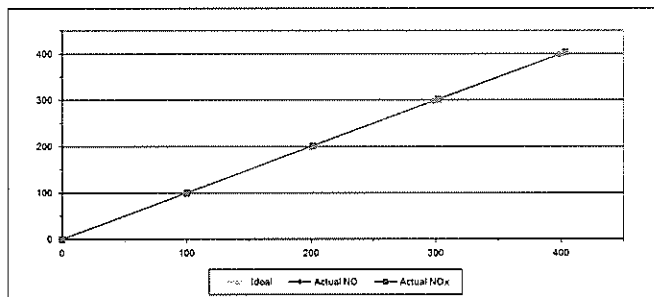
ALS Laboratory Group
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T95HWM41	Equipment ID	RYG_FS0481
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

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



Calibrated By

Approved By

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

(Mr. Sarayuth Jitranont)
Assistant General Manager

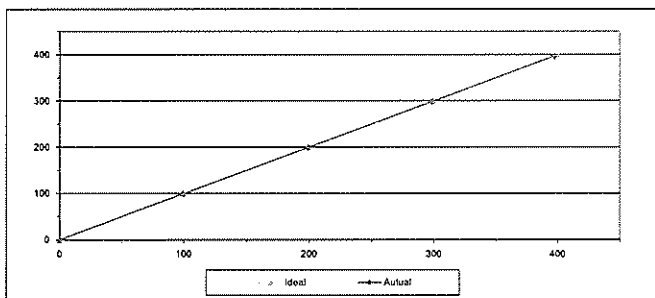
ALS Laboratory Group
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	YS3NSFB	Equipment ID	BKK_FS0781
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.70	-0.30	-0.30
2	200.00	199.20	-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. Sarayuth Jitranont)
Assistant General Manager

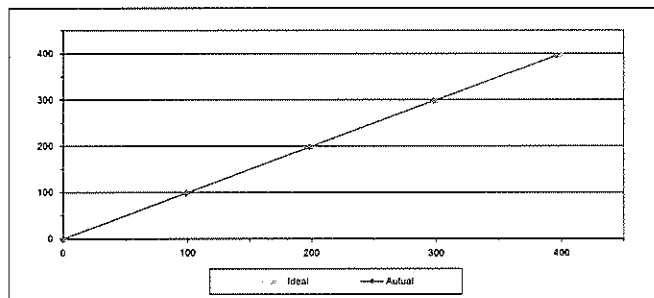
ALS Laboratory Group
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	G2CH438B	Equipment ID	BKK_FS0786
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
1	100.00	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. Sarayuth Jitranont)
Assistant General Manager

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

CERTIFICATE OF CALIBRATION

Calibration No. HN-00012023
Page 1 of 1 Pages

Measurement Item Relative humidity with data logger
Manufacturer Novatyna
Model/Type H10 WS 26R D
Serial Number A5660
ID No RYG-FS0530
Customer A&S Laboratory Group (Thailand) Co., Ltd.
104 Phatthanasak 40 Phatthanasak Rd. Khwaeng Suan Luang, Rhet Suan Luang, Bangkok
10260 Thailand

Environmental Condition
The measurement was carried out in an ambient temperature of (20±3)°C, and relative humidity of (50±10)%.

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

Traceability
This equipment 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 20141101 Exp date: Mar 14, 2023

Measurement Date Jan 10, 2023
Issued Date Jan 20, 2023

Measurement Results
This equipment was connected with indoor air quality probe and Displayed (UI3) on display Model: HM16D Serial num ber: 04620631
Calibration was performed in the range of 20RH to 80RH
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	0.68
50	50.28	48.6	1.7	0.57
80	80.29	79.6	0.6	0.58

Performed by
☐ Mr. Gornwit Thachalad
☒ Ms. Jiraporn Tertsomphol

Approved Signatory
M. Panyia 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

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Page: 1 Page

MEASUREMENT RESULTS

The calibration results are reported in table below

W_h (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	W_{th} (m/s)	Error (m/s)	$U(h=2)$ (m/s)
0.00	24.30	24.30	7.3	7.3	6.18
1.11	24.30	24.30	8.4	7.3	7.18
1.65	24.30	24.30	9.5	7.2	8.25
2.18	24.30	24.30	10.6	7.2	9.39
2.72	24.30	24.30	11.7	7.1	10.56
3.25	24.30	24.30	12.8	7.1	11.75
3.79	24.30	24.30	13.9	7.0	12.95
4.32	24.30	24.30	15.0	6.9	14.17
4.86	24.30	24.30	16.1	6.8	15.40
5.39	24.30	24.30	17.2	6.7	16.64
5.93	24.30	24.30	18.3	6.6	17.89
6.46	24.30	24.30	19.4	6.5	19.15
7.00	24.30	24.30	20.5	6.4	20.42
7.53	24.30	24.30	21.6	6.3	21.70
8.07	24.30	24.30	22.7	6.2	22.99
8.60	24.30	24.30	23.8	6.1	24.29
9.14	24.30	24.30	24.9	6.0	25.60
9.67	24.30	24.30	26.0	5.9	26.92
10.21	24.30	24.30	27.1	5.8	28.25
10.74	24.30	24.30	28.2	5.7	29.59
11.28	24.30	24.30	29.3	5.6	30.94
11.81	24.30	24.30	30.4	5.5	32.30
12.35	24.30	24.30	31.5	5.4	33.67
12.88	24.30	24.30	32.6	5.3	35.05
13.42	24.30	24.30	33.7	5.2	36.44
13.95	24.30	24.30	34.8	5.1	37.84
14.49	24.30	24.30	35.9	5.0	39.25
15.02	24.30	24.30	37.0	4.9	40.67
15.56	24.30	24.30	38.1	4.8	42.10
16.09	24.30	24.30	39.2	4.7	43.54
16.63	24.30	24.30	40.3	4.6	44.99
17.16	24.30	24.30	41.4	4.5	46.45
17.70	24.30	24.30	42.5	4.4	47.92
18.23	24.30	24.30	43.6	4.3	49.40
18.77	24.30	24.30	44.7	4.2	50.89
19.30	24.30	24.30	45.8	4.1	52.39
19.84	24.30	24.30	46.9	4.0	53.90
20.37	24.30	24.30	48.0	3.9	55.42
20.91	24.30	24.30	49.1	3.8	56.95
21.44	24.30	24.30	50.2	3.7	58.49
21.98	24.30	24.30	51.3	3.6	60.04
22.51	24.30	24.30	52.4	3.5	61.60
23.05	24.30	24.30	53.5	3.4	63.17
23.58	24.30	24.30	54.6	3.3	64.75
24.12	24.30	24.30	55.7	3.2	66.34
24.65	24.30	24.30	56.8	3.1	67.94
25.19	24.30	24.30	57.9	3.0	69.55
25.72	24.30	24.30	59.0	2.9	71.17
26.26	24.30	24.30	60.1	2.8	72.80
26.79	24.30	24.30	61.2	2.7	74.44
27.33	24.30	24.30	62.3	2.6	76.09
27.86	24.30	24.30	63.4	2.5	77.75
28.40	24.30	24.30	64.5	2.4	79.42
28.93	24.30	24.30	65.6	2.3	81.10
29.47	24.30	24.30	66.7	2.2	82.79
30.00	24.30	24.30	67.8	2.1	84.49
30.54	24.30	24.30	68.9	2.0	86.20
31.07	24.30	24.30	70.0	1.9	87.92
31.61	24.30	24.30	71.1	1.8	89.65
32.14	24.30	24.30	72.2	1.7	91.39
32.68	24.30	24.30	73.3	1.6	93.14
33.21	24.30	24.30	74.4	1.5	94.90
33.75	24.30	24.30	75.5	1.4	96.67
34.28	24.30	24.30	76.6	1.3	98.45
34.82	24.30	24.30	77.7	1.2	100.24
35.35	24.30	24.30	78.8	1.1	102.04
35.89	24.30	24.30	79.9	1.0	103.85
36.42	24.30	24.30	81.0	0.9	105.67
36.96	24.30	24.30	82.1	0.8	107.50
37.49	24.30	24.30	83.2	0.7	109.34
38.03	24.30	24.30	84.3	0.6	111.19
38.56	24.30	24.30	85.4	0.5	113.05
39.10	24.30	24.30	86.5	0.4	114.92
39.63	24.30	24.30	87.6	0.3	116.80
40.17	24.30	24.30	88.7	0.2	118.69
40.70	24.30	24.30	89.8	0.1	120.59
41.24	24.30	24.30	90.9	0.0	122.50
41.77	24.30	24.30	92.0	-0.1	124.42
42.31	24.30	24.30	93.1	-0.2	126.35
42.84	24.30	24.30	94.2	-0.3	128.29
43.38	24.30	24.30	95.3	-0.4	130.24
43.91	24.30	24.30	96.4	-0.5	132.20
44.45	24.30	24.30	97.5	-0.6	134.17
44.98	24.30	24.30	98.6	-0.7	136.15
45.52	24.30	24.30	99.7	-0.8	138.14
46.05	24.30	24.30	100.8	-0.9	140.14
46.59	24.30	24.30	101.9	-1.0	142.15
47.12	24.30	24.30	103.0	-1.1	144.17
47.66	24.30	24.30	104.1	-1.2	146.20
48.19	24.30	24.30	105.2	-1.3	148.24
48.73	24.30	24.30	106.3	-1.4	150.29
49.26	24.30	24.30	107.4	-1.5	152.35
49.80	24.30	24.30	108.5	-1.6	154.42
50.33	24.30	24.30	109.6	-1.7	156.50
50.87	24.30	24.30	110.7	-1.8	158.59
51.40	24.30	24.30	111.8	-1.9	160.69
51.94	24.30	24.30	112.9	-2.0	162.80
52.47	24.30	24.30	114.0	-2.1	164.92
53.01	24.30	24.30	115.1	-2.2	167.05
53.54	24.30	24.30	116.2	-2.3	169.19
54.08	24.30	24.30	117.3	-2.4	171.34
54.61	24.30	24.30	118.4	-2.5	173.50
55.15	24.30	24.30	119.5	-2.6	175.67
55.68	24.30	24.30	120.6	-2.7	177.85
56.22	24.30	24.30	121.7	-2.8	180.04
56.75	24.30	24.30	122.8	-2.9	182.24
57.29	24.30	24.30	123.9	-3.0	184.45
57.82	24.30	24.30	125.0	-3.1	186.67
58.36	24.30	24.30	126.1	-3.2	188.90
58.89	24.30	24.30	127.2	-3.3	191.14
59.43	24.30	24.30	128.3	-3.4	193.39
59.96	24.30	24.30	129.4	-3.5	195.65
60.50	24.30	24.30	130.5	-3.6	197.92
61.03	24.30	24.30	131.6	-3.7	200.20
61.57	24.30	24.30	132.7	-3.8	202.49
62.10	24.30	24.30	133.8	-3.9	204.79
62.64	24.30	24.30	134.9	-4.0	207.10
63.17	24.30	24.30	136.0	-4.1	209.42
63.71	24.30	24.30	137.1	-4.2	211.75
64.24	24.30	24.30	138.2	-4.3	214.09
64.78	24.30	24.30	139.3	-4.4	216.44
65.31	24.30	24.30	140.4	-4.5	218.80
65.85	24.30	24.30	141.5	-4.6	221.17
66.38	24.30	24.30	142.6	-4.7	223.54
66.92	24.30	24.30	143.7	-4.8	225.94
67.45	24.30	24.30	144.8	-4.9	228.34
67.99	24.30	24.30	145.9	-5.0	230.75
68.52	24.30	24.30	147.0	-5.1	233.17
69.06	24.30	24.30	148.1	-5.2	235.60
69.59	24.30	24.30	149.2	-5.3	238.04
70.13	24.30	24.30	150.3	-5.4	240.49
70.66	24.30	24.30	151.4	-5.5	242.95
71.20	24.30	24.30	152.5	-5.6	245.42
71.73	24.30	24.30	153.6	-5.7	247.90
72.27	24.30	24.30	154.7	-5.8	250.39
72.80	24.30	24.30	155.8	-5.9	252.89
73.34	24.30	24.30	156.9	-6.0	255.40
73.87	24.30	24.30	158.0	-6.1	257.92
74.41	24.30	24.30	159.1	-6.2	260.45
74.94	24.30	24.30	160.2	-6.3	262.99
75.48	24.30	24.30	161.3	-6.4	265.54
76.01	24.30	24.30	162.4	-6.5	268.10
76.55	24.30	24.30	163.5	-6.6	270.67
77.08	24.30	24.30	164.6	-6.7	273.25
77.62	24.30	24.30	165.7	-6.8	275.84
78.15	24.30	24.30	166.8	-6.9	278.44
78.69	24.30	24.30	167.9	-7.0	281.05
79.22	24.30	24.30	169.0	-7.1	283.67
79.76	24.30	24.30	170.1	-7.2	286.30
80.29	24.30	24.30	171.2	-7.3	288.94
80.83	24.30	24.30	172.3	-7.4	291.59
81.36	24.30	24.30	173.4	-7.5	294.25
81.90	24.30	24.30	174.5	-7.6	296.92
82.43	24.30	24.30	175.6	-7.7	299.60
82.97	24.30	24.30	176.7	-7.8	302.29
83.50	24.30	24.30	177.8	-7.9	304.99
84.04	24.30	24.30	178.9	-8.0	307.70
84.57	24.30	24.30	180.0	-8.1	310.42
85.11	24.30	24.30	181.1	-8.2	313.15
85.64	24.30	24.30	182.2	-8.3	315.89
86.18	24.30	24.30	183.3	-8.4	318.64
86.71	24.30	24.30	184.4	-8.5	321.40
87.25	24.30	24.30	185.5	-8.6	324.17
87.78	24.30	24.30	186.6	-8.7	326.95
88.32	24.30	24.30	187.7	-8.8	329.74
88.85	24.30	24.30	188.8	-8.9	332.54
89.39	24.30	24.30	189.9	-9.0	335.35
89.92	24.30	24.30	191.0	-9	

MEASUREMENT RESULTS¹

The cup anemometer was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 45° in both 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 ₅₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
0.000	0	0	0	0.58
45.000	45	41	4	0.74
46.000	87	83	4	0.74
135.000	135	131	4	0.74
150.000	182	178	4	0.74
275.000	225	221	4	0.68
275.000	272	268	4	0.74
315.000	315	311	4	0.74

Remark:

Calibration results only cover for the listed circumstances and environmental conditions during which calibration took place.
Velocity of standard
Velocity of Wind under Calibration

End of Certificate of Calibration

MEASUREMENT RESULTS¹

The cup anemometer was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 45° in both 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.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.584	24.10	24.00	0.7	0.1	0.36
2.229	24.08	24.00	1.8	0.1	0.16
3.644	24.06	24.00	2.1	0.2	0.16
4.236	24.20	24.00	3.8	0.3	0.20
5.00	24.30	24.00	4.1	0.2	0.21
5.49	24.24	24.00	5.4	0.5	0.17
7.05	23.90	24.00	6.9	0.0	0.16
8.10	24.24	24.00	8.0	0.2	0.19
9.09	24.18	24.00	8.9	0.2	0.20
10.09	24.18	24.00	9.6	0.2	0.19
11.26	23.74	24.00	11.0	0.2	0.21
12.13	23.67	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	0.1	0.28
15.24	23.66	24.00	14.9	0.3	0.23
16.30	23.70	24.00	16.0	0.3	0.23

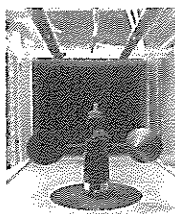
Remark:

Calibration results only cover for the listed circumstances and environmental conditions during which calibration took place.

Velocity of standard

Velocity of Wind under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the cup anemometer. Calibration in the wind tunnel of Jnanatee 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 limiting geometry.

End of Certificate of Calibration

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Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 101-115 J 17025
CALIBRATION C/167

Air speed measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Cup anemometer

Novayna

Sensor WS-031

Data logger: 700 WS-7518

Sensor

Data logger: AS335

RYG, FS0413

Used item

ALS Laboratory group (Thailand) Co., Ltd

104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10350 Thailand

Calibration procedure:

The cup anemometer was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 45° in both 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.

Traceability:

This certificate provides the traceability of the measurement to recognized national standards and to the reduction of the international system of units (SI) through the NIMT that was Metrology Institute of Thailand with certificate number: MIV 0092-21 and MIV 0066-27.

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. Refer to the expression of uncertainty in measurement.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 900 cm²Wind direction frontal area²: 100 cm²Diameter of mounting pipe³: 10 mmBlockage ratio of test object⁴: 0.111 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions

The average values during measurement are (24.01 °C, (41.7) %RH and (1010.5) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

1. Mr. Sorawat Thachabud

2. Miss Intaraporn Leelaporn



Approved signatory

Mr. Panyap Booncharoen

Calibration Department Manager

Remarks:

1. Wind tunnel cross section area of the wind tunnel

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

3. Diameter of mounting pipe

4. Ratio to 1

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

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 101-115 J 17025
CALIBRATION C/167

Air speed measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor

Novayna

Sensor WS-031

Data logger: 700 WS-7518

Sensor

Data logger: AS335

RYG, FS0413

Used item

ALS Laboratory group (Thailand) Co., Ltd

104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10350 Thailand

Calibration procedure:

The wind direction sensor was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 45° in both 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.

Traceability:

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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. Refer to the expression of uncertainty in measurement.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 900 cm²Wind direction frontal area²: 125 cm²Diameter of mounting pipe³: 10 mmBlockage ratio of test object⁴: 0.14

Certificate Number
CL 011 65

Page 2 of 2 Pages

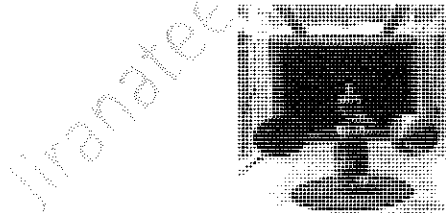
MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel nozzle. UUC was installed in 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_{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	$U(\pm 2)$ (m/s)
0.983	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	0.19
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
8.16	23.50	23.45	8.0	0.2	0.19
9.10	23.26	23.45	9.0	0.1	0.20
10.02	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	0.1	0.21
12.14	23.42	23.45	12.0	0.1	0.25
13.20	23.22	23.45	13.1	-0.1	0.26
14.35	23.34	23.45	14.1	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

Remark:
Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.
Velocity of standard
Velocity of unit under calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jivanatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. 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 (mmHg) 751
Relative Humidity (%) 60.9
Temperature (°C) 29.0
Reference Dry Gas Meter Data
Reference Dry Gas Meter ID BKK-FS1122
Serial No. A2003240
Correction Factor (Y) 1.0160
Next Calibration Date 25-Nov-23
Calibration Date 13-Jul-23
Next Cal. Date 13-Jan-24
Console Control Meter Data
Calibration No. C-130723-BKK_FS0468
Dry Gas Meter ID BKK-FS0468
Serial No. 1302005
Model No. XC-572-V

ΔH (mm H ₂ O)	Θ (mm H ₂ O)	Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter				Dry Gas Meter Correction Factor (Y)	Office Calibration Factor (Y)	Altitude
		Final	Initial	Total	T ₁ (°C)	Final	Initial	Total	T ₁ (°C)			
15	12.05	150.00	0.00	150.00	26.0	241330.0	211175.0	150.00	25.0	26.0	0.9816	48.8673
25	9.98	150.00	0.00	150.00	26.0	241438.0	211343.0	150.00	25.0	26.0	0.9803	49.9909
50	6.82	150.00	0.00	150.00	26.0	241659.0	211594.0	150.00	25.0	26.0	0.9784	47.3666
100	4.62	150.00	0.00	150.00	26.0	241823.0	211669.0	150.00	25.0	26.0	0.9693	47.3171
150	4.02	150.00	0.00	150.00	26.0	241938.0	211844.0	150.00	25.0	27.0	0.9765	49.2959
										Avg	0.9792	48.5300

Y Ratio of reading of reference to dry gas meter. Tolerance for individual values ± 0.07 from average.

Avg Office pressure differential test equates to 21.74 mm of air @ 75°C and 160 mm of mercury. mmH₂O tolerance for individual values ± 5.00 from average.

Procedure: ISO 9100 APP AMETH SEC 5.3.8.7

Calibrated by Saket Phaisanphut (Mr Saket Phaisanphut)
Field Scientist (1)

Approved by

Nattapon Jangwareewong (Mr Nattapon Jangwareewong)
Field Specialist (1)

FORM NO. F-04-029 REVISED NO. 1 DATE 04/11/2014

Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0472
Lab test duct Number 258-1-13-01
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 (ΔP mm H ₂ O)	Type S pitot tube (ΔP mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
		\bar{C}_p		0.842	0.842

$$C_p(S) = C_p = \sqrt{\frac{\Delta P_{(std)}}{\Delta P_{(s)}}}$$

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

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

Calibrated by Saket Phaisanphut
(Mr Saket Phaisanphut)
Field Scientist (4)

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

FORM NO. F-04-029 REVISED NO. 1 DATE 04/11/2014

Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0473
Lab test duct Number 258-1-13-01
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 (ΔP mm H ₂ O)	Type S pitot tube (ΔP mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
		\bar{C}_p		0.842	0.842

$$C_p(S) = C_p = \sqrt{\frac{\Delta P_{(std)}}{\Delta P_{(s)}}}$$

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

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

Calibrated by Saket Phaisanphut
(Mr Saket Phaisanphut)
Field Scientist (4)

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

FORM NO. F-04-029 REVISED NO. 1 DATE 04/11/2014



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date	13 Jul 23	Ambient Temperature (°C)	29		
Calibration sheet No	C-130723-BKK_FS0459	Relative Humidity (%)	60		
Digital Temperature ID	BKK_FS0459	Reference Temperature ID	BKK_FS1144		
Serial No	1302005	Serial No	201090006013		
Model	XC-572-V	Model	Digicon-CC-VT-MS		
		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
	500	501	1	±3	Pass
	100	101	1	±3	Pass
Probe	120	120	0	±3	Pass
	140	140	0	±3	Pass
	160	101	-	±3	-
Oven	120	121	1	±3	Pass
	140	141	1	±3	Pass
	160	141	1	±3	Pass
Filter	100	102	2	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	19	-1	±3	Pass
Meter	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
	50	48	-2	±3	Pass
AUX	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by: Sakrit Phasongphut (Mr. Sakrit Phasongphut) Field Scientist (4)
Approved by: Natthapol Jongsawadwong (Mr. Natthapol Jongsawadwong) Specialist (1)

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE: 16/2/23

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	13 Jul 23	Nozzle Set ID	BKK_FS0474
Calibration Sheet No	C-130723-BKK_FS0474	Vernier Caliper ID	BKK_FC1123

Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo ΔD	(D ₁ + D ₂ + D ₃) / 3
	D ₁	D ₂	D ₃		
1	0.300	0.299	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	1.090	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

D1, D2, D3

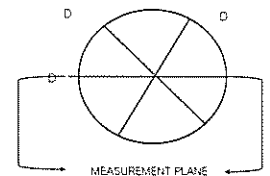
Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm

ΔD

Maximum distance between any two diameters must be < 0.100 mm

D3

(D1 - D2) ÷ 3



Calibrated by: Sakrit Phasongphut (Mr. Sakrit Phasongphut) Field Scientist (4)
Approved by: Natthapol Jongsawadwong (Mr. Natthapol Jongsawadwong) Field Specialist (1)

FORM NO. F-05-027 REVISION NO. 2 ISSUE DATE: 16/2/23

RYG_EN0003

Sartorius (Thailand) Co., Ltd.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2043 8351-6 e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

Model Number: MSE224S 100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No: RYG_EN0003
Manufacturer: Sartorius
Certificate No: 23BCI0115
Issued Date: Friday, March 03, 2023
Reference No: 204833
Page No: 1 of 2

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

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

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

Metrological data
Capacity: 220 g Readability: 0.0001 g
Ambient Conditions
Temperature: 23.0 °C ± 5.0 °C
Humidity: 55.0 % RH ± 10.0 % RH
Pressure: ± 0.1 kPa
Reasons for calibration
☒ New Installation ☐ Service / Required ☐ Recalibration / Maintenance ☐ Equipment Condition ☐ Good Operation ☐ 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 Metrology Specifications

Traceability:

Model Number	Description	Traceability	Certificate No	Due Date
YC5011-522-00	Sensor weight set 1mg 5000g E2 YC5011-522-00	SPC-RT	C02212555	14-Sep-2023
MHB-382SD	Humidity/Barenster/Temp. Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Mr. Chonchai Intithana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
125 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2043 8351-6 Fax: +66 2043 8357 e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No: RYG_EN0003
Manufacturer: Sartorius
Certificate No: 23BCI0115
Issued Date: Friday, March 03, 2023
Reference No: 204833
Page No: 2 of 2

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The reproducibility of the ability of a weighing instrument to display nearly identical results under constant test conditions when the same operation is repeated in a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability as a relative value.	The off-center loading error is yielded by the difference between the result of the load ÷ 10 or 1/10 of maximum capacity, placed in the middle of the weighing pan and between each of four additional pressure-center points positions defined according to GUM, 1995.
Nominal Value (Low Load) 20 g Tolerance 0.0001 g	Nominal value 100 g Tolerance 0.0004 g
Nominal Value (High Load) 200 g Tolerance 0.0001 g	Difference 1 2 3 4 5 6
Standard Deviation	

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)
0.001	0.0000	0.0000	0.0000	0.0001
0.005	0.0000	0.0000	0.0000	0.0001
0.01	0.0000	0.0000	0.0000	0.0001
0.05	0.0000	0.0000	0.0000	0.0001
0.1	0.0000	0.0000	0.0000	0.0001
0.5	0.0000	0.0000	0.0000	0.0001
1	0.0000	0.0000	0.0000	0.0001
5	0.0000	0.0000	0.0000	0.0001
10	0.0000	0.0000	0.0000	0.0001
50	0.0000	0.0000	0.0000	0.0001
100	0.0000	0.0000	0.0000	0.0001
500	0.0000	0.0000	0.0000	0.0001
1000	0.0000	0.0000	0.0000	0.0001

End of Report

SOP FM 33 03 February 2022



Lot No 23125319-1

ANALYZER CALIBRATION DATA

Client : Gulf T&B Co., Ltd. Location : Uster HRSG 11
Date : 28 Nov 23 Test Operator : Sakai P.

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.01	0.04
Low-Level Gas	7.93	7.95	7.94	0.04
Span Gas	16.00	16.02	16.01	0.04

NO_x 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

SO₂ 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	159.90	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	79.48	79.46	79.48	0.00
Span Gas	407.40	407.38	407.40	0.00

Calibrated by

Sakai P

(Mr. Sakai Phaisanghaed)

Environmental Field Scientist (4)

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

ALS Laboratory Group

Page 1 of 5



Lot No 23125319-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf T&B Co., Ltd. Location : Uster HRSG 11
Date : 28 Nov 23 Test Operator : Sakai P.

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

	O ₂ Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.02	0.02	0.00	0.01	0.04	0.04
Upscale Gas	16.02	16.02	0.00	16.01	0.04	0.04

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

	NO _x Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.04	0.04	0.00	0.01	0.02	0.02
Upscale Gas	164.44	164.44	0.00	164.41	0.02	0.02

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

	SO ₂ Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	159.88	159.88	0.00	159.89	0.00	0.00

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

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

Calibrated by

Sakai P

(Mr. Sakai Phaisanghaed)

Environmental Field Scientist (4)

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

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Page 2 of 5



EMISSION TEST RESULT

Client : Gulf T&B Co., Ltd. Run # : 1
Date : 28 Nov 23 Location : Uster HRSG 11
Start Time : 12:40 Test Operator : Sakai P.
Finish Time : 13:00
SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 437
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 774
CO/CO₂ Analyzer Model : TELEDYNE API 300EH Serial No. : 481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12.40	14.30	3.75	16.46	0.18	1.57	
12.41	14.29	3.74	17.49	0.18	1.47	
12.42	14.28	3.75	18.67	0.18	1.47	
12.43	14.29	3.75	18.73	0.19	1.67	
12.44	14.29	3.75	18.54	0.18	1.67	
12.45	14.31	3.73	18.82	0.17	1.66	
12.46	14.31	3.73	18.60	0.18	1.71	
12.47	14.34	3.72	18.97	0.16	1.54	
12.48	14.34	3.71	19.08	0.18	1.45	
12.49	14.40	3.67	19.54	0.18	1.32	
12.50	14.47	3.62	20.71	0.16	1.35	
12.51	14.59	3.66	21.76	0.16	1.45	
12.52	14.35	3.70	21.42	0.15	1.49	
12.53	14.33	3.72	19.93	0.16	1.42	
12.54	14.27	3.78	19.19	0.14	1.35	
12.55	14.22	3.77	18.79	0.12	1.50	
12.56	14.22	3.77	18.81	0.13	1.46	
12.57	14.23	3.79	18.79	0.12	1.28	
12.58	14.33	3.72	18.76	0.12	1.46	
12.59	14.27	3.74	19.12	0.12	1.53	
13.00	14.18	3.79	18.62	0.12	1.42	
Average	14.30	3.73	18.07	0.15	1.49	

Sakai P

(Mr. Sakai Phaisanghaed)

Environmental Field Scientist (4)

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

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EMISSION TEST RESULT

Client : Gulf T&B Co., Ltd. Run # : 2
Date : 28 Nov 23 Location : Uster HRSG 11
Start Time : 13:01 Test Operator : Sakai P.
Finish Time : 13:21
SO₂ Analyzer Model : TELEDYNE API 100EH Serial No. : 437
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 774
CO/CO₂ Analyzer Model : TELEDYNE API 300EH Serial No. : 481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13.01	14.19	3.80	11.76	0.18	1.43	
13.02	14.27	3.75	11.43	0.18	1.40	
13.03	14.31	3.73	11.70	0.17	1.55	
13.04	14.29	3.72	13.31	0.19	1.66	
13.05	14.21	3.78	14.95	0.20	1.51	
13.06	14.24	3.75	15.37	0.18	1.30	
13.07	14.28	3.72	15.69	0.16	1.13	
13.08	14.24	3.75	14.26	0.15	1.12	
13.09	14.33	3.73	13.18	0.17	1.06	
13.10	14.30	3.72	13.81	0.16	1.08	
13.11	14.31	3.72	14.97	0.16	1.04	
13.12	14.31	3.72	15.90	0.15	1.16	
13.13	14.37	3.70	15.56	0.15	1.17	
13.14	14.38	3.67	15.08	0.14	1.06	
13.15	14.28	3.74	15.22	0.15	1.13	
13.16	14.32	3.72	15.32	0.14	1.08	
13.17	14.32	3.71	15.23	0.13	1.10	
13.18	14.32	3.71	15.23	0.13	1.00	
13.19	14.34	3.71	15.56	0.11	1.04	
13.20	14.31	3.73	15.56	0.11	1.10	
13.21	14.31	3.71	15.42	0.12	1.21	
Average	14.28	3.72	14.66	0.15	1.21	

Sakai P

(Mr. Sakai Phaisanghaed)

Environmental Field Scientist (4)

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

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EMISSION TEST RESULT

Client	Gulf T&A Co., Ltd.	Run #	3
Date	28 Nov 23	Location	Site HRSG 11
Start Time	13:22	Test Operator	Saksit P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	13:42
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:22	14.19	3.79	16.52	0.13	1.24	
13:23	14.31	3.73	16.69	0.11	1.25	
13:24	14.34	3.70	16.46	0.11	1.40	
13:25	14.33	3.72	16.69	0.10	1.19	
13:26	14.29	3.74	16.37	0.10	1.28	
13:27	14.34	3.71	16.49	0.09	1.20	
13:28	14.30	3.72	16.68	0.10	1.27	
13:29	14.35	3.70	16.00	0.08	1.37	
13:30	14.38	3.67	15.45	0.08	1.27	
13:31	14.36	3.69	14.60	0.19	1.05	
13:32	14.31	3.71	15.63	0.20	0.98	
13:33	14.32	3.72	15.68	0.19	0.91	
13:34	14.30	3.72	16.39	0.20	1.20	
13:35	14.24	3.76	16.85	0.21	1.28	
13:36	14.29	3.74	17.12	0.19	1.08	
13:37	14.34	3.71	16.87	0.18	0.91	
13:38	14.37	3.68	16.17	0.17	0.92	
13:39	14.36	3.69	15.81	0.18	0.87	
13:40	14.34	3.69	15.80	0.18	0.90	
13:41	14.26	3.74	16.28	0.17	1.06	
13:42	14.26	3.75	16.80	0.18	1.03	
Average	14.31	3.71	16.18	0.14	1.13	

Saksit P.

(Mr. Saksit Phaisangphol)

Environmental Field Scientist (4)



Lot No. 23125320-1

ANALYZER CALIBRATION DATA

Client	Gulf T&A Co., Ltd.	Location	Site HRSG 12
Date	28 Nov 23	Test Operator	Saksit P.
O ₂ 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	7.55	7.54	0.04
Span Gas	16.00	16.02	16.01	0.04

NO _x 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 ₂ 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	159.90	159.68	159.69	0.00

CO ANALYZER			
Model	TELEDYNE API 300EM	Serial No.	451
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	79.48	0.00
Span Gas	407.40	407.38	407.40	0.00

Calibrated by

Saksit P.

(Mr. Saksit Phaisangphol)

Environmental Field Scientist (4)

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ALS Laboratory Group

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FORM NO. F-06-202 REVISION NO. 3 ISSUE DATE 2011/23

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Lot No. 23125320-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	Gulf T&A Co., Ltd.	Location	Site HRSG 12
Date	28 Nov 23	Test Operator	Saksit P.

O ₂ ANALYZER			
Cylinder Conc. (%)	16.00	Span (%)	25

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

NO _x ANALYZER			
Cylinder Conc. (ppm)	164.40	Span (ppm)	200

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

SO ₂ ANALYZER			
Cylinder Conc. (ppm)	159.90	Span (ppm)	200

	SO ₂ Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.02	-0.02	0.00	0.00	-0.01	0.01	0.01	0.01
Upscale Gas	159.88	159.88	0.00	0.00	159.89	0.00	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	0.00	0.00
Upscale Gas	407.38	407.38	0.00	0.00	407.40	0.00	0.00	0.00

Calibrated by

Saksit P.

(Mr. Saksit Phaisangphol)

Environmental Field Scientist (4)



EMISSION TEST RESULT

Client	Gulf T&A Co., Ltd.	Run #	1
Date	28 Nov 23	Location	Site HRSG 12
Start Time	14:40	Test Operator	Saksit P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	15:50
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:40	14.37	3.69	17.34	0.23	0.79	
14:41	14.40	3.66	17.29	0.23	0.91	
14:42	14.43	3.64	16.69	0.19	0.73	
14:43	14.31	3.71	17.00	0.20	0.86	
14:44	14.32	3.72	17.22	0.20	0.82	
14:45	14.28	3.73	17.68	0.18	0.82	
14:46	14.25	3.75	17.68	0.19	0.66	
14:47	14.29	3.73	17.38	0.18	0.81	
14:48	14.36	3.70	17.53	0.19	0.65	
14:49	14.31	3.72	17.69	0.18	0.63	
14:50	14.28	3.74	17.87	0.18	0.76	
14:51	14.28	3.73	17.78	0.17	0.73	
14:52	14.24	3.75	18.38	0.19	0.76	
14:53	14.26	3.74	18.26	0.17	0.74	
14:54	14.23	3.75	18.82	0.16	0.91	
14:55	14.20	3.78	17.92	0.16	0.77	
14:56	14.22	3.78	17.50	0.16	0.89	
14:57	14.31	3.71	16.80	0.13	0.76	
14:58	14.34	3.68	16.61	0.13	0.67	
14:59	14.40	3.65	15.76	0.13	0.67	
15:00	14.43	3.65	16.12	0.13	0.60	
Average	14.38	3.71	17.44	0.17	0.78	

Saksit P.

(Mr. Saksit Phaisangphol)

Environmental Field Scientist (4)

FORM NO. F-06-053 REVISION NO. 3 ISSUE DATE 2011/23

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EMISSION TEST RESULT

Client	Gulf TSB Co., Ltd.	Run #	2
Date	28 Nov 23	Location	Unit HRSG 12
Start Time	18:01	Test Operator	Bakht P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	18:21
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	481



EMISSION TEST RESULT

Client	Gulf TSB Co., Ltd.	Run #	3
Date	28 Nov 23	Location	Unit HRSG 12
Start Time	18:22	Test Operator	Bakht P.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	18:42
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	481

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:01	14.44	3.64	16.68	0.21	0.65	
15:02	14.41	3.64	16.99	0.22	0.73	
15:03	14.35	3.68	17.31	0.22	0.66	
15:04	14.36	3.69	17.65	0.22	0.69	
15:05	14.37	3.68	18.02	0.21	0.74	
15:06	14.37	3.68	18.36	0.22	0.68	
15:07	14.36	3.69	18.51	0.23	0.64	
15:08	14.39	3.68	18.68	0.21	0.63	
15:09	14.40	3.65	18.56	0.20	0.58	
15:10	14.34	3.68	18.55	0.21	0.62	
15:11	14.41	3.60	18.20	0.20	0.52	
15:12	14.46	3.62	17.67	0.19	0.57	
15:13	14.41	3.65	17.70	0.20	0.60	
15:14	14.45	3.64	17.85	0.18	0.52	
15:15	14.47	3.60	17.90	0.18	0.47	
15:16	14.42	3.65	17.95	0.18	0.54	
15:17	14.46	3.64	18.25	0.17	0.64	
15:18	14.45	3.62	18.09	0.17	0.61	
15:19	14.43	3.67	17.99	0.18	0.64	
15:20	14.41	3.65	18.23	0.16	0.70	
15:21	14.42	3.64	18.09	0.16	0.61	
Average	14.40	3.66	17.85	0.19	0.62	

Sakht P

(Mr. Bakht Phalanchaud)

Environmental Field Scientist (4)

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:22	14.35	3.68	18.58	0.18	0.58	
15:23	14.38	3.68	18.95	0.16	0.50	
15:24	14.40	3.66	19.04	0.16	0.50	
15:25	14.42	3.65	18.53	0.14	0.55	
15:26	14.39	3.65	18.40	0.15	0.53	
15:27	14.41	3.66	18.42	0.13	0.56	
15:28	14.42	3.66	18.25	0.14	0.57	
15:29	14.40	3.66	18.24	0.15	0.54	
15:30	14.38	3.67	18.47	0.15	0.61	
15:31	14.39	3.64	18.76	0.23	0.58	
15:32	14.40	3.64	18.31	0.20	0.67	
15:33	14.30	3.71	18.52	0.22	0.65	
15:34	14.31	3.71	19.05	0.21	0.68	
15:35	14.32	3.71	19.07	0.19	0.58	
15:36	14.33	3.67	18.06	0.19	0.61	
15:37	14.35	3.67	17.56	0.20	0.57	
15:38	14.35	3.68	18.08	0.20	0.51	
15:39	14.38	3.67	18.78	0.20	0.44	
15:40	14.39	3.69	18.61	0.20	0.47	
15:41	14.26	3.74	18.70	0.18	0.47	
15:42	14.33	3.70	18.12	0.17	0.58	
Average	14.38	3.67	18.50	0.17	0.58	

Sakht P

(Mr. Bakht Phalanchaud)

Environmental Field Scientist (4)

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FORM NO F-06-16 REVISION NO 0 ISSUE DATE 2011/03

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ALS Laboratory Group

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Airgas Specialty Gases
Airgas USA LLC
6161 Batten Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	AIR LIQUIDE	Reference Number:	160-402340013-1
Part Number:	(THAILAND) LTD	Cylinder Volume:	247.2 CF
Cylinder Number:	E04N199E3HA0002	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-12/231, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.30 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	80.00 PPM	78.48 PPM	G1	+/- 0.6% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	82.36 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/2022
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	CG731106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	CG760944	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMSI	124206889139	CC323707	4.097 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010410	KAL004813	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 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



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04N199E3HA00026	Reference Number:	82-401257890-1
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-12/231, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/03/2018, 08/07/2018
NITRIC OXIDE	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/03/2018, 08/07/2018
SULFUR DIOXIDE	160.0 PPM	159.8 PPM	G1	+/- 1.1% NIST Traceable	07/03/2018, 08/07/2018
CARBON MONOXIDE	400.0 PPM	407.4 PPM	G1	+/- 1.1% NIST Traceable	07/03/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	17000241	E80070597	103.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	May 11, 2019
PRM	12208	5604118	26.88 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMSI	2042016104	CC050341	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	11010410	KAL004792	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	15065336	CC453507	491.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 08, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 CO	FTIR	Jul 19, 2018
Nicolet 6700 APW1100391 NO	FTIR	Jul 12, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 03, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 02, 2018

Triad Data Available Upon Request

NOTES:
Net weight: 8197 grams
Gross weight: 47690 grams



This calibration std. has been certified in accordance with the May 2012 EPA Traceability document EPA-600/R-12/231. All testing processes and measurements conform to the ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this document as being NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

CERTIFICATE OF ANALYSIS

Customer Detail ALS Laboratory Group (Thailand)		Production Order Number: 90132928 Material Number: 478100-J-44 Certification Date: 20-Jan-2016 Expiry Date: 20-Jan-2024	
Cylinder Description: Steel 42L The contents of this cylinder are intended for use as a calibration gas for the analysis of Oxygen. The purity of this gas is guaranteed to be 99.999% (99.999% Oxygen, 0.001% Nitrogen). The gas is supplied in a cylinder with a nominal capacity of 42L. The gas is supplied in a cylinder with a nominal capacity of 42L.		Analyst:  THIRAT EONGPAT	
Certificate Number: 467615		Approve:  THIRAT EONGPAT	
Cylinder Number: 559730		To Re-Order Please Quote: 478100-J-44	
Nominal Cylinder Content: 6.520 M³			
Nominal Pressure: 145.0 Bar			
Valve Outlet: CGA 550 BRASS			
Comment: <ul style="list-style-type: none"> It is recommended that this product be not used below 5% of actual capacity or should not be used when gas pressure is below 150psig. Other impurities that affect the analytical condition of this mixture shall be reported if it is more than 10% of maximum minor component. Keep and use in well-ventilated and secure area. 			

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บริษัท ออล (ประเทศไทย) จำกัด (มหาชน)
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

Linde (Thailand) Public Company Limited
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

CERTIFICATE OF ANALYSIS



Analytical Result					
Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	8.00 %	7.93 %	± 0.1 % relative	(2) I-PB-354	20-Jan-2015
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen in Nitrogen	243625SG	25.08 ± 0.13 %	19-Aug-2017		
Analytical Instruments used in Assay					
Instrument Make/Model	Analytical Principle	Last Calibration Calibration			
Servomex 4100 O2 Analyzer	Paramagnetic	23-Dec-2015			
Method of Analysis: 1. Gas Chromatography 2. Paramagnetic Oxygen Analyzer 3. Gravimetric Oxygen Analyzer 4. Gas Chromatography/Mass Spectrometry 5. Gas Chromatography/Mass Spectrometry 6. Other specified					
Cylinder Number: 559730			Certification Date: 20-Jan-2016		
Production Order Number: 90132928			Expiration Date: 20-Jan-2024		

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บริษัท ออล (ประเทศไทย) จำกัด (มหาชน)
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

Linde (Thailand) Public Company Limited
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

CERTIFICATE OF ANALYSIS

Customer Detail ALS Laboratory Group (Thailand)		Production Order Number: 90137389 Material Number: 557200-J-44 Certification Date: 24-Sep-2016 Expiry Date: 24-Sep-2024	
Cylinder Description: Steel 42 L The contents of this cylinder are intended for use as a calibration gas for the analysis of Oxygen. The purity of this gas is guaranteed to be 99.999% (99.999% Oxygen, 0.001% Nitrogen). The gas is supplied in a cylinder with a nominal capacity of 42L. The gas is supplied in a cylinder with a nominal capacity of 42L.		Analyst:  THIRAT EONGPAT	
Certificate Number: 285716		Approve:  THIRAT EONGPAT	
Cylinder Number: 363075		To Re-Order Please Quote: 557200-J-44	
Nominal Cylinder Content: 6.560 M³			
Nominal Pressure: 145.0 Bar			
Valve Outlet: CGA 550 BRASS			
Comment: <ul style="list-style-type: none"> It is recommended that this product be not used below 5% of actual capacity or should not be used when gas pressure is below 150psig. Other impurities that affect the analytical condition of this mixture shall be reported if it is more than 10% of maximum minor component. Keep and use in well-ventilated and secure area. 			

Page 1 of 2

บริษัท ออล (ประเทศไทย) จำกัด (มหาชน)
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

Linde (Thailand) Public Company Limited
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

CERTIFICATE OF ANALYSIS

Analytical Result					
Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	16.0 %	16.0 %	± 0.1 % relative	(2) I-PB-354	24-Sep-2016
Reference Standard used in Assay					
Reference Standard	Cylinder No.	Concentration	Expiry Date		
Oxygen in Nitrogen	243625SG	25.08 ± 0.13 %	19-Aug-2017		
Analytical Instruments used in Assay					
Instrument Make/Model	Analytical Principle	Last Calibration Calibration			
Servomex 4100 O2 Analyzer	Paramagnetic	24-Sep-2016			
Method of Analysis: 1. Gas Chromatography 2. Paramagnetic Oxygen Analyzer 3. Gravimetric Oxygen Analyzer 4. Gas Chromatography/Mass Spectrometry 5. Gas Chromatography/Mass Spectrometry 6. Other specified					
Cylinder Number: 363075			Certification Date: 24-Sep-2016		
Production Order Number: 90137389			Expiration Date: 24-Sep-2024		

Page 1 of 2

บริษัท ออล (ประเทศไทย) จำกัด (มหาชน)
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

Linde (Thailand) Public Company Limited
 15 ถนนสุขุมวิท 21 (จ. 14) แขวงคลองเตย เขต คลองเตย กรุงเทพฯ 10110
 โทรศัพท์: 02-576 5555 โทรสาร: 02-576 5556
 โทรสาร: 02-576 5555 โทรสาร: 02-576 5556

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. : ACC23009
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 : ALST LABORATORY GROUP (THAI AND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUAFNG 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 : 24 JANUARY 2023
Calibration Date : 26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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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-03-0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL-BP-05-0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V741B6069	EF-0010-22	07-Feb-23

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

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

3.1 National Institute of Metrology (Thailand)

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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : 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	93.16	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

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. : ACC23009
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42; Microphone UC-52 / Preamplifier NH-24
Serial No. : 60296518 66239 / 34375
ID No. : RYG_FS0431

Condition As Found : GOOD

Customer : ALST LABORATORY GROUP (THAI AND) CO. LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUAFNG 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 : 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)

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QF-TS12-04-04-020664

QF-TS12-04-04-020664

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	ET-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-23	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	ET-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

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

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

3.1 National Institute of Metrology (Thailand).

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

QI-1S12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL23081
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 (93.9)	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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.4	-0.3	-0.2	± 5.0

QI-1S12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL23081
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

QI-1S12-04-04-020664

T. Retch.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

Frequency Weighting	SLM Display at initial (dB)	SUM 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. Retch.

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-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

QI-TS12-04-04-020664

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

451-451/1 Sirthorn Rd, Banghurn, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8809 Fax: 0-2435-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23080
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier MH-24
Serial No.: 00296517 135220 / 87527
ID No.: RYG F80434

Condition As Found : GOOD

Customer : AIS LABORATORY GROUP (THAI) AND CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHUET SUAN I UANG,
BANGKOK, 10250 THAILAND.

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch.
(Thanakul Petchunai)

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QI-TS12-04-04-020664

T. Petch.

QI-TS12-04-04-020664

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	L.L.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	L.L.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	L.L.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	LI-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. : ACL23080
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

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 (92.95)	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

QF-TS12-04-04-020664

T. Petch.

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	SI M Display at initial (dB)	SI M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	94.0	0.0	± 0.3

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

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

7. Level linearity on the reference level range

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

Continuation of Calibration Certificate

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

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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11. Overload indication

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

12. High level stability

Frequency Weighting	SI M Display at initial (dB)	SI 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

451/451/1 Sirinthern Rd., Bangpumru, Bangplud Bangkok 10700 THAILAND
Tel: 2435-8806 Fax: 0-2435-1679 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 / Preamplifier NH-25
Serial No.: 00920831 22191 / 22220
ID No.:

Condition As Found : GOOD

Customer : ACSI LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUANG PHATTHANAKAN, KHUANG 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 : Nathakorn Pisutpaian

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. : 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	FF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	FF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	FF-BP-04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	FF-BP-03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	FF-BP-05/0265	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-5005-22	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	0.55
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QT-1S12-04-04-020604

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23073
Job No. : VC66AC0029
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)
14.0

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)	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)	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	±0.2
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	±0.1
Slow	94.0	0.0	±0.1
1 eq	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. Petch.

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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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T. Petchum

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

10. Peak C sound level

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

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T. Petchum

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	SIM Display at initial (dB)	SIM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.1

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 Srinthorn Rd., Bangsumru, 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 : AISI LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN-40 PHATTHANAKAN ROAD,
KHUANG 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 Pisupaisan

Approved by :

T. Petchum
(Thanakul Petchum)

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QH-TS12-04-04-020664

T. Petchum

QH-TS12-04-04-020664

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 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	11-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	11-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	11-0009-22	09-Feb-23
Digital Multimeter	33461A	MY53220076	11-0009-22	09-Feb-23
Digital Multimeter	33461A	MY60024273	11-0009-22	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	11-0009-22	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. : 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

QF-TS12-04-04-020604

T. Pich

QF-TS12-04-04-020604

T. Pich

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

QF-TS12-04-04-020604

T. Pich

QF-TS12-04-04-020604

T. Pich

Continuation of Calibration Certificate

Cert. No. : ACL23099
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

QT-1512-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23099
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

Tone	Tone burst duration, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	124.0	124.0	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
SEI	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.1	-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

QT-1512-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23099
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	S/L M Display at initial (dB)	S/L M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Weighting				
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

45/1-45/1/1 Sinitthorn Rd, Bangbunru, Bangkok 10700 THAILAND
Tel: 2433-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23038
Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI-21 Microphone UC-52 / Preamplifier NI-21
Serial No.: 00465461 108081 19513
ID No.: RYG-150007

Condition As Found : GOOD

Customer : AIST LABORATORY GROUP (THAI) AND CO., LTD.
104 PHATTHANAKAN 40 PHATTHANAKAN ROAD,
KHUAI NG 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 : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 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.

QT-1512-04-04-020664

T. Petchurai

QT-1512-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23038
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 result 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	EE-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EE-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EE-0009-22	09-Feb-23
Digital Multimeter	33461A	MY53220076	EE-0009-22	09-Feb-23
Digital Multimeter	3846A	MY60024273	EE-0009-22	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EE-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).

QI-TS12-04-04-020664

T. B. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23038
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)
23.5

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

Frequency Weighting	Measured value (dB)
A-weight	22.2
C-weight	21.6
Flat	22.2

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	0.2	0.2	0.2	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.1	0.2	0.2	±5.0

QI-TS12-04-04-020664

T. B. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23038
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	✓	-	0.4	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For 4 kHz to 10 kHz	✓	-	0.3	0.7
For 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long-term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QI-TS12-04-04-020664

T. B. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23038
Job No. : VC66AC0024
Pages : 5 of 9

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QI-TS12-04-04-020664

T. B. L. A.

Continuation of Calibration Certificate

Cert. No. : ACL23038
Job No. : VC66AC0024
Pages : 6 of 9

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
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

Continuation of Calibration Certificate

Cert. No. : ACL23038
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	32.6	-0.4	±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	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
SEI	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

QF-TS12-04-04-020664

T. P. A.

QF-TS12-04-04-020664

T. P. A.

Continuation of Calibration Certificate

Cert. No. : ACL23038
Job No. : VC66AC0024
Pages : 8 of 9

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.0	-0.4	±2.0
Negative half cycle	135.4	135.0	-0.4	±2.0

11. Overload Indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.3	-0.1	±1.5

Continuation of Calibration Certificate

Cert. No. : ACL23038
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. P. A.

QF-TS12-04-04-020664

T. P. A.

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

45/1-45/11 Srinithorn Rd., Bangbunru, Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22296
Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No. : 00376364 / 71486 / 23142
ID No. : RYG FS0012

Condition As Found : GOOD

Customer : A.S. LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40 PHATTHANAKAN ROAD,
KHUANG PHATTHANAKAN KHUANG PHATTHANAKAN,
BANGKOK 10250 THAILAND

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

Received Date : 07 DECEMBER 2022
Calibration Date : 16-20 DECEMBER 2022
Date of Issue : 21 DECEMBER 2022

Calibrated by : Nathakorn Prutparan

Approved by :

T. Petch
(Thanakul Petchurak)

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QH-TS12-04-04-020604

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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 Instrument.

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	11-0607-22	04-Feb-23
Waveform Generator	33511B	MY52302742	11-0608-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	11-BP-04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	11-BP-03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	11-BP-05/0265	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	11-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand)

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

QH-TS12-04-04-020604

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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)
24.0

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

Frequency Weighting	Measured value (dB)
A-weight	22.2
C-weight	21.9
Flat	21.6

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

QH-TS12-04-04-020604

T. Petch

QH-TS12-04-04-020604

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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	-0.2	0.0	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	-0.1	0.0	0.0	±1.5
500	-0.1	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.0	0.2	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	94.1	0.1	± 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
F eq	94.0	0.0	± 0.1

6. Long - term stability

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

QI-TS12-04-04-020661

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 6 of 9

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
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

QI-TS12-04-04-020661

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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	108.0	0.0	1.5 , -5.0
	2	8	117.0	117.0	0.0	1.0 , -2.5
	200	800	134.0	134.0	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
SE1	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

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
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	136.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-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	89.2	-0.2	±1.5

QI-TS12-04-04-020661

QI-TS12-04-04-020661

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 9 of 9451-451/1 Srinthorn Rd, Bangbunma, Bangplud Bangkok 10700 THAILAND
Tel:0 2435-8900 Fax:0 2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23009
Pages : 1 of 8

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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 01122579 / 172172 / 74102
ID No. : RYG FS0018

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
164 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHE 1 SUAN LUANG,
BANGKOK, 10250 THAILAND

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

Received Date : 14 DECEMBER 2022
Calibration Date : 03-05 JANUARY 2023
Date of Issue : 06 JANUARY 2023

Calibrated by : Nathakorn Pisutparisan

Approved by :

(Thanakul Petchurai)

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

QI-TS12-04-04-020604

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 2 of 8

Calibration Procedure : (P 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 EMC 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	EE-0006-22	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	MA1-1070	62100114	EJ-0009-22	07-Feb-23
Condenser Microphone	4180	2927900	AA-1013-23	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-0005-22	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. : ACL23009
Job No. : VC66AC0021
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	✓	-	0.2	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	✓	-	0.3	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QI-TS12-04-04-020604

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	20.1
Flat	26.6

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

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	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

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C' sound level

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

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

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23009
Job No. : VC66AC0021
Pages : 8 of 8

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



Cert. No. : ACL22240
Pages : 1 of 8

11. Overload indication

Measured value (dB)		Desired 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	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Weighting				
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

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

Condition As Found : GOOD

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

Calibrated by : Nathakorn Piatpaisan

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

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Continuation of Calibration Certificate

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	17.1
Flat	23.0

3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

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

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 7 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-04-020664

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

10. Peak C sound level

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

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22240
Job No. : VC65AC0089
Pages : 8 of 8451-451/1 Sirinthon Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22193
Pages : 1 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

QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 2 of 8

Calibration Procedure : C P 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	11-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	11-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	111-BP-04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EF1-BP-03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP-05/0265	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QI-TS12-04-04-020664

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Pre-amplifier N11-24
Serial No. : 00597167 / 157778 / 34375
ID No. : RYG TS0437

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

Calibrated by : Nathakorn Pisunpaisan

Approved by :

(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

QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 3 of 8

Summary of Measurement Result :

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

QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.3

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

Frequency Weighting	Measured value (dB)
A-weight	15.1
C-weight	21.4
Flat	27.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.3	±1.5
1000	-0.1	-0.1	-0.1	±1.0
8000	-0.6	-0.6	-0.6	±5.0

QI-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

QI-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	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	27.1	0.1	±1.1
26.0	26.0	0.0	±1.1
25.0	24.9	-0.1	±1.1

QI-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

QI-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 8 of 8451-451/1 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. : ACL23078
Pages : 1 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

QE-TS12-04-04-020064

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23078
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 in Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	FI-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	FI-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	L11-BP-04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	L11-BP-03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	L11-BP-05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand)

3.2 Thailand Institute of Scientific and Technological Research (TISTR)

QE-TS12-04-04-020064

T. Petchur

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00296515 / 179119 / 87526
ID No. : RYG TS0432

Condition As Found : GOOD

Customer : AISI LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG PHATTHANAKAN, KHUET SUAN PHUANG,
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.

QE-TS12-04-04-020064

Continuation of Calibration Certificate

Cert. No. : ACL23078
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

QE-TS12-04-04-020064

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23078
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)
14.6

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	23.4

3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
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	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
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	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
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	136.2	-0.2	±3.0

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

QF-TS12-04-04-020664

7. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
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		
89.7	89.6	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

451-451/1 Sirdinthorn Rd., Bangbunru, Bangkok 10700 THAILAND
Tel:0-2435-6800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23320
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00597167 / 179118 / 87525
ID No. : RYG_FS0437

Condition As Found : GOOD

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

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QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
Pages : 2 of 8

Calibration Procedure : (P-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	FEL-BP 30-0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	LEL-BP 29-0266	13-FEB-24
Digital Multimeter	33461A	MY60024273	LEL-BP 31-0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter.

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

Continuation of Calibration Certificate

Cert. No. : ACL23320
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	11.2
C - weight	17.5
Flat	23.1

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

QH-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23320
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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±3.0
One	136.4	136.1	-0.3	±3.0

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23320
Job No. : VC67AC0011
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	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

451-451/1 Sirinthern 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. : ACL23040
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42: Microphone UC-52 / Preamplifier NH-24
Serial No.: 00709746 / 187332 / 01297
ID No.: RYG.FS0491

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.1 ± 3.1) 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 :

(Thanakul Petchurai)

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QI-TS12-04-04-020604

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL23040
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : (P-AE-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.	Exp. Date
Waveform Generator	33210A	MY43017076	11-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	11-0008-22	04-Feb-23
Digital Multimeter	34461A	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	MA1-1070	62100114	F1-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34360495	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. : ACL23040
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. : ACL23040
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)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.5
C - weight	18.3
Flat	23.6

3. Acoustical signal tests of frequency weightings

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

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

QT-1S12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23040
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	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	49.1	0.1	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23040
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	-0.2	-0.2	-0.2	±2.0
125	-0.1	-0.1	-0.1	±1.5
250	0.0	-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	0.0	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
1 eq	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. : ACL23040
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: 1b (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	135.9	-0.5	±3.0

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23040
Job No. : VC66AC0024
Pages : 8 of 8

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CALIBRATION 0334

Cert. No. : ACL23042
Pages : 1 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

QI-TS12-04-04-020664

T. Petchur

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00900071 / 188464 / 01733
ID No. : RYG TS0492

Condition As Found : GOOD

Customer : AIS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHAI THANAKAN 40, PHAI THANAKAN ROAD,
KHUAI-NG PHATHANAKAN, KHUET SUAN LUANG,
BANGKOK, 10250 THAILAND

Location :
Ambient Temperature : (23.0 ± 3.1) °C
Pressure : (101.3 ± 3.1) 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 Pisutpisan

Approved by :

(Thanakul Petchur)

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QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
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.	Exp. Date
Waveform Generator	33210A	MY48017076	11-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	11-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53270104	11-11-04-020665	09-Feb-23
Digital Multimeter	33461A	MY53220076	11-11-04-020665	09-Feb-23
Digital Multimeter	34461A	MY60024273	11-11-04-020665	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	11-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42RAI	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. : ACL23042
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

QI-TS12-04-04-020664

T. Petchur

QI-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23042
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)
14.6

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	17.9
Flat	23.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.3	0.4	0.4	± 5.0

QH-TS12-04-04-020664

B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

QH-TS12-04-04-020664

B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	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	26.8	-0.2	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QH-TS12-04-04-020664

B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23042
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, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

QH-TS12-04-04-020664

B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23042
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	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

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

End of Calibration Certificate

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



Cert. No. : ACL23045
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00900074 / 18E467 / 01736
ID No. : RYG F50495

Condition As Found : GOOD

Customer : AISI LABORATORY GROUP (THAI) AND CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUAEANG PHATTHANAKAN, KIBI 1 SUANPHUANG,
BANGKOK, 10250 THAILAND

Location :
Ambient Temperature : (23.0 ± 3.1) °C
Pressure : (101.3 ± 3.1) 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 Pisunpaisan

Approved by :

(Thanakul Petcharai)

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

QH-TS12-04-04-02064

QH-TS12-04-04-02064

Continuation of Calibration Certificate

Cert. No. : ACL23045
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : (P-A-C-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	MY46017076	FI-0907-22	04-Feb-23
Waveform Generator	33511B	MY52302742	FI-0908-22	04-Feb-23
Digital Multimeter	33461A	MY5320104	IEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY5320076	IEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	IEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	FI-0909-22	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. : ACL23045
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

QH-TS12-04-04-02064

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Continuation of Calibration Certificate

Cert. No. : ACL23045
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	9.9
C - weight	16.8
Flat	22.8

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	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-2.0	-1.9	-1.9	±5.0

QH-TS12-04-04-020664

- B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23045
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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	-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	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QH-TS12-04-04-020664

- B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23045
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	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 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

QH-TS12-04-04-020664

- O.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23045
Job No. : VC66AC0024
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C' sound level

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

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

QH-TS12-04-04-020664

- B.L.H.

Continuation of Calibration Certificate

Cert. No. : ACL23045
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	89.5	-0.1	±1.5

12. High level stability

Frequency	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Weighting				
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

CERTIFICATE OF CALIBRATION

Certificate No. : CL 012 66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018311
ID No: RYG_FS0356

Customer
Name: AI 5 laboratory group (thailand) Co., Ltd
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand

Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1 Standard Temperature Probe Model: STS-100 A500.
Serial No : 607662 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 IT-0034 22. Certificate number: ER-0032-22

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
EFFECTIVE DATE: 2/6/24

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphet



Approved Signature: *[Signature]*
Mr. Panyya Booncharoen
Calibration Department Manager

QT-TS12-04-04-020664



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



Certificate No. : CL 012 66
Page 2 of 2

Result of Calibration: 7 Without Adjustment 1 With Adjustment
Calibration Range: 20 - 40 °C
Function:

Table 1: This equipment was connected with standard temperature probe Model: TP327G 2 S/N: 18020493
Dimension: Diameter 14 mm Length 130 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.056	20.0	0.1	0.099
60	25.046	25.0	0.0	0.099
60	30.039	30.0	0.0	0.099
60	35.029	35.0	0.0	0.099
60	40.016	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP327G 2 S/N: 18020493
Dimension: Diameter 14 mm Length 130 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.057	20.2	0.1	0.099
70	25.046	25.1	0.1	0.099
70	30.039	30.0	0.0	0.099
70	35.029	35.0	0.0	0.099
70	40.016	39.9	0.1	0.099

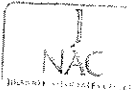
Table 3: This equipment was connected with Globe thermometer probe Model: TP327G 2 S/N: 18020493
Dimension: Diameter 8 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.056	20.1	0.0	0.099
110	25.047	25.1	0.1	0.099
110	30.039	30.1	0.1	0.099
110	35.028	35.1	0.1	0.099
110	40.015	40.1	0.1	0.099

UUC* = Una Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Certificate No. : CL 015 66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018314
ID No: RYG_FS0350

Customer
Name: AI 5 laboratory group (thailand) Co., Ltd
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand

Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1 Standard Temperature Probe Model: STS-100 A500.
Serial No : 607662 09. Due date: 23 Mar 2023
2 Digital Temperature Indicator Model: DTI-1000-A Mk II. Serial No. 671407 00591 Due date: 22 Jul 2023

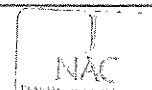
Calibration Condition
Temperature: (23±3) °C
Relative Humidity: (55±15)%

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 IT-0034 22. Certificate number: ER-0032-22

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
EFFECTIVE DATE: 2/6/24

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphet



Approved Signature: *[Signature]*
Mr. Panyya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function: Table 1: This equipment was connected with wet bulb probe Model HP3201.2 S/N: 18021465.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	0.1	0.099
60	25.048	25.0	0.0	0.099
60	30.045	30.0	0.0	0.099
60	35.030	35.0	0.0	0.099
60	40.021	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model TP3207.2 S/N: 18021262
Dimension: Diameter 14 mm. Length 150 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.1	0.0	0.099
70	25.048	24.9	0.1	0.099
70	30.040	29.9	0.1	0.099
70	35.032	34.8	0.2	0.099
70	40.021	39.8	0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model TP3276.2 S/N: 20008280
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.0	-0.1	0.099
110	25.050	25.1	0.1	0.099
110	30.039	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.022	40.1	0.1	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

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

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018316
ID No: RY6_F50360

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

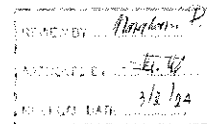
Received date: 23 Jan 2023
Calibration date: 03 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100-A500.
Serial No: 667682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DT11000-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
comparator 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-0692-
22



Calibrated by
☒ Mr. Soravit Thachulad
☐ Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Panyo Booncharoen
Calibration Department Manager

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Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function: Table 1: This equipment was connected with wet bulb probe Model HP3201.2 S/N: 18021471
Dimension: Diameter 14 mm. Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	0.1	0.099
60	25.053	25.0	0.1	0.099
60	30.042	30.0	0.0	0.099
60	35.026	35.0	0.0	0.099
60	40.014	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model TP3207.2 S/N: 18021266
Dimension: Diameter 14 mm. Length 150 mm

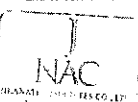
Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.1	0.0	0.099
70	25.053	25.0	0.1	0.099
70	30.043	30.0	0.0	0.099
70	35.030	34.9	0.1	0.099
70	40.015	39.9	0.1	0.099

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

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.1	0.0	0.099
110	25.053	25.1	0.0	0.099
110	30.044	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.017	40.1	0.1	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

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

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018316
ID No: RY6_F50360

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

Received date: 24 Feb 2023
Calibration date: 04 Feb 2023
Issue date: 24 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: DT11000-A-MK
II, Serial No: 671407-00591 Due date: 22 Jul 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
comparator 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-0692-
22

Signature of Mr. Panyo Booncharoen

Calibrated by
☒ Mr. Soravit Thachulad
☐ Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Panyo Booncharoen
Calibration Department Manager

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Certificate No.: CL-042-05
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: TP3261.2 S/N: 21001213
Dimension: Diameter 14 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.054	20.1	0.0	0.099
60	25.061	25.2	0.1	0.099
60	30.054	30.2	0.1	0.099
60	35.046	35.2	0.1	0.099
60	40.045	40.2	0.1	0.099

Table 2: This equipment was connected with standard temperature probe Model: TP3261.2 S/N: 21001213
Dimension: Diameter 14 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.054	20.1	0.0	0.099
70	25.061	25.1	0.0	0.099
70	30.054	30.0	0.0	0.099
70	35.046	35.0	0.0	0.099
70	40.045	40.1	0.1	0.099

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

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.1	0.0	0.099
110	25.061	25.1	0.0	0.099
110	30.054	30.1	0.0	0.099
110	35.045	35.1	0.1	0.099
110	40.045	40.1	0.1	0.099

UUC*: Unit Under Calibration

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

★ End of Certificate ★



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CERTIFICATE OF CALIBRATION

Certificate No.: CL-017-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006715
ID No: RYG_F50220

Customer

Name: AIS laboratory group (thailand) Co., Ltd
Address: 104 Phatthanakan 40, Phatthanakan Rd,
Khuang Suan Luang, Khet Suan Luang, Bangkok
10260 Thailand.

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

Reference Used During Calibration

1 Standard Temperature Probe Model: STS-160 AS60
Serial No: 667682 09, Due date: 23 Mar 2023
2 Digital Temperature Indicator Model: DH 1000 A MK
II Serial No: 671407 00591 Due date: 22 July 2023

Calibration Condition

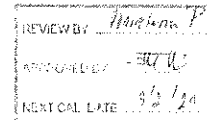
Temperature: (23±3) °C
Relative Humidity: (55±15)%

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: IT-0034-22, Certificate number: ER-0002-
22



Calibrated by:
3 Mr. Sorawat Thachalad
1 Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate No.: CL-017-66
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: TP3261.2 S/N: 21001213
Dimension: Diameter 14 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.052	20.0	0.1	0.099
60	25.054	25.0	0.1	0.099
60	30.045	30.0	0.0	0.099
60	35.034	35.0	0.1	0.10
60	40.046	39.9	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3261.2 S/N: 15015667
Dimension: Diameter 14 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.051	20.2	0.1	0.099
70	25.053	25.1	0.0	0.099
70	30.043	30.0	0.0	0.099
70	35.031	35.0	0.0	0.099
70	40.014	39.9	0.1	0.099

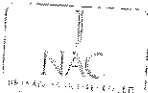
Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20016632
Dimension: Diameter 8 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.061	20.0	0.1	0.099
110	25.055	25.1	0.0	0.099
110	30.064	30.1	0.0	0.10
110	35.053	35.1	0.1	0.099
110	40.011	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-017-66
Page 1 of 2

Equipment Name: Heat stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006715
ID No: RYG_F50220

Customer

Name: AIS laboratory group (thailand) Co., Ltd
Address: 104 Phatthanakan 40, Phatthanakan Rd,
Khuang Suan Luang, Khet Suan Luang, Bangkok
10260 Thailand.

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

Reference Used During Calibration

1 Standard Temperature Probe Model: STS-160 AS60
Serial No: 667682 09, Due date: 23 Mar 2023
2 Digital Temperature Indicator Model: DH 1000 A MK
II Serial No: 671407 00591 Due date: 22 July 2023

Calibration Condition

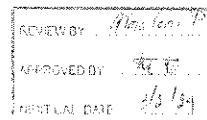
Temperature: (23±3) °C
Relative Humidity: (55±15)%

Calibration Procedure

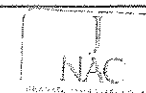
The temperature calibration was done by In-House
calibration method as WtCL 001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS 90

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: IT-0034-22, Certificate number: ER-0002-
22



Calibrated by:
3 Mr. Sorawat Thachalad
1 Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate No.: CL-018-66
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: 18009586.
Dimension: Diameter 14 mm, Length 170 mm.

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

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015439.
Dimension: Diameter 14 mm, Length 150 mm.

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

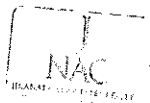
Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20019638
Dimension: Diameter 8 mm, Length 170 mm.

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

UUC*: Unit Under Calibration

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

★ End of Certificate ★



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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: H032.2
Serial No: 15006720
ID No: RYG_FS0224

Customer
Name: ALS laboratory group (thailand) Co., Ltd
Address: 104 Phatthana 40, Phatthana 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: S15 100 A500
Serial No.: 667082 09. Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DT1100A 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
[X] Mr. Sorawat Thachalad
[X] Miss Jitraporn Lertsomphol

Approved Signatory:
Mr. Panyia Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009586.
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.048	20.2	0.3	0.099
60	25.046	25.2	0.4	0.099
60	30.044	30.1	0.3	0.099
60	35.041	35.2	0.3	0.099
60	40.046	39.7	-0.3	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015439.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.048	20.3	0.3	0.099
70	25.058	25.1	0.0	0.099
70	30.049	30.0	0.0	0.099
70	35.046	34.8	-0.2	0.099
70	40.046	39.7	-0.3	0.099

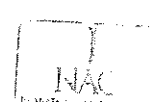
Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20032619
Dimension: Diameter 8 mm, Length 170 mm.

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

UUC*: Unit Under Calibration

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

★ End of Certificate ★



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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: H032.2
Serial No: 15006720
ID No: RYG_FS0224

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

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

Reference Used During Calibration
1. Standard Temperature Probe Model: S15 100 A500
Serial No.: 667082 09. Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DT1100A 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-0036-23, Certificate number ER 0092 22

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

Calibrated by
[X] Mr. Sorawat Thachalad
[X] Miss Jitraporn Lertsomphol
[X] Miss Ruangsriwan Phasomai

Approved Signatory:
Mr. Panyia Booncharoen
Calibration Department Manager



63/14-15,67/36-36, Sor Petchkasem 7/71, Petchkasem Rd,
Wattapra, Banghokyai, Bangkok 10600 Thailand
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Certificate No. CD1-036-00
Page: 2 of 2



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534 PATTANAKARN ROAD SOI 18, SUANLUANG, SUAN LUANG, BANGKOK 10250
TEL: 0-2717-3962-24 FAX: 0-2710-9184



Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function: Table 1: This equipment was connected with anti bulb probe Model HP3701 2 S/N: 22075583
Dimension: Diameter 14 mm Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	26.053	26.0	0.053	0.059
80	25.059	25.0	0.059	0.059
80	30.045	29.0	0.1	0.059
80	35.038	34.0	0.1	0.059
90	40.030	39.0	0.1	0.059

Table 2: This equipment was connected with anti bulb probe Model HP3701 2 S/N: 22075583
Dimension: Diameter 3.3 mm Length 205 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	26.053	26.0	0.053	0.059
80	25.059	25.0	0.059	0.059
100	30.045	29.0	0.1	0.059
80	35.038	34.0	0.1	0.059
90	40.030	39.0	0.1	0.059

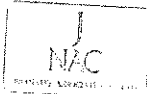
Table 3: This equipment was connected with temperature probe Model TP3207 2 S/N: 22025054
Dimension: Diameter 3 mm Length 150 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	26.053	26.0	0.053	0.059
80	25.059	24.0	0.1	0.059
80	30.045	29.0	0.1	0.059
80	35.038	34.0	0.1	0.059
90	40.030	39.0	0.1	0.059

UUC* Unit Under Calibration

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

★ End of Certificate ★



Calibrated by: Nivat Nitas
Issue Date: 09 September 2022

Approved Signatory

☒ Pholnab Prapapal
☐ Chatchawan Khunpuek
☒ Nattawat Khomchai

11 0296366



Cert. No. 22PH447
Page: 2 of 2



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Certificate of Calibration

Certificate No. 22PH447
Page: 1 of 2

Result of calibration: ☐ Without adjustment ☒ After adjustment
Function: Illuminance Measurement Range Autorange

Standard Value (lx)	Before Adjust UUC* Reading (lx)	After Adjust UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
0	0.00	0.00	0.00	0.060
15		14.25	0.75	0.22
100		95.5	3.5	1.5
500		492	-8	7.3
1000	861	992	8	15
2000		1906	14	30
3000		2980	10	45
4000		4020	20	59
5000	4550	5005	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: L0 = 1.058

After adjustment light source factor setting mode: L0 = 1.209

UUC* = Unit Under Calibration

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Equipment: Lux Meter

Manufacturer: PEAK METER

Model: PM6612L

Serial No.: H12A D16371

ID No.: RYG_F50036

Condition As Received: Used Item

Received Date: 19 September 2022

Calibration Date: 26 September 2022

Reference: 2209-1093W5C

Ambient Temperature: 23 ± 2 °C

Relative Humidity: 55 ± 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 PH01 by measuring against luminous-intensity standard lamp (source-based method) According to the inverse square law measurement method

Condition of this result of calibration

1 Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Exp. Date
1) Photometry & Encoder	LMguide 9.6 m	120RC003	DL 0004 22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL FET-U	F 1471	TP 1037 21	18 Oct 2022

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

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

4 Test Equipment: Illuminance Meter (Model: 51002 S/N: 660129)

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

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

National Institute of Metrology Thailand (NIMT)

National Institute of Metrology (Thailand) NSG ONEC Accredited No. Calibration 0144

Calibrated by: Nivat Nitas
Issue Date: 21 September 2022

Approved Signatory

☒ Pholnab Prapapal
☐ Chatchawan Khunpuek
☒ Nattawat Khomchai

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
514/4 PATTANAKARN ROAD SOI 18 SUANLUANG SUANLUANG BANGKOK 10250
TEL: 0-2710-9800-2 FAX: 0-2710-9804



Cert.No.: 23CH827
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	0.060
15	-	15.18	0.18	0.20
100	-	100.8	0.8	1.3
500	-	500	0	6.5
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 : L0 = 1.227

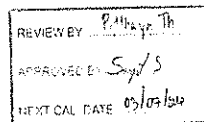
After adjustment light source factor setting mode : L0 = 1.264

UUC* = Unit Under Calibration.

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Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : B712869291
ID No. : RYG_FS0286
Condition As-Received : Used Item
Received Date : 30 June 2023
Calibration Date : 03 July 2023
Reference : 2306-0084DSC-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 Lermagatrakul

Approved by :
Approved Signatory

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

Issue Date : 6 July 2023

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

This certificate is valid only for the purpose stated on the certificate and is not valid for any other purpose.
Approved by the head of the corporate services & equipment calibration and testing services.

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL: 0-2710-9800-2 FAX: 0-2710-9804



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	130RC110	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-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.00B	CPA chem	863832	28 Dec 2024
pH 6.98G	CPA chem	863833	28 Dec 2023
pH 10.01G	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading	Uncertainty of Measurement	Coverage factor
	pH	mV	mV	(± mV)	k
pH Meter	4.00	177.48	178	0.58	2.00
S/N B712869291	7.00	0.00	0	0.58	2.00
	10.00	-177.48	-178	0.58	2.00

Function : pH Measurement

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

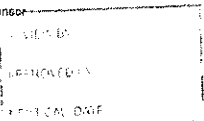
Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode	4.00B	4.01	188	0.0085	2.05
S/N 3184144	6.98G	7.00	13	0.011	2.00
	10.01G	10.01	-165	0.0095	2.00

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. : B712869291
ID No. : RYG_FS0286
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 Bulkruea

Approved by :
Approved Signatory

() Pornthippa Tomoyakul
(/) Suwit Imjai

Issue Date : 11 July 2023

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

This certificate is valid only for the purpose stated on the certificate and is not valid for any other purpose.
Approved by the head of the corporate services & equipment calibration and testing services.

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A 0056044



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

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

Procedure Used :-

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

The temperature scale used was based on ITS-90

Condition of this result of calibration

1. Reference standard instrument -

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND AND JAPAN)
CORPORATE SERVICES, EQUIPMENT CALIBRATION AND TESTING SERVICES
514 PATTANAKARNY-EDD-SOIL-BE-SHANG-LANY-AMANT-LANG-RANGKON-2370
TEL: 0-2611-0001 FAX: 0-2611-0002



Cert.No.: 22CH1733
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No. : 8834291445
ID No. : RYG EN0152
Condition As-Received : Used Item

Received Date : 21 December 2022

Calibration Date : 22 December 2022

Reference : 2212-0602DSC-1

Submitted by : ALS Laboratory Group (Thailand) Co. Ltd
Rayong Branch
616/10 Moo 5 T Maenam Kha,
A Phuakdaeng Rayong 21146 Thailand

Ambient Temperature : (25 ± 2.5) °C

Relative Humidity : (50 ± 15) %

Calibration Procedure : In house method

- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lermagatrakul

Approved by : Maha
Approved Signatory

(/) Mahee Bulkruea
(/) Sathip Meangmai
(/) Warakorn Lermagatrakul

Issue Date : 26 December 2022

The Uncertainties are for a confidence probability of approximately 95 %

This certificate is valid only to the item calibrated on date and place of calibration.
Signed and sealed by the Calibration Officer, S. Lermagatrakul, on 26 Dec 2022 at Rayong Branch

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Cert.No.: 22CH1733
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at -
Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : Two measurement results are traceable to SI through CPA chem. Ltd
ANSI-ASQ National Accreditation Board Accredited No. AR 1839

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
	pH		mV	pH		
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	2.00
	6.987	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe.

- Model : InLab Expert Pro-ISM

- Serial No : 1475518

Dimension of probe

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °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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Certificate of Calibration

Certificate No.: 22E4098
Page: 1 of 2

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenExcellence
Serial No.: B934291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 21 December 2022
Calibration Date: 21 December 2022
Reference: 2212-0602DSC
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Ambient Temperature: 23 ± 2 °C
Relative Humidity: 50 ± 10 %
Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator

Condition of this result of calibration

1. Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1. Multi-Product Calibrator	5500A	6315011	22E1431	05 May 2023
2. This result of calibration was made on requested at the point specified by customer				
3. This certificate is valid only to the item calibrated on date and place of calibration				
4. This Certification is traceable to the International System of Unit maintained at National Institute of Metrology Thailand (NIMT)				

Calibrated by: Wutcharaporn Wongchutakane
Issue Date: 26 December 2022
Approved Signatory: [Signature]
[Signature]
[Signature]
[Signature]

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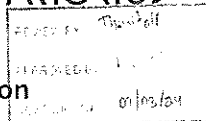
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RYG_EN0002

Sartorius (Thailand) Co., Ltd.
122 Rama 9 Road Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 e-mail: service.thailand@sartorius.com



SARTORIUS



Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0028207038
ID No.: RYG_EN0002
Manufacturer: Sartorius
Certificate No: 23BCI0112
Issued Date: Friday March 03 2023
Reference No: 204833
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: (V1-003)
Based on UKAS LAB 14: 2019

Metrological data
Capacity: 220 g Readability: 0.0001 g
Reasons for calibration
☐ New Installation ☐ Service / Required ☐ Re-calibration / Maintenance
Equipment Condition: ☒ Good Operate ☐ Fa-

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

Traceability:

Model Number	Description	Traceability	Certificate No	Due Date
YCS011-522-00	Sartorius weight set 1mg 5000g E2 YCS011 522 00	SPC-RT	C02212585	14-Sep-2023
MHB-382SD	Humidity/Barcrometer/Temp. Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Mr Chonchai Inthana (Technical Manager)



Sartorius (Thailand) Co., Ltd.
122 Rama 9 Road Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643 8367 e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0028207038
ID No.: RYG_EN0002
Manufacturer: Sartorius
Certificate No: 23BCI0112
Issued Date: Friday March 03 2023
Reference No: 204833
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 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, i.e. 10 g or 10 g at maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points in positions defined according to OIML R110.
Nominal Value (Low Load): 20 g Tolerance: 0.0001 g	Nominal value: 100 g Tolerance: 0.0004 g
Nominal Value (High Load): 200 g Tolerance: 0.0001 g	Difference: 1, 2, 3, 4, 5, 6
Standard Deviation: 0.000002, 0.000003	

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: 0.0, 0.05, 0.1, 0.5, 1, 5, 10, 20, 50, 100, 200
Conventional Mass Value: 0.0100, 0.0500, 0.1000, 0.5000, 1.0000, 5.0000, 10.0000, 20.0000, 50.0000, 100.0000, 200.0000
Displayed Value: 0.0100, 0.0500, 0.1000, 0.5000, 1.0000, 5.0000, 10.0000, 20.0000, 50.0000, 100.0000, 200.0000
Deviation: 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000, 0.0000
Uncertainty: 0.000013, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014, 0.000014

End of Report



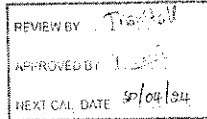
TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES, EQUIPMENT CALIBRATION AND TESTING SERVICES
574/4 PATTANAKARN ROAD, SUKHUMVIT 11, BANGKOK 10110
TEL : 0 2717 3080 FAX : 0 2719 9484



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

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Mommert
Model : UFE 500
Serial No. : Q511 1572
IO No. : RYG_EN0010
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Phukdaeng,
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 : Mah Pattanapongpaiboon



Approved by :
() Ponthippa Tameyakul
(x) Malee Dulkrua
() Suwat Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

The values are based on the reported uncertainty multiplied by a coverage factor k providing a level of confidence of approximately 95%.

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-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	MY45023932	22LM97	29 Jul 2023

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

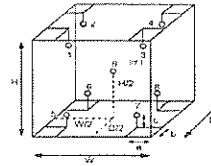
3 This certification is traceable to the International System of Unit

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 m³

Ref. Std. ID No. : @ Calibration Point		
Position :	(160) °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

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-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
160.0	160.0	160.0	0.13	0.89	1.2	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.760	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
160.0	179.723	179.359	179.439	179.489	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES, EQUIPMENT CALIBRATION AND TESTING SERVICES
574/4 PATTANAKARN ROAD, SUKHUMVIT 11, BANGKOK 10110
TEL : 0 2717 3080 FAX : 0 2719 9484

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. Phukdaeng,
Rayong 21140, Thailand

Laboratory Condition : Temperature (25 ± 5) °C

Humidity (50 ± 20) %

Test Procedure : In-house method CP-CH9

by Comparison Technique with Azide Modification Method

Tested by : Watlak Sirthean

Approved by :
Approved Signatory

() Malee Dulkrua
(x) Sathip Maangma
() Warakorn Lertgajirakul

Issue Date : 26 July 2023

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Cert.No.: 23TW166
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	1125143764	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.

-o-o-

Signature
a 1172155



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 16 SEANUKUL SUKUMVIT RANGKON 10250
TEL: 02-017-19600 FAX: 02-017-19601



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. Phukdaeng,
Rayong 21140 Thailand
Location : TPA On-Site Calibration Laboratory
Received Order : 25 July 2023
Calibrated Date : 27 July 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Preecha Hiahib

Approved by : *Signature*
Approved Signatory

() Pornthippa Tameyakul
() Malee Bulkruea
(x) Suwit Injai

Issue Date : 31 July 2023

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

This certificate is valid 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.

A 0052616



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713DSC-2
Procedure Used :

Cert. No.: 23LM125
Page: 2 of 2

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

Condition of this result of calibration

1. Reference standard instrument

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2186080	221285	TPA	21 Oct 2023

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

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

Result of Calibration : () Without Adjustment

Function : Temperature measurement

This instrument was connected with temperature sensor, S/N: 1228475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC* : Unit Under Calibration

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

-o-o-

Signature
a 1159515



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 16 SEANUKUL SUKUMVIT RANGKON 10250
TEL: 02-017-19600 FAX: 02-017-19601



Cert. No.: 23TM002
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Monmert
Model : IPP750
Serial No : V816 0004
ID No : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu.
A. Phukdaeng, Rayong 21140 Thailand
Location : BOD Room
Received Order : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpanboon

Approved by : *Signature*
Approved Signatory

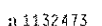
() Pornthippa Tameyakul
() Malee Bulkruea
(x) Suwit Injai

Issue Date : 7 June 2023

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

This certificate is valid 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.

A 0054967



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

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 %.

— 219 —



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

Approved by : Md.
Approved Signatory

Issue Date : 2 November 2022

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

$$\|f\|_{L^1(\mathbb{R}^n)} = \int_{\mathbb{R}^n} |f(x)| dx = \int_{\mathbb{R}^n} |f(x)|^p dx^{1/p} = \|f\|_{L^p(\mathbb{R}^n)}.$$
$$N(\{t_0, \dots, t_n\}) = \{t_0, \dots, t_n\} \text{ and } \text{if } t = q_0 \dots q_{n-1} \in \mathcal{A} \text{ then } N(t) = \{t_0, \dots, t_n\} \text{ if } t_0 = q_0, \dots, t_n = q_n$$

8 1132472

A 0046906



Cert No.: 22TM1491
Page: 2 of 3

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 Units.

Result of Calibration :- (*) Without Adjustment

Function of UUC^a : Temperature Source

Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5 (ref.)	N37P300730



Cert. No : 22TM1491
Page : 3 of 3

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor K
85.0	0.12	0.001	0.18	2

Average* : The average of 30 values in each position

Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location, which are observed at the same time or at as close an observation time as possible

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 %.

-900-

a 1132471

a 1132470



Metrological Center

SCI ECO Services Company Limited

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Saraburi Tel : +66 3627 3056 Fax : +66 3627 3100
Bangkok Tel : +668 8265 6851 +669 8247 2300
Website : www.sci-eco.co.th E-Mail : calibrate@scg.com



Metrological Center

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Certificate No. T230116

Page 2 of 4

Certificate No. T230116

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling Room)
Manufacturer : MODULAR
Model : IREVOHCOO
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. Phakdaeng, 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.

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 :

- 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.
- 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
- 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 : 1 Hour
Fresh Air Damper : ☐ Open ☐ Mm ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment : (X) without adjustment () after adjustment

Approved By. [Signature]



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Metrological Center

SCI ECO Services Company Limited

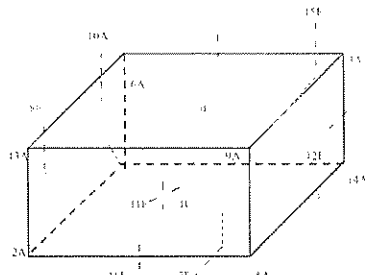
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Certificate No. T230116

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	16F = TN156
6A = TN146	
7F = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11F = TN151	

Approved By. [Signature]

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	TN151	TN152				
3.0	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	TN153	TN154	TN155	TN156												
	3.28	3.22	3.28	3.25												

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	0.20	2.05

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. [Signature]



Certificate of Calibration

Certificate No.: C08220464 Page 2 of 3

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

Certificate No.: C08220464
Issued Date: 27 September 2022
Job No.: KSPR2212224
Page: 1 of 3

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

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 27/12/24
3.2 %RH

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

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

Calibration By: Mr. Chaturphon Folthong
Calibration Date: 27 September 2022

The Method used: In house method, CAL-W-24, base on ASTM E 275-03 and ASTM E 397-04

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. 91410 and 91435
The standard for Photometric Certificate No. 91441 and 101088
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

[Signature]
(Mr. Chaturphon Folthong)
Person in charge

[Signature]
(Mr. Thalongkeat Pongphong)
Authorized signatory

This certificate is based on the units of measurement according to the International System of Units (SI). It provides traceability of measurements 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, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Prachinburi 10250
Phone: +66 2029 7020 Email: info@calibration@dksh.com Website: www.dksh.com/calibration/thailand

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Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of 634 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.4	0.21	0.14	
536.68	536.7	-0.04	0.14	
637.98	638.3	-0.32	0.14	
748.46	748.8	-0.32	0.14	
897.03	897.4	-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
	0.5605	0.563	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
440 nm	1.0534	1.057	-0.0036	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
465 nm	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
	0.0000	0.000	0.0000	0.0045
546.1 nm	0.5024	0.506	-0.0036	0.0045
	0.6893	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0036	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5108	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
635 nm	0.9604	0.992	-0.0116	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5025	0.554	-0.0015	0.0045
655 nm	0.7176	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
	0.0000	0.000	0.0000	0.0045
655 nm	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

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CALFM-C08-13 20 Jul 2022

Certificate No.: C08220464 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	0.0080
	0.8609	0.861	-0.0001	0.0084
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	0.638	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 % w/v	Peak	Trough	Ratio	SDW
Standard Wavelength (nm)	268.60	268.63	1.39	2.00
UUC: Wavelength (nm)	268.2	268.1		
Std Absorbance (A)	0.4610	0.3176		
Absorbance (A)	0.373	0.268		

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

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่อง: SPECTROPHOTOMETER รุ่น: DR6000				
หมายเลขเครื่อง: 1627845				
ตรวจสอบ (วัน)		ตรวจสอบ (ครั้ง)		หมายเหตุ
27 Sep 2022		27 Sep 2022		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. หัววัด ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Spectrophotometer				
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.6 VDC	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	656.1 นาโนเมตร 656.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่ตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
pH Meter and Conductivity Meter				
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>
Turbidimeter				
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ทดสอบ (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไมล์ 3.0)	<input type="checkbox"/>	<input type="checkbox"/>
Automatic Diluter				
<input type="checkbox"/>	<input type="checkbox"/>	18. การฉีดล้าง (Rinsing)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อส่งสารและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>

เพื่อตรวจสอบเพิ่มเติม:

Mr. Chaturphon Folthong
Service Engineer

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Metrological Center

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Bangkok Tel : +666 0206 6851 +669 8247 2360
Website : www.sci-eco.co.th E-Mail : calibrator@sci-eco.com



Metrological Center

SCI ECO Services Company Limited

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Certificate No. T230116

Page 2 of 4

Certificate No. T230116

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling Room)
Manufacturer : MODULAR
Model : IREVCOHCOO
Serial No. : C00351459
Customer Code : RYG-EN0184
ID No. : T1939A5
Customer : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T Maenam Khu.
A.Pluakdaeng, Rayong 21140
Customer Location : Laboratory
Date of Receipt : 23 January 2023
Calibrated By : Atuphong 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

TMFC-015-11-05-06

TMFC-015-11-05-06



Metrological Center

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Metrological Center

SCI ECO Services Company Limited

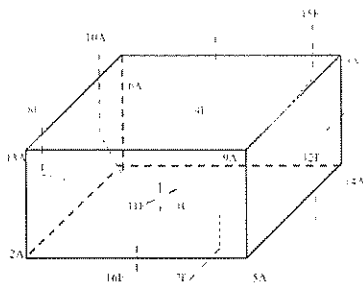
33/2 Moo 3 T Bangpa A Kaengkhon Saraburi 18110 Thailand



Certificate No. T230116

Page 3 of 4

Measurement Results



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

1C = TN141	12F = TN152
2A = TN142	13A = TN153
3A = TN143	14A = TN154
4E = TN144	15E = TN155
5A = TN145	16E = TN156
6A = TN146	
7E = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11H = TN151	

Approved By: _____

TMFC-015-11-05-06

Certificate No. T230116

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 :

- 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 accordance to WI-T20 (based on ASTM E145-04 (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.
- 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
- 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 : 1 Hour
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment
(X) without adjustment () after adjustment

Approved By: _____

Certificate No. T230116

Page 4 of 4

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)															
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152	TN153	TN154	TN155	TN156
3.0	3.03	3.00	3.15	3.14	3.45	3.27	3.1	3.5	3.54	3.4	3.4	3.4				
	TN153	TN154	TN155	TN156												
	3.28	3.25	3.28	3.24												

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	1.26	1.20	2.05

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 uncertainties multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By: _____

TMFC-015-11-05-06

Certificate of Calibration

Certificate No.: C29230010

Page: 2 of 4

Equipment: Block Digestion Unit
Model: KT-20s
Serial No. (or ID.): 5720210002/5770200073
Manufacturer: Garhardt
Condition: In Condition
Certificate No.: C29230010
Issued Date: 18 March 2023
Job No.: KSFR2304392
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. Phluakdaeng,
 Rayong 21140, Thailand.

Environment Condition: Temperature: 25 °C ± 0.5 °C
 Humidity: 65 %RH ± 3.7 %RH
 Voltage: 231 VAC ± 3.1 VAC

REVIEW BY: *[Signature]*
 APPROVED BY: *[Signature]*
 NEXT CAL DATE: 15/03/24

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

Calibration By: Mr. Nakarin Ruengroa

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

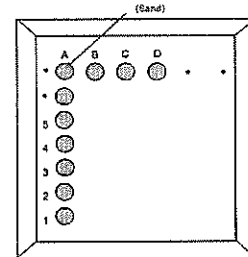
(Mr. Nakarin Ruengroa)
 Person in charge

(Mr. Udon Srichana)
 Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to
 international or national standard or other recognized national standard laboratories.
 The measurement uncertainty stated 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 compared. The report must
 not be reproduced except in full without approval of DKSH Technology Limited.



Fig. 1.: Front view



Location of standard

Fig. 2.: Digestion block

Definitions

Indicating Temperature The average reading of indicating device which forms the integral part of the Digestion block.

Measured Temperature The average reading of working standard at any positions or location.

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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				373.5	-6.5	1.5
C2				372.8	-7.2	1.5
C3				372.1	-7.9	1.5
C4				372.2	-7.8	1.5
C5				374.5	-5.5	1.5
D1				374.7	-5.3	1.5
D2				375.3	-4.7	1.5
D3				375.5	-4.5	1.5
D4				375.8	-4.2	1.5
D5				375.1	-4.9	1.5

Certificate No.: C29230010

Page: 4 of 4

Calibration Results: After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	379.0	-1.0	1.5
A2				378.7	-1.3	1.5
A3				379.4	-0.6	1.5
A4				379.2	-0.8	1.5
A5				379.2	-0.8	1.5
B1				379.8	-0.2	1.5
B2				379.2	-0.8	1.5
B3				379.5	-0.5	1.5
B4				378.9	-1.1	1.5
B5				379.1	-0.9	1.5
C1				379.1	-0.9	1.5
C2				377.7	-2.3	1.5
C3				378.4	-1.6	1.5
C4				378.2	-1.8	1.5
C5				378.0	-2.0	1.5
D1				379.5	-0.5	1.5
D2				378.7	-1.3	1.5
D3				379.7	-0.3	1.5
D4				379.5	-0.5	1.5
D5				379.4	-0.6	1.5

The End of Certificate

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Agilent
CrossLab
From Insight to Outcome

เลขที่ใบงาน: KSPR2304362

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ครั้ง)		หมายเหตุ
15 Mar 2023			15 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<i>General</i>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพขั้วบิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพหัวเครื่อง	<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"/>	

REVIEW BY *Shanell L*
 APPROVED BY *Shanell L*
 EFFECTIVE DATE *01/01/24*



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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.

Instrument Maintenance

System Information

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

Instrument System Name and ID	G9000A ; M416010005
Instrument System Site and Location	ALS (UK)

List System Component Product Numbers	List the Serial Numbers of each Component
1 G9000A	M416010005
2 G9410A	A016440964
3 G3291	6016-00169
4 G9405	A016040115
5	
6	
7	
8	
9	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	<u>Sea Spray</u> <u>GeneNeb</u> <u>Conical</u> Other
Spray Chamber	<u>Cyclonic Single Pass</u> <u>Cyclonic Double Pass</u> Other
Torch	<u>Radial</u> <u>Dual View</u> Other
Torch Type	<u>One Piece</u> <u>Semi-Dismountable</u> <u>Fully Dismountable</u> Other
Injector Diameter	<u>2.4mm</u> <u>1.8mm</u> <u>1.6mm</u> <u>0.8mm</u> Other
Injector Material	<u>Quartz</u> <u>Ceramic</u> Other

Preparation

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

Preventive Maintenance Procedures

Record Pre-PM Instrument performance

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

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water, cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, debris or necessity.
- ☒ 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 as 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 check out

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation
- ☒ Record the Preventive Maintenance service activity in the customer's record logbook
- ☒ Record the PM event in the Smart Alerts logbook, if applicable
- ☒ Update/re-set 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*
Hy 219.507 nm SRR	33603.9	146365.1	33,349.9	169,369.5
Mn 279.483 nm SRR	153635.9	630860.3	159,350.0	912,496.1
Al 396.152 nm SRR	29553.5	205141.7	28,955.9	196,802.0
P 406.491 nm SRR	90216.9	316127.8	99,395.4	286,3954.9

* 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	219.599 VAC	216.135 VAC
Mains Current	0.217 A	0.116 A
Instrument Temperature	24.4 °C	24.3 °C
RF Air Flow (sensor speed)	16.0 Hz	20.0 Hz
Plasma Exhaust Temperature	No measurement	49.3 °C
Water Flow Operator	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
Polyimide Matrix Temperature	35.0 °C	35.0 °C
CCD Temperature	-40.0 °C	-40.0 °C
Thermal Stabilizer	34.8 °C	35.0 °C
Argon Supply Pressure	613.93 kPa	561.92 kPa
Purge Gas Supply Pressure*1	669.34 kPa	567.97 kPa
Option Gas Supply Pressure*1	— kPa	— kPa
Nebulizer Flow	No measurement	0.90 L/min
Nebulizer Back Pressure	No measurement	155.76 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	9.229 A
RF Supply Voltage	No measurement	194.432 V

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Anal Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A, G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-003*	Agilent Water Recirculator	—
Purge Gas Filter	G8010-60136	All	1
Air dryer filter	G8010-60202	All	1
High Capacity Air Filter	G8010-60189	Optional	—
Rotar seal for 6-port valve for A/360	G8454-00002	G8454A, G8495	—
Rotar seal for 4-port valve for A/54	G8453-00001	G8493A	—
Reverse solution to waste solution 2 Standard x 1m	G8410-50123	SFS 4	1
Barbed connector 7.5mm ID x 5mm ID	G8410-50124	SFS 4	1
PVC waste tubing 5mm ID x 5mm ID 2m	G8410-50122	SFS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	541094/500	SFS 3	—
Z axis drive belt	541094/400	SFS 2	—
Peristaltic pump tubing PVC Solvaflex 3 bridged	571004/400	SFS 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: 6005635434 Date Service Completed: 2 - May - 2023

Service Engineer Name: Surin Ngamvijit Customer Name: Thitiwong

Service Engineer Signature: Surin Ngamvijit Customer Signature: Thitiwong

Total number of pages in this document:

Metrological Center

P.O. Box 10, Bangkok, Thailand 10110

33/2 Moo 3 T.Banpa A.Kaengkhro Saraburi 18110

Telephone: +66 2 586 5762 J Fax: +66 2 586 5109

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



Certificate No. T231676

Page 1 of 6

Certificate of Calibration

Equipment : HEATING BLOCK

Manufacturer : Environmental Express

Model : SC 196

Serial No. : 6974CECW3285

Customer Code : BKK_EL0054

ID No. : T5306A3


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

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

Customer Location : Acid Digestion Lab

Date of Receipt : 13 September 2023

Calibrated By : Sanee Musikawan (Site Calibration Manager)

Approved By :  / Sujjar Nakhakred (Site Calibration Manager)

Date of Issue : 21 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



Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T231676

Page 2 of 6

Calibration Report

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

Condition of this results of calibration :

- 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-120
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 (SSC T151 T15 T152 °C CALIBRATION 0241)
- 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. _____

FM111108 10405 57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhohi, 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 1231676

Page 4 of 6

Calibration Report

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	Cal Point	TN21	TN22	TN23	TN24	TN25	TN26
	Max	95.01	94.41	95.20	95.41	94.93	95.17
	Min	94.57	94.15	94.78	94.97	94.89	94.77
Average		94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12	Cal Point	TN27	TN28	TN29	TN30	TN31	TN32
	Max	95.15	95.43	95.19	95.16	95.35	94.97
	Min	94.94	94.95	94.72	94.71	94.89	94.67
Average		95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18	Cal Point	TN33	TN34	TN35	TN36	TN37	TN38
	Max	95.17	95.50	95.22	95.21	95.33	95.31
	Min	94.93	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	TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.59	94.42	94.52	94.24	94.63	94.67
	Min	95.21	94.06	94.13	93.88	94.28	94.27
Average		95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30	Cal Point	TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.91	95.30	95.14	95.03
	Min	94.83	95.03	92.56	94.95	94.79	94.76
Average		95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36	Cal Point	TN31	TN32	TN33	TN34	TN35	TN36
	Max	94.63	94.90	94.77	94.31	94.24	93.87
	Min	94.24	94.55	94.44	93.98	94.02	93.56
Average		94.43	94.72	94.60	94.14	94.68	93.71
R7 Hole37-Hole42	Cal Point	TN37	TN38	TN39	TN40	TN21	TN22
	Max	94.70	94.44	94.94	93.81	94.89	95.35
	Min	93.95	94.05	93.67	93.48	94.39	94.90
Average		94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48	Cal Point	TN23	TN24	TN25	TN26	TN27	TN28
	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. _____

FM111108 10405 57



Metrological Center

SCI ECO Services Company Limited

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

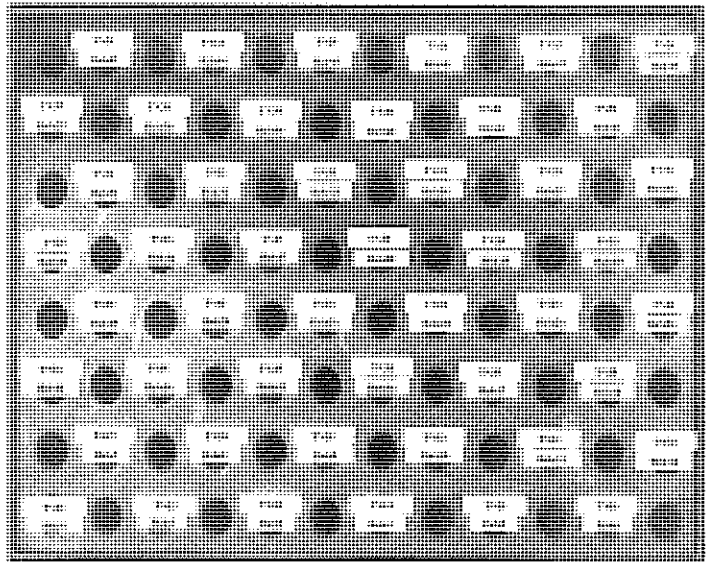
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Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By. _____

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Metrological Center

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Certificate No T231676

Page 5 of 6

Calibration Report

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	Cal Point	TN21	TN22	TN23	TN24	TN25	TN26
	Max	105.23	104.32	105.43	105.25	104.44	105.27
	Min	104.84	103.95	105.15	105.04	104.11	104.96
Average		105.07	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12	Cal Point	TN27	TN28	TN29	TN30	TN31	TN32
	Max	105.38	105.12	105.18	105.22	105.12	105.16
	Min	105.11	104.92	104.96	105.09	104.92	104.97
Average		105.25	105.02	105.07	105.11	105.07	105.06
R3 Hole13-Hole18	Cal Point	TN33	TN34	TN35	TN36	TN37	TN38
	Max	105.37	105.63	105.62	104.90	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	TN39	TN40	TN21	TN22	TN23	TN24
	Max	105.31	104.43	106.41	104.71	105.63	105.82
	Min	105.08	104.22	106.15	104.41	105.37	105.56
Average		105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30	Cal Point	TN25	TN26	TN27	TN28	TN29	TN30
	Max	104.95	106.26	103.34	105.78	105.59	105.87
	Min	104.67	105.96	103.68	105.56	105.36	105.68
Average		104.81	106.11	103.21	105.67	105.48	105.77
R6 Hole31-Hole36	Cal Point	TN31	TN32	TN33	TN34	TN35	TN36
	Max	104.75	104.86	104.89	105.20	104.50	104.39
	Min	104.54	104.63	104.59	105.07	104.32	104.18
Average		104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42	Cal Point	TN37	TN38	TN39	TN40	TN21	TN22
	Max	104.70	104.90	104.85	104.65	104.88	104.85
	Min	104.69	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	TN23	TN24	TN25	TN26	TN27	TN28
	Max	105.71	105.85	105.39	105.61	105.42	105.19
	Min	105.45	105.61	105.14	105.27	105.18	104.94
Average		105.58	105.73	105.27	105.44	105.30	105.07

Approved By. _____

FM111108 10405 57



Metrological Center

SCI ECO Services Company Limited

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

Certificate No. T231676

Page 6 of 6

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	0.87
107.0	107.0 107.1	107.1	0.19	0.78

* The quoted uncertainty exclude 1 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-1.13 108-30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, 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	T210909	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 3 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.Kaengkhoi, Saraburi 18110, Thailand.

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

Bangkok Tel : +668 9205 6851 , +669 8247 2380

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 Nakkakred (Site Calibration Manager)

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

Date of Issue : 04 JUL 2022

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

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

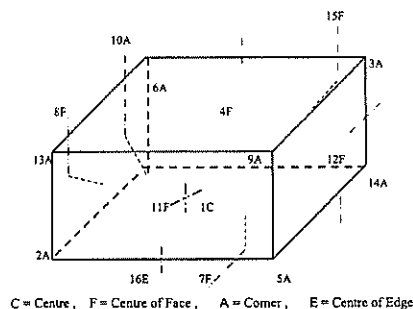
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T221644

Page 3 of 4

Calibration Report



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

Approved By: _____

FM-L15 117/15-05-63



Certificate No. T221644

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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	3.63	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-L15111715-05-63

BKK_EN0284

BKK_EN0130

REVIEWED: Autchongwan S.
APPROVED: Sornrat M.
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

Certificate of System Qualification

GC-QC - GCMS-QC

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

Date: May 25, 2023 11:05:07 AM
EOP Name: AgilentRecommended AgilentRecommended
EOP Revision: GC.Q2.52 GCMS.Q2.51
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: SESSIONNAME

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front: MM

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

Page 1 / 17

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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 °C
Accuracy: 0.0 °C
Agilent Recommended: >= -1.0 °C % setpoint in K (-5.0 °C)
<= 1.0 °C % setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 100.0 / 100.0 °C
Temperature: 100.0 °C
Accuracy: 0.0 °C
Agilent Recommended: >= -1.0 °C % setpoint in K (-3.7 °C)
<= 1.0 °C % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Zone: Oven
Setpoint/Average: 100.0 / 100.0333 °C
Temperature: 100.0 °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

Page 2 / 17

Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	7693A			
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	Front	MMI	/ External	TQ
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 %	14.08	%
Agilent Recommended	<= 15.00	<= 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
Vial Heater	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN18153080
Firmware Revision	B.02.05
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Inlet 2

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

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

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Manufacturer	Agilent Technologies
Source Type	El + Extractor
Number of filaments	2

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Signature Creation Date:	May 25, 2023
Reason for Signature:	Executed protocol and published this original version of document

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System ID: 734 10
Print Date: May 26, 2022 11:05:08 AM

.....

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:32:30 PM	Audit	Session Created	Session	None
May 22, 2023 1:32:33 PM	Start	Configuration	Session	None
May 22, 2023 1:32:50 PM	Audit	Enrollment	Licensing	User is FieldEngineer and does not require an unlock code
May 22, 2023 1:37:48 PM	Audit	ExpLoaded	Session	EGP data for primary technique [G1]. File path: {Protocol\Peaks\GeoMapConfiguration\G2\G2_03_03_02.ecp}. EGP File Name: {G2_03_02.ecp}. EGP Name: {AgentRecommendations\Preval Revision [G2_03_02]}. EGP points to hypertextive technique [G134]. File path: {Protocol\Peaks\GeoMapConfiguration\G2_51\G2_51_02_51_01.ecp}. EGP File Name: {G2_51_02_51.ecp}. EGP Name: {AgentRecommendations}
May 22, 2023 1:37:52 PM	End	Configuration	Session	None
May 22, 2023 1:37:56 PM	Start	Qualification	Session	EO
May 22, 2023 1:38:58 PM	Start	Execution	CDS Logon Verification - QC - Qualitative test	None
May 22, 2023 2:02:21 PM	Start	Execution	CDS Logon Verification - QC - Qualitative test	None
May 22, 2023 2:02:33 PM	Start	Execution	Insured Detection Limit	None
			Injection Tower, Front MWL TQ; Source: C1 - Eutrope - RSD L (Age) = 12.00% - RSD L (Rel. Error) = 1.00%	

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System ID: GM-10
Print Date: May 24, 2023 11:03:07 AM

Age Group	Percentage
18-24	10%
25-34	15%
35-44	20%
45-54	25%
55-64	20%
65-74	15%
75-84	10%
85+	5%

Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 9:02 97 PM	Start	Execution	CDS Logon Verification - GC - Qualitative test	None
May 22, 2023 9:03 33 PM	End	Execution	CDS Logon Verification - GC - Qualitative test	Run Count: 1
May 22, 2023 9:21 48 PM	Start	Execution	System Inspection and Basic Safety and Operation - T8950 - Qualitative Test - No salpines associated	None
May 22, 2023 9:35 02 PM	End	Execution	System Inspection and Basic Safety and Operation - T8950 - Qualitative Test - No salpines associated	Run Count: 1
May 22, 2023 9:35 17 PM	Start	Execution	Intel Pressure Accuracy - Front MM - Pressure Controlled Inlet S: 25.0 psi - L: \approx 1.2 psi	None
May 22, 2023 9:35 52 PM	End	Execution	Intel Pressure Accuracy - Front MM - Pressure Controlled Inlet S: 25.0 psi - L: \approx 1.2 psi	Run Count: 1
May 22, 2023 9:50 04 PM	Start	Execution	GC Oven Temperature Accuracy - T8920 - Temperature Oven - S: 250.0°C - L: \approx 1.0 AHD \approx 1.0% setpoint in K	None
May 22, 2023 9:50 48 PM	Audit	Data	GC Oven Temperature Accuracy - T8920 - Temperature Oven - S: 250.0°C - L: \approx 1.0 AHD \approx 1.0% setpoint in K	Manual Data Entry
May 22, 2023 9:55 04 PM	End	Execution	GC Oven Temperature Accuracy - T8920 - Temperature Oven - S: 250.0°C - L: \approx 1.0 AHD \approx 1.0% setpoint in K	Run Count: 1

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User Name: natthapat.hongcharoen
Hostname: ASBKKW235

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

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:35:55 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:59:02 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	None
May 27, 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) <= 12.00% - RSD L (Rel. Time) <= 1.00%	None
May 22, 2023 3:12:01 PM	Start	Execution	Mass Rate Prediction - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 6.00%	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 3:17:55 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 3:18:00 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

Page 3/9

User Name: natthapat.hongcharoen
Hostname: ASBKKW235

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 3:29:07 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None
May 22, 2023 3:29:10 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	None
May 22, 2023 4:02:50 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	None
May 22, 2023 4:03:00 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	None
May 22, 2023 4:03:52 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	Manual Data Entry
May 22, 2023 4:03:54 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	Run Count: 1
May 23, 2023 3:16:15 PM	Audit	AccClosed	Session	None
May 24, 2023 4:03:19 PM	Audit	AccRestarted	Session	None
May 24, 2023 4:14:49 PM	Audit	AccClosed	Session	None
May 25, 2023 10:13:37 AM	Audit	AccRestarted	Session	None
May 25, 2023 10:27:12 AM	Audit	SessionReleased	Session	None

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

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

Page 12 / 17

User Name: natthapat.hongcharoen
Hostname: ASBKKW235

System ID: GM-10
Print Date: May 25, 2023 11:05:03 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:27:13 AM	Start	Qualification	Reason	OD
May 25, 2023 10:27:18 AM	Start	Execution	Tune EI - 70000 TQ - Source - None (Qualitative - No setpoints associated)	
May 25, 2023 10:27:42 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 1 (Qualitative - No setpoints associated)	
May 25, 2023 10:27:56 AM	End	Execution	Tune EI - 70000 TQ - Source - Run Count: 1 EI - Extractor Element 1 (Qualitative - No setpoints associated)	
May 25, 2023 10:27:57 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 2 (Qualitative - No setpoints associated)	
May 25, 2023 10:28:07 AM	End	Execution	Tune EI - 70000 TQ - Source - Run Count: 1 EI - Extractor Element 2 (Qualitative - No setpoints associated)	
May 25, 2023 10:28:08 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	
May 25, 2023 10:28:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	
May 25, 2023 10:28:20 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	

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User Name: natthapat.hongcharoen
Hostname: ASBKKW235

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 10:28:58 AM	Audit	Data	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	Data Risk Path D:\MassHunter\GCMS\1\data\AgilentAQ_2023\REQ_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) <= 12.00% - RSD L (Rel. Time) <= 1.00%	
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data Risk Path D:\MassHunter\GCMS\1\data\AgilentAQ_2023\REQ_001.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data Risk Path D:\MassHunter\GCMS\1\data\AgilentAQ_2023\REQ_002.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data Risk Path D:\MassHunter\GCMS\1\data\AgilentAQ_2023\REQ_003.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data Risk Path D:\MassHunter\GCMS\1\data\AgilentAQ_2023\REQ_004.D

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

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

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User Name: nartapat.hangchansen
Hostname: ASBKKW0285
System ID: GM-10
Print Date: May 25, 2023 11:05:00 AM

ALS_GM-10 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:50 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_005.D
May 25, 2023 10:30:59 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_006.D
May 25, 2023 10:30:59 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_007.D
May 25, 2023 10:30:59 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_008.D
May 25, 2023 10:31:02 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_009.D
May 25, 2023 10:30:51 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\01_010.D
May 25, 2023 10:50:19 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ • Source: • EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. 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: nartapat.hangchansen
Hostname: ASBKKW0285
System ID: GM-10
Print Date: May 25, 2023 11:05:00 AM

ALS_GM-10 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:31:02 AM	Start	Reporting	Session	None
May 25, 2023 11:04:34 AM	Auto	Reporting	Session	Report Generated Certificate

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

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User Name: nartapat.hangchansen
Hostname: ASBKKW0285
System ID: GM-10
Print Date: May 25, 2023 11:05:00 AM

ALS_GM-10 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:52 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	None
May 25, 2023 10:30:49 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_01.D
May 25, 2023 10:30:49 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_02.D
May 25, 2023 10:30:49 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_03.D
May 25, 2023 10:30:49 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_04.D
May 25, 2023 10:30:49 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_05.D
May 25, 2023 10:30:46 AM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Data File Path: D:\MassHunter\GCMS\data Agilent\QO_2023\MRP_06.D
May 25, 2023 10:30:57 AM	End	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ • Source: • EI - Extractor - L (RSD) <= 5.00%	Run Count: 1
May 25, 2023 10:31:02 AM	End	Qualification	Session	QC

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

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Bara Scientific Co., Ltd.
8/6 L, Chulalongkornrajavidyalaya University
100, Phra Pradaeng Road, Phra Pradaeng Sub-township,
Bangkok 10130, Thailand
Tel: 02-26241111, Fax: 02-26241112, Email: info@bsc.co.th



Certificate of Calibration

Number of Pages: 1 of 1

Certificate No: BSCC-UV-197-23
Equipment: UV-Vis Spectrophotometer
Model: Shimadzu
Manufacturer: Shimadzu
Serial No: A11454060133CD
ID No: 6166-112006
Date of receipt: 15 September 2023
Date of calibration: 16 September 2023
Date of issue: 27 September 2023

Customer name: ALS Laboratory Group (Thailand) Co., Ltd.
Address: 164 Soi Phatthanakorn 40, Phatthanakorn House, Phatthanakorn Suan Luang Bangkok 10250

Temperature: (23.4 - 24.7) °C (On site)
Humidity: (65.5 - 61.2) %RH (On site)

Equipment condition: Good Operation

Calibration Location: Organ & Prep

Calibration Procedure: in-house method: Wt UV 702-01 based on ASTM E275-01

Traceability: Wavelength Accuracy is traceable to certificate No. 95917 and 95918
Photometric Accuracy is traceable to certificate No. 95937 and 95924
Spectral Light is traceable to certificate No. 95868
The above certificate are traceable to SI unit through Bara Scientific Ltd.
(UKAS accredited calibration laboratory No. 06659)

Calibrated by: Mr. Wanchana Jantasee

Approved by:

Mr. Kanchit Choothep
Technical Manager



Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375486-7
www.barascientific.com



Certificate of Calibration

Certificate No BSCC-UV-367/23

Number of Pages: 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
572.89	573.14	0.25	0.16
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	0.7469	-0.0002	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

This is a copy of the certificate of calibration. It is not valid if it is not signed by the calibration engineer. The calibration engineer is responsible for the accuracy of the calibration. The calibration engineer is responsible for the accuracy of the calibration. The calibration engineer is responsible for the accuracy of the calibration.

PM UV 705/02 Rev 01 (23/01/13)

BSC-EL0026



Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375486-7
www.barascientific.com



Certificate of Calibration

Certificate No BSCC-UV-367/23

Number of Pages: 1 of 3

Calibration Results

3 Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5765	0.5761	-0.0004	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.0205	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	0.7452	-0.0003	0.0042
	0.9285	0.9289	0.0004	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5223	-0.0004	0.0042
	0.6889	0.6873	-0.0016	0.0042
	0.9487	0.9486	-0.0001	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9353	0.9344	-0.0009	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
	1.0342	1.0325	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5612	-0.0004	0.0042
	0.6927	0.6903	-0.0024	0.0042
	1.0581	1.0566	-0.0015	0.0042

*CNR = Customer not request

4 Stray Light*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC) Wavelength (nm)	Transmission (T)	Absorbance (A)
200 95±0.1nm	200.55	0.9770	2.0104

The Stray Light transmission reference is less than 1.01% and Stray Light Absorbance reference is greater than 2.00A
*Stray Light not NSC-ONSC 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

This is a copy of the certificate of calibration. It is not valid if it is not signed by the calibration engineer. The calibration engineer is responsible for the accuracy of the calibration. The calibration engineer is responsible for the accuracy of the calibration. The calibration engineer is responsible for the accuracy of the calibration.

PM UV 705/02 Rev 01 (23/01/13)

7700 Series ICP-MS Preventive Maintenance Checklist - Standard

Agilent Technologies

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/pdfs/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 List 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.

REVIEWED BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 01/01/14

7700 Series ICP-MS Preventive Maintenance Checklist - Standard

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System Information

Instrument system name and ID: 7700x ICP-MS

Instrument system site and location: ALS Laboratory Group (Thailand) Ltd.

List system component product numbers	List the serial numbers of each component
1 63881A	1 7812044612
2 63881A	2 444220700
3 63881A	3 021204510
4 63881A	4
5 63881A	5
6 63881A	6
7 63881A	7

ICP-MS configuration table	Circle the type or write in the type if other
Nebulizer	Micro Mist Micro Flow <input checked="" type="radio"/> Ultra Mist other
Spray Chamber	Quartz PFA other
Torch	Quartz Demountable other
Sampling Cone	S P Pt other
Skimmer Cone	S P Pt N-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.

7700 Series ICP-MS Preventive Maintenance Checklist - Standard

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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 5100-0145 for E2M18, P/N 5100-0202 for E2M18-2)
- ✓ 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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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 mode hunt
 - ✓ Verify good gas control function by changing the flow and observing the meter readings; perform an automatic offset adjustment for the MFCs
 - ✓ Verify in Tune using the customer's last time that changes in lens voltages result in the expected sensitivity change
 - ✓ Perform Startup including performance report and an Anosure. Print the Anosure 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. For Performance report with G7201A-1 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 Preventive Maintenance Checklist - Standard

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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 ₂ Gas @ 4ml/min	Analysis Mode He Gas @ 4ml/min
RF Power	7.65 W	2.42 W		2.42 W
RF Reflect				
Plasma Freq	1.00 MHz	1.00 MHz		1.00 MHz
Carrier Gas (CF ₄)	15.5 L/min	15.5 L/min		15.5 L/min
Water Temp	0 °C	15.0 °C		
Water Temp		22.0 °C		
Inlet Temp	25.0 °C	25.0 °C		
Inlet Temp	25.0 °C	25.0 °C		
RF Power		15.51 Watts		
RF Reflect		5 Watts		
Plasma Freq		2.00 MHz		
Carrier Gas (CF ₄)		15.51 L/min		
Ar Gas Tank Press		5.0 MPa		
Carrier Gas		1.00 L/min		
MU Inlet Gas		0.10 L/min		
Plasma Gas		15.00 L/min		
Aux Gas		0.50 L/min		
S/C Temperature		2.0 °C		
Orb Gas Tank Press 1		~ MPa		
Orb Gas Tank Press 2		~ MPa		

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	1496 V
Discriminator Voltage	Not applicable	2.5 mV

7700 Series ICP-MS Parts List Table

Part Description	Part Number	Product/Model # where used	Quantity Consumed
HL Rough Pump Unit	0040-0833	7700 ICP-MS	2
Oil Mist Filter Kit for E2M18	3162-1056	7700 ICP-MS	1
Oil Mist Filter for D8402	9460-04250002	7700 ICP-MS	1
Graphite Gasket for Sample Cone (Lpk)	G3280-07009	7700 ICP-MS	1
7700 Octopole	G3280-07045	7700 ICP-MS	1
Poly clear cooling fluid	G3292-80010	G1870B G3292A	1
Rinse - Drain tubing	G3286-80117	ASX-500	1
Tubing - connection kit for drain	G3286-80118	ASX-500	1
Peristaltic pump tubing set	G3160-05326	I-AS	1
Drain tubing to rinse bottle and drain bottle	G3160-05328	I-AS	1
Rotary seal for Valve (ISJS)	G3338-05117	ISJS	1
Additional parts may be required from engineers stock			
Inlet Filter E2M18	5180-0145	7700 ICP-MS	1
Inlet Filter D8402	SH03700237	7700 ICP-MS	1
Peristaltic pump tape (30m roll)	5013-0030	7700 ICP-MS	1
Polishing Paper Kit (4000 #1200, 5 sheets each)	G1833-05404	7700 ICP-MS	1
Cotton Swabs, ultra-fine conical head shape at both ends (100/pk)	0300-2574	7700 ICP-MS	1
Alumina Powder	8660-0701	7700 ICP-MS	1
Lint-free paper	05980-08051	7700 ICP-MS	1
Z-Axis Drive PEEK Cable (Anti-Rink)	G3286-00331	ASX-500	1
Z-Axis Drive Assembly (PEEK Anti-Rink)	G3286-00330	ASX-500	1

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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
- Need technical support, FAQs? www.agilent.com/chem/techsupport
- Need supplies? www.agilent.com/chem/supplies

Service Completion

Service request number: 609 6141623 Date service completed: 12 June 2023

Agilent signature: [Signature] Customer signature: [Signature]

Document part number: G3280-90078

Issued: 7-Feb-2014, Revision: 1.2

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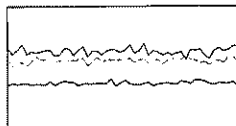
Agilent Technologies

Tune Report

Operator Name: Supakwan Mak
Acq/Data Batch: C:\Agilent\CPM\H1\UserTune.b
Acq. Date/Time: 6/12/2023 4:05:12 PM
Report Comment: PM 12 June 2023
Instrument Name: G3281A JP12091612

[No Gas]

Sensitivity



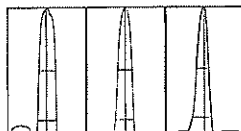
Mass	Range	Count	RSD%	Background
7	10000	6310	4.424	2.100
89	50000	27817	3.328	3.600
205	50000	18565	3.537	9.500

Sampling Period [sec]: 0.311
Integration Time [sec]: 0.1

Oxide/Doubly Charged Ratio

Oxide: 156 / 140: 1.492 %
Doubly Charged: 70 / 140: 1.506 %

Resolution/Axis



Mass	Peak Height	Axis	FW-50%	FW-10%
7	8337.86	7.00	0.84	0.730
89	27961.94	89.00	0.55	0.710
205	12916.73	205.00	0.45	0.726

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 Makeup Gas: 0.10 L/min
RF Power: 1550 W Option Gas: --- Auxiliary Gas: 0.50 L/min
RF Matching: 1.80 V Nebulizer Pump: 0.10 rps Plasma Gas: 15.0 L/min
Sample Depth: 8.0 mm S/C Temp: 2 °C

Lens Parameters

Extract 1: 0.0 V Omega Lens: 9.4 V Defect: 11.8 V
Extract 2: +145.0 V Cell Entrance: -30 V Plate Bias: -40 V
Omega Bias: -90 V Cell Exit: -50 V

Cell Parameters

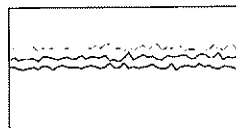
Use Gas: No 3rd Gas Flow: --- Energy Discrimination: 5.0 V
He Flow: 0.0 mL/min OctP Bias: -8.0 V

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
89	20000	11826	2.752	7.200
89	20000	13307	2.527	5.800
205	50000	25571	2.706	13.300

Sampling Period [sec]: 0.31
Integration Time [sec]: 0.1

Oxide/Doubly Charged Ratio

Oxide: 156 / 140: 1.165 %
Doubly Charged: 70 / 140: 1.586 %

Tune Parameters

Plasma Parameters

Plasma Mode: --- Nebulizer Gas: 1.00 L/min Makeup Gas: 0.10 L/min
RF Power: 1550 W Option Gas: --- Auxiliary Gas: 0.50 L/min
RF Matching: 1.80 V Nebulizer Pump: 0.10 rps Plasma Gas: 15.0 L/min
Sample Depth: 8.0 mm S/C Temp: 2 °C

Lens Parameters

Extract 1: 0.0 V Omega Lens: 7.4 V Defect: 3.6 V
Extract 2: -200.0 V Cell Entrance: -90 V Plate Bias: -115 V
Omega Bias: -90 V Cell Exit: -70 V

Cell Parameters

Use Gas: Yes 3rd Gas Flow: --- Energy Discrimination: 3.0 V
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 QP Bias: -18.0 V
Mass Offset: 124 Axis Offset: 0.12

Hardware Settings

Torch: Torch H: -0.4 mm Torch V: 0.0 mm

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
visual check Goldtraps	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
Absorption cell Incl window	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
lens	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
Swivel drive (SEV)	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
check pump hoses	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
check hoses and hose connectors	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
check and clean reactor	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.	<input checked="" type="checkbox"/> changed. <input type="checkbox"/>
check bubble-sensor	o.k.	<input checked="" type="checkbox"/> not o.k. <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	12 - 15 bar	15 bar
Valve 1	10 NL/h or 0.166 NL/min	0.163 NL/min
Valve 2	50 NL/h or 0.833 NL/min	0.403 NL/min
Valve 3	5 NL/h or 0.083 NL/min	0.140 NL/min
Valve 4	10 NL/h or 0.166 NL/min	0.108 NL/min
Acid	2.5 ml/min ± 1 ml	2.5 ml/min
Red -agent	2.5 ml/min ± 1 ml	2.5 ml/min
Sample	10 ml/min ± 2 ml	10 ml/min
Adventitious light - values	(V)	from file
100	0	0
200	0	0
300	0	0
350	0	0
400	0	0
450	2	2
500	5	5
550	10	10
575	15	14
600	20	20

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions . max conc. 10 µg/L PMT-voltage . 360 V		
Blank-solution	Int. 0.00024	Int. 0.00024
without enrichment / FBR 30 ng/L	Int. > 0.0015	Int. 0.00172
	RSD < 3 %	RSD 0.45 %
Conditions . max conc. 1.7 µg/L PMT-voltage . 352 V		
Blank-solution	Int. 0.00370	Int. 0.00370
with enrichment / FBR 30 ng/L	Int. > 0.008	Int. 0.01060
	RSD < 3 %	RSD 2.38 %
Fok - factor (Int ₂ / Int ₁)	> 3.5	6.16
Analytical parameters Absorption cell		
Blank solution	Ext. 0.00093	Ext. 0.00093
without enrichment / FBR 100 ng/L	Ext. > 0.0012	Ext. 0.00449
	RSD < 5 %	RSD 2.58 %
Comments		

Signature Technician

Signature Customer

24 May 2023
Place, Date (DD/MM/YYYY)

24 May 2023
Place, Date (DD/MM/YYYY)

5/24/2023 12:46 Page 1/4

Customer's address
Customer's Ref. No.
Date of delivery
Date of return
Date of payment

Service Report

Customer's address	Customer's Ref. No.
STERN UNIVERSITÄT WÜRZBURG Fakultät für Chemie Lehrstuhl für Analytische Chemie Am Hubland 97074 Würzburg	
Phone	
Fax	
Job No. 20230221 PM	User
Instrument model Mercur	Serial No. K170A0143
Software Version No. 4.7.10.0	
Repair (RE) <input checked="" type="checkbox"/> Maintenance (PM) <input type="checkbox"/> Installation (IN) <input type="checkbox"/> Upgrade <input type="checkbox"/> Application (AP) <input type="checkbox"/> Risk Prep (RP) <input type="checkbox"/> Upgrade <input type="checkbox"/> Error Code	
Fault / Claim - maintenance contract year 2023 (1 time / year 2023)	
Action taken - maintenance contract year 2023 (1 time / year 2023)	
Action Pending / Recommendation	
Space Pen <input type="checkbox"/> Instrument Configuration <input type="checkbox"/>	
Item No.	Name
1	
2	
3	
4	
5	
6	
7	
8	
Hereby the undersigned confirm the data provided to the work performed, the correct function of the device and the receipt of the specified spare parts. Travelled hours and kilometers can only be entered after the return of the service engineer.	
Date: Signature of Customer	Date: Signature of Service Engineer
Work completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

Mercur

Report file	C:\WinAAS\TMP\2023\May\Pro_632
Program version	4.7.10.0
Operator	PSU OTA
Laboratory	ALS-BKK
Code	IL_Hg095_2023
Remarks	
Food water	

Method parameters

Method	Without enrichment / FBR 30 ng/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
PMT	350 V
AZ time	5 s
Delay	0 s
Working mode	w/o enrich
FBR technique	on
Pump speed	3
Sample load time	10 s
Reaction time	10 s
Waiting time AZ	5 s
Delay	0 s
Purge time1	28 s
Purge time2	15 s
Autosampler	
Autosampler	AS15S/F
Working mode	continuous
System cleaning	Acid
Wash time acid	10 s
Soaking time	20 s
Gas load time	5 NL/h
Gas wash time2	10 NL/h
Tray type	87/139

Dilution

QC parameters

QC type	Conc check	QC check samp 2	---
QC check samp 1	---	Conc	---
Conc	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep measurement	off	QC std 2 no	1(30 000 ng/L)
QC std 1 no	1(30 000 ng/L)	QC std 2 limit	± 50 00%
QC std 1 limit	± 50 00%	Reaction	flag + continue
QC std act	flag + continue	QC Recal factor	off
Expect blank abs	0 0100± 0 0100		
QC precision	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
		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	Ints	SD	RSD/%
1	Cal-Zero	(--)	79	0.000	H 0.000249 A 0.004274	0.000132 0.001698	63.13 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

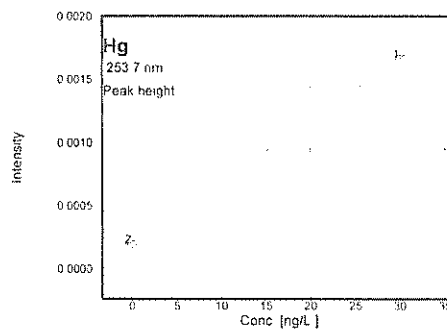
5/24/2023 12:44 Calibration (Peak height)

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)

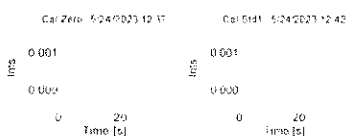
Hg	Without enrichment / FBR 30ng/L PM 24052023	5/24/2023	12:35
ID	Conc.	Ints	BG SD RSD/% Int type Time
Cal-Zero		0.000143	PKH 12:37
		0.000397	12:38
		0.000207	12:40
	0ng/L	0.000249	0.0001324 53.13 12:40
Cal-Std1		0.001720	PKH 12:42
		0.001712	12:43
		0.001728	12:44
	30.00ng/L	0.001720	0.000007897 0.459 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
Operator	PSU GTA
Laboratory	AL S BKK
Code	li_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
PMT	352 V
AZ time	5 s
Delay	0 s
Working mode	Enr w/o reload
FBR technique	off
Pump speed	3
Sample load time	10 s
Reaction time	10 s
Waiting time AZ	10 s
Purge time1	30 s
Purge time2	15 s
Purge time3	20 s
Heat time coil 1	20 s
Integr time	40 s
Peak smoothing	12/11
System cleaning	Off
Wash time acid	10 s
Soaking time	20 s
Gas load time	10 NL/h
Gas AZ wait	10 NL/h
Gas wash time2	5 NL/h
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	---	Reaction	flag + continue
Rep measurement	off	QC std 2 no	1(30 000 ng/L)
QC std 1 no	1(30 000 ng/L)	QC std 2 limit	± 50 00%
QC std 1 limit	± 50 00%	Reaction	flag + continue
QC std act	flag + continue	QC Recal factor	Off
Expect blank abs.	0 0100± 0 0100		
QC precision	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
		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 06689	0 000253 0 002766	2.386 4.136

Hg

Calibration function 1

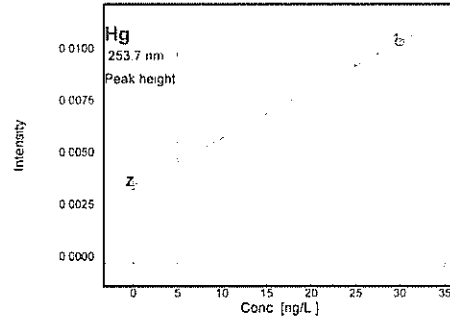
5/24/2023 14:00 Calibration (Peak height)

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)

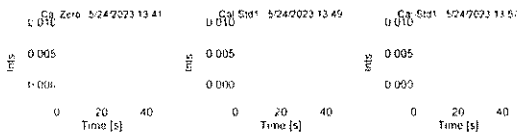
Hg	Enrichment / FER 30ng/L PM_24052023					5/24/2023	13:37
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0 003792				PkH	13:41
		0 003666					13:43
		0 003640					13:44
	0ng/L	0 003700		0 000081090	2.192		13:44
Cal-Std1		0 009498				PkH	13:49
		0 008333					13:50
		0 008961					13:52
	30.00ng/L	0 008931		0 0005630	6.528		13:52
Cal-Std1		0 01031				PkH	13:57
		0 01074					13:58
		0 01076					14:00
	30.00ng/L	0 01060		0 0002530	2.386		14:00
Calibration	Calibration function 01						14:00

Mercur

Mercur

Peak plots

Hg



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	IL_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/o enrich	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 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

Mercur

Mercur

QC parameters

QC type	Conc check	QC check samp 2	---
QC check samp 1	---	Conc	---
Conc	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep measurement	off	QC std 2 no	1(100.00 ng/L)
QC std 1 no	1(100.00 ng/L)	QC std 2 limit	± 0.00%
QC std 1 limit	± 50.00%	Reaction	flag + continue
QC std act	flag + continue	QC Recal factor	Off
Expect blank abs	0.0100± 0.0100		
QC precision	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
		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
Confid 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	0.000136 0.006208	14.68 17.28
2	Cal-Std1	(--)	#	100.00	H 0.004494 A 0.061286	0.000116 0.001275	2.586 2.082

Hg

Calibration function 1

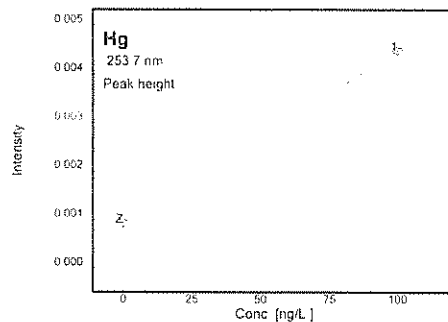
5/24/2023 14:33 Calibration (Peak height)

Abs=k1+k2*conc

k1=0.000932 k2=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)

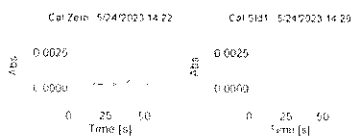
Hg	Without enrichment / Abs / FBR 100ng/L _PM 24052023					5/24/2023	14 19
ID	Conc	Abs	BG	SD	RSD%	int. type	Time
Cal-Zero		0.001639				Fl-H	14 22
		0.000775					14 23
		0.000681					14 25
	0ng/L	0.000632		0.00013672	14.88		14 25
Cal-Std1		0.004528				Fl-H	14 28
		0.004364					14 31
		0.004589					14 33
	100 ng/L	0.004494		0.00011623	2.566		14 33
Calibration	Calibration function 01						14 33

Mercur

Mercur

Peak plots

Hg



Mercur