

# ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0181	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0661	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0395	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0179	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0192	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0190	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0183	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0400	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	BKK_FS1064	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_FS0255	4-Jan-24	4-Jul-24	6
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_FS0252	4-Jan-24	4-Jul-24	6
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_FS0455	4-Jan-24	4-Jul-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0266	4-Jan-24	4-Jul-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0254	4-Jan-24	4-Jul-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0251	4-Jan-24	4-Jul-24	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0454	4-Jan-24	4-Jul-24	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0531	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0414	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0412	10-Feb-23	10-Aug-24	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0527	31-Jan-24	30-Jul-24	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0518	9-Jan-24	9-Jul-24	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0532	31-Jan-24	31-Jul-24	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0523	9-Jan-24	9-Jul-24	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0563	26-Jan-24	25-Jan-25	12
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0564	24-Apr-24	23-Apr-25	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	22-Feb-24	22-Feb-25	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Standard gas	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0030	25-Jan-24	24-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0029	20-Jun-23	20-Jun-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0620	12-Jan-24	11-Jan-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	20-Sep-23	20-Sep-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0017	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0023	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0022	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0020	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0018	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	20-Sep-23	20-Sep-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0300	1-Sep-23	1-Sep-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0493	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0615	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0613	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0614	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0492	23-Feb-24	22-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0017	22-Jan-24	21-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0524	26-Jan-24	25-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0523	26-Jan-24	25-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0217	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0221	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0581	20-Jul-23	20-Jul-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0219	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0221	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0679	27-Oct-23	27-Oct-24	12
Illuminance	Illuminance	Lux Meter	RYG_FS0536	28-Nov-23	27-Nov-24	12
Illuminance	Illuminance	Lux Meter	RYG_FS0471	14-Mar-24	13-Mar-25	12



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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG_FS0550	24-Jul-23	24-Jul-24	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	14-Dec-23	14-Dec-24	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	29-May-23	29-Nov-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Dissolved Oxygen	Chamber (Cooling Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Chloride	pHISE Meter	RYG_EN0152	14-Dec-23	14-Dec-24	12
Rayong Lab	Cyanide	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Formaldehyde	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Phenol	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Sulfide	Chamber (Cooling Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Fluoride	pHISE Meter	RYG_EN0152	14-Dec-23	14-Dec-24	12
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_EN0188	11-Mar-24	11-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_EN0152	14-Dec-23	14-Dec-24	12
Water Lab	Calcium	ICP-OES	BKK_EL0037	28-Feb-24	28-Feb-25	12
Water Lab	Calcium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Calcium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	28-Feb-24	28-Feb-25	12
Water Lab	Magnesium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Magnesium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	28-Feb-24	28-Feb-25	12
Water Lab	Sodium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Sodium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	SAR	ICP-OES	BKK_EL0037	28-Feb-24	28-Feb-25	12
Water Lab	SAR	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	SAR	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Chlorite	Ion Chromatography	BKK_EN0069	12-Jan-24	12-Jan-25	12
Water Lab	Organochlorine Pesticide	GC MSMS	BKK_EN0284	25-May-23	25-Nov-24	18
Water Lab	Anionic Surfactant	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Water Lab	Anionic Surfactant	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Water Lab	Silver	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Silver	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Silver	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Barium	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Barium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Lead	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Lead	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Iron	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Iron	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Iron	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Manganese	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Copper	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Copper	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18



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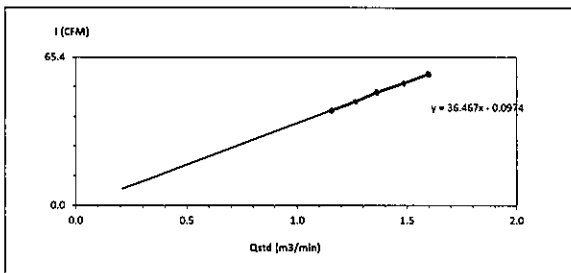
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Arsenic	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Selenium	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Selenium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Cadmium	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Zinc	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Trivalent Chromium	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Mercury	DUO-CVAFS / CVAAS	BKK_EL0023	24-May-23	23-Nov-24	18



### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งสำราญ Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0181  
Calibration Sheet No. : C-240524-RYG\_FS0181 High Volume Model : TE-S170D  
Calibrator ID : RYG\_FS0205 High Volume S/N : 5334  
Calibrator Model : TE-S028A Calibrator Slope : 1.52567  
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.1583	42	Slope: 36.4675 Intercept: -0.0974 Correlation Coefficient: 0.9995
2	3.6	1.2654	46	
3	4.2	1.3639	50	
4	5.0	1.4848	54	
5	5.8	1.5964	58	



Calibrated by Satcha P.  
(Mr. Satcha Phetsawaeng)  
Field Scientist(3)

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

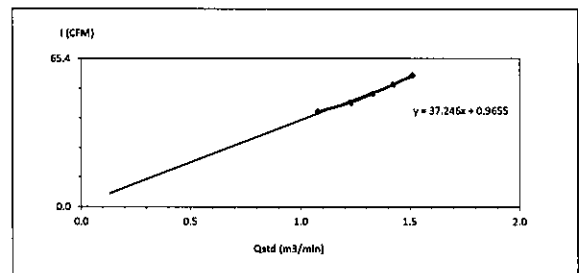
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งสำราญ Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0561  
Calibration Sheet No. : C-240524-RYG\_FS0561 High Volume Model : TE-S009X  
Calibrator ID : RYG\_FS0205 High Volume S/N : 6258  
Calibrator Model : TE-S028A Calibrator Slope : 1.52567  
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0808	42	Slope: 37.2456 Intercept: 0.9655 Correlation Coefficient: 0.9936
2	3.4	1.2307	46	
3	4.0	1.3319	50	
4	4.6	1.4257	54	
5	5.2	1.5135	58	



Calibrated by Satcha P.  
(Mr. Satcha Phetsawaeng)  
Field Scientist(3)

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

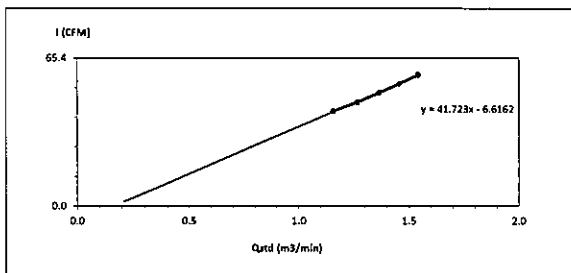
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งสำราญ Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0395  
Calibration Sheet No. : C-240524-RYG\_FS0395 High Volume Model : TE-S170D  
Calibrator ID : RYG\_FS0205 High Volume S/N : 5692  
Calibrator Model : TE-S028A Calibrator Slope : 1.52567  
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.1583	42	Slope: 41.7232 Intercept: -6.6162 Correlation Coefficient: 0.9991
2	3.6	1.2654	46	
3	4.2	1.3639	50	
4	4.8	1.4555	54	
5	5.4	1.5417	58	



Calibrated by Satcha P.  
(Mr. Satcha Phetsawaeng)  
Field Scientist(3)

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

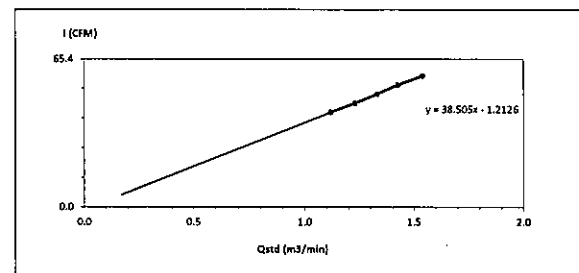
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS4 Co., Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งสำราญ Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0179  
Calibration Sheet No. : C-240524-RYG\_FS0179 High Volume Model : TE-S170D  
Calibrator ID : RYG\_FS0205 High Volume S/N : 4805  
Calibrator Model : TE-S028A Calibrator Slope : 1.52567  
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.1202	42	Slope: 38.505x - 1.2126 Intercept: -1.2126 Correlation Coefficient: 0.9995
2	3.4	1.2307	46	
3	4.0	1.3319	50	
4	4.6	1.4257	54	
5	5.4	1.5417	58	



Calibrated by Satcha P.  
(Mr. Satcha Phetsawaeng)  
Field Scientist(3)

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

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



SARTORIUS

# Certificate of Calibration

Model Number: LA130S-F Certificate No.: 24BCI0068  
Description: Analytical Balance Issued Date: Friday, February 23, 2024  
Serial Number: 25409684 Reference No.: 229195  
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.Chonchal Inthana  
Calibration Date: Thursday, February 22, 2024  
Calibration Procedure No.: This calibration was conducted by  
Using In-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

Metrological data:  
Capacity: 150 g Readability: 0.0001 g  
Reasons for calibration:  
☐ New Installation ☐ Service / Repair ☒ Re-calibration/ Maintenance  
Ambients Conditions:  
Temperature: 23.6 °C ± 5.0 °C  
Humidity: 54.0 % RH ± 10.0 % RH  
Pressure: ±  
Equipment Condition: ☒ Good Operate ☐ Fair

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

## Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Berometer Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relates 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.Chonchal Inthana(Technical Manager)

SOP FM 33 03 February 2022

SARTORIUS

# Certificate of Calibration

Model Number: LA130S-F Certificate No.: 24BCI0068  
Description: Analytical Balance Issued Date: Friday, February 23, 2024  
Serial Number: 25409684 Reference No.: 229195  
ID No.: RYG\_EN0001  
Manufacturer: Sartorius Page No.: 2 of 2

## Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is plotted by the difference between the readout of the load, i.e. 10g or 100g of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).		
Nominal Value: (Low Load)	10.0000	99.9999	Nominal value:	50	9
10 g	10.0000	100.0000	Tolerance	0.0004	9
Tolerance	0.0001 g	0.0001 g	Difference		
	0.0001 g	0.0001 g		1	-
Nominal Value: (High Load)	10.0000	100.0001		2	-0.0001
100 g	10.0000	100.0000		3	0.0001
Tolerance	0.0001 g	0.0001 g		4	0.0002
	0.0001 g	0.0001 g		5	0.0000
	0.0001 g	0.0001 g		6	-
Standard Deviation	0.00005	0.00008			

## Linearity

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

Tolerance 0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00020
0.05	0.0500	0.0500	0.0000	0.00021
0.1	0.1000	0.1000	0.0000	0.00021
0.5	0.5000	0.5000	0.0000	0.00021
1	1.0000	1.0000	0.0000	0.00021
2	2.0000	2.0000	0.0000	0.00021
5	5.0000	5.0000	0.0000	0.00021
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00021
100	100.0000	99.9999	-0.0001	0.00024

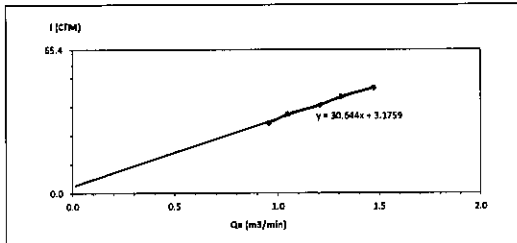
End of Report.

SOP FM 33 03 February 2022

## High Volume Air Sampler Calibration Worksheet

Project Site: Gulf T54 Co., Ltd. Barometric Pressure (mm Hg): 755  
Calibrate Location: T54 T54 Co., Ltd. Temperature (°C): 30  
Calibrate Date: 24-May-24 High Volume ID: RYG\_F50192  
Calibration Sheet No.: C-240524-RYG\_F50192 High Volume Model: TS-5009X  
Calibrator ID: RYG\_F50205 High Volume S/N: 5331  
Calibrator Model: TE-5028A Calibrator Slope: 0.95561  
Calibrator S/N: 1166 Calibrator Intercept: -0.02266

Test No.	Delta H <sub>2</sub> O (Inch)	Qa (m <sup>3</sup> /min)	1: Chart (CFM)	Linear Regression
1	2.0	0.960	32	Slope: 30.6438
2	2.4	1.050	36	Intercept: 3.1759
3	3.2	1.209	40	Correlation Coefficient: 0.9961
4	3.8	1.315	44	
5	4.8	1.475	48	



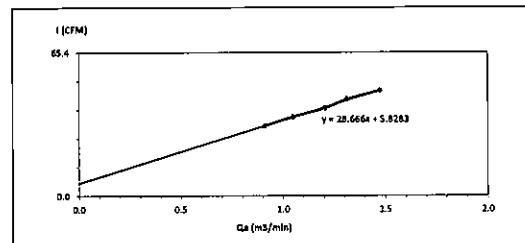
Calibrated by: Satcha P.  
(Mr.Satcha Phetsawaeng)  
Field Scientist(3)

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

## High Volume Air Sampler Calibration Worksheet

Project Site: Gulf T54 Co., Ltd. Barometric Pressure (mm Hg): 755  
Calibrate Location: T54 T54 Co., Ltd. Temperature (°C): 30  
Calibrate Date: 24-May-24 High Volume ID: RYG\_F50199  
Calibration Sheet No.: C-240524-RYG\_F50199 High Volume Model: G1051  
Calibrator ID: RYG\_F50205 High Volume S/N: 1625  
Calibrator Model: TE-5028A Calibrator Slope: 0.95561  
Calibrator S/N: 1166 Calibrator Intercept: -0.02266

Test No.	Delta H <sub>2</sub> O (Inch)	Qa (m <sup>3</sup> /min)	1: Chart (CFM)	Linear Regression
1	1.8	0.912	32	Slope: 28.6661
2	2.4	1.050	36	Intercept: 5.9283
3	3.2	1.209	40	Correlation Coefficient: 0.9985
4	3.8	1.315	44	
5	4.8	1.475	48	



Calibrated by: Satcha P.  
(Mr.Satcha Phetsawaeng)  
Field Scientist(3)

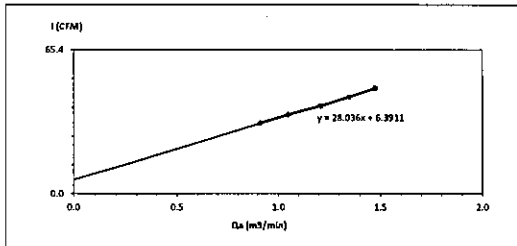
Approved by: (Mr.Noppong Jantarapan)  
Enviro Field Coordinator Scientist (3)



# High Volume Air Sampler Calibration Worksheet

Project Site: Gulf T54 Co., Ltd. Barometric Pressure (mm Hg): 755  
 Calibrate Location: Tratthunthunthun (m³/min) Temperature (°C): 30  
 Calibrate Date: 24-May-24 High Volume ID: RYG\_F80183  
 Calibration Sheet No.: C-240524-RYG\_F80183 High Volume Model: TE-5009X  
 Calibrator ID: RYG\_F80205 High Volume S/N: 4791  
 Calibrator Model: TE-5028A Calibrator Slope: 0.95561  
 Calibrator S/N: 1166 Calibrator Intercept: -0.02266

Test No.	Delta H <sub>2</sub> O (Inch)	Q <sub>a</sub> (m³/min)	I: Chart (CFM)	Linear Regression
1	1.8	0.912	32	Slope: 28.0360
2	2.4	1.050	36	Intercept: 6.3911
3	3.2	1.209	40	Correlation Coefficient: 0.9993
4	4.0	1.349	44	
5	4.8	1.475	48	



Calibrated by: Satcha P.  
 (Mr. Satcha Phetsawang)  
 Field Scientist (3)

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

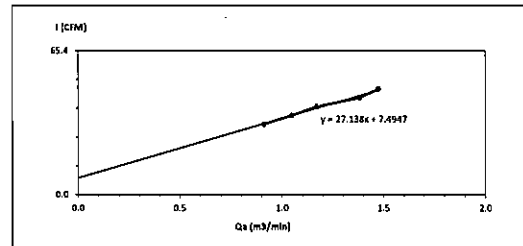
FORM NO.: F-06-074 REVISION NO.: 2 ISSUE DATE: 20/11/23



# High Volume Air Sampler Calibration Worksheet

Project Site: Gulf T54 Co., Ltd. Barometric Pressure (mm Hg): 755  
 Calibrate Location: Tratthunthunthun (m³/min) Temperature (°C): 30  
 Calibrate Date: 24-May-24 High Volume ID: RYG\_F80400  
 Calibration Sheet No.: C-240524-RYG\_F80400 High Volume Model: TE-5009X  
 Calibrator ID: RYG\_F80205 High Volume S/N: 5691  
 Calibrator Model: TE-5028A Calibrator Slope: 0.95561  
 Calibrator S/N: 1166 Calibrator Intercept: -0.02266

Test No.	Delta H <sub>2</sub> O (Inch)	Q <sub>a</sub> (m³/min)	I: Chart (CFM)	Linear Regression
1	1.8	0.912	32	Slope: 27.1377
2	2.4	1.050	36	Intercept: 7.4947
3	3.0	1.171	40	Correlation Coefficient: 0.9944
4	4.2	1.381	44	
5	4.8	1.475	48	



Calibrated by: Satcha P.  
 (Mr. Satcha Phetsawang)  
 Field Scientist (3)

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

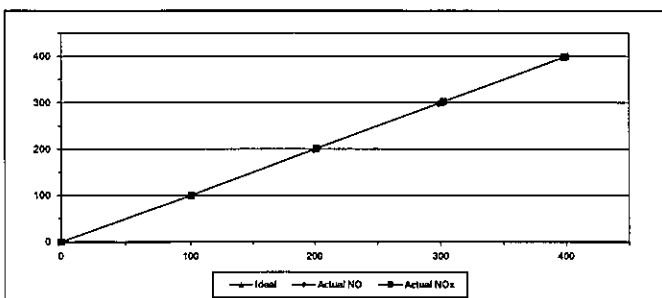
FORM NO.: F-06-074 REVISION NO.: 2 ISSUE DATE: 20/11/23



## MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jan-24 Equipment Name: NOx Analyzer  
 Manufacturer: HORIBA Model: APNA-370  
 Serial No.: 148EH0E0 Equipment ID: BIOC\_FS1084  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: GN0027222  
 Cylinder Pressure (psi): 1800 Certified By: Airgas Inc.  
 Certified Date: 9-Feb-22 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.70	0.70	0.70
2	200.00	199.40	-0.60	-0.30	201.40	1.40	0.70
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	401.40	1.40	0.35	398.30	-1.70	-0.42
AVERAGE (%)				-0.25			0.37



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

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

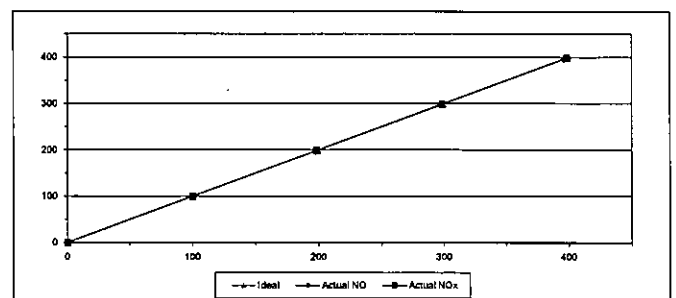
ALS Laboratory Group  
 FORM NO.: F-08-058 REVISION NO.: 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-24 Equipment Name: NOx Analyzer  
 Manufacturer: Teledyne API Model: T200  
 Serial No.: 2187 Equipment ID: RYG\_F80255  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 947  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: GN0027222  
 Cylinder Pressure (psi): 1800 Certified By: Airgas Inc.  
 Certified Date: 9-Feb-22 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	100.10	0.10	0.10
2	200.00	198.00	-2.00	-1.00	198.50	-1.50	-0.75
3	300.00	297.30	-2.70	-0.90	298.70	-1.30	-0.43
4	400.00	396.40	-3.60	-0.90	398.50	-1.50	-0.38
AVERAGE (%)				-0.62			-0.27



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

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

ALS Laboratory Group  
 FORM NO.: F-08-058 REVISION NO.: 1 ISSUE DATE: 02/04/12

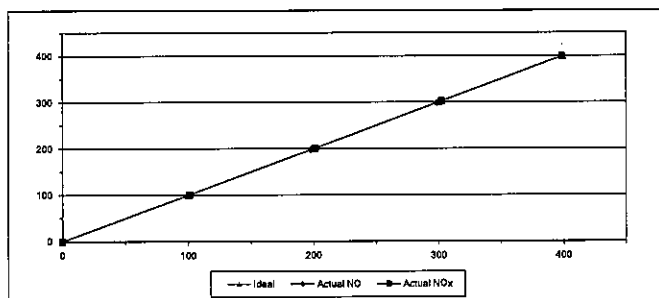




## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	2186	Equipment ID	RYG_FS0252
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	101.00	1.00	1.00
2	200.00	198.00	-2.00	-1.00	201.20	1.20	0.60
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	398.20	-1.80	-0.45	398.70	-1.30	-0.33
AVERAGE (%)				-0.63			0.43



Calibrated By

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

Approved By

(Mr. Sarayuth Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

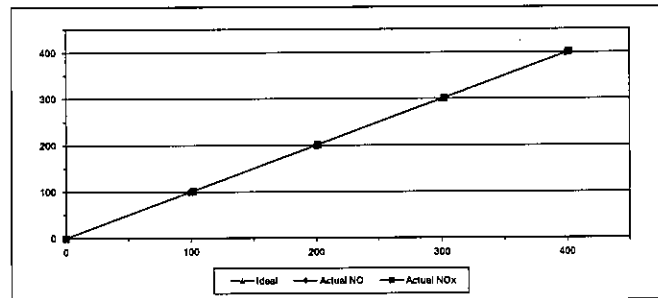
FORM NO.: F 06-058 REVISION NO.: 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APMA-370
Serial No.	ALP0V0WY	Equipment ID	RYG_FS0455
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.60	-1.40	-1.40	101.60	1.60	1.60
2	200.00	198.80	-1.20	-0.60	201.20	1.20	0.60
3	300.00	301.00	1.00	0.33	301.80	1.80	0.60
4	400.00	398.50	-1.50	-0.38	401.30	1.30	0.33
AVERAGE (%)				-0.39			0.84



Calibrated By

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

Approved By

(Mr. Sarayuth Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

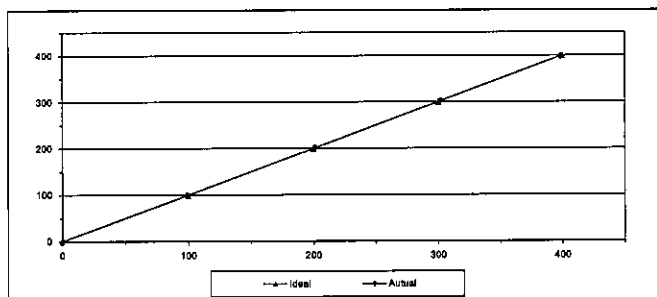
FORM NO.: F 06-058 REVISION NO.: 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	NM3M2D5M	Equipment ID	RYG_FS0288
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	201.40	1.40	0.70
3	300.00	302.30	2.30	0.77
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				0.01



Calibrated By

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

Approved By

(Mr. Sarayuth Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

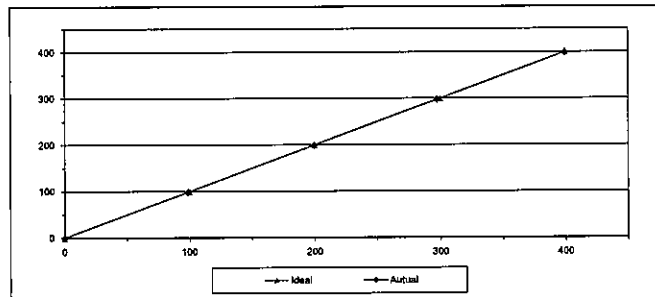
FORM NO.: F 06-058 REVISION NO.: 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1772	Equipment ID	RYG_FS0254
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
1	100.00	99.10	-0.90	-0.90
2	200.00	199.60	-0.40	-0.20
3	300.00	297.50	-2.50	-0.83
4	400.00	398.90	-1.10	-0.28
AVERAGE (%)				-0.43



Calibrated By

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

Approved By

(Mr. Sarayuth Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

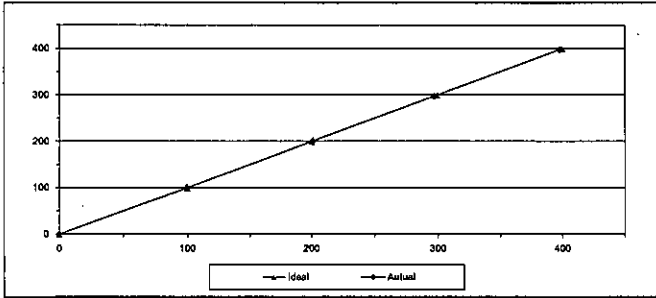
FORM NO.: F 06-058 REVISION NO.: 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1773	Equipment ID	RYO_F80251
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Alrgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	201.20	1.20	0.60
3	300.00	297.20	-2.80	-0.93
4	400.00	397.60	-2.40	-0.60
AVERAGE (%)				-0.25



Calibrated By

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

Approved By

(Mr.)Barayuth Jitranont  
Assistant General Manager

ALS Laboratory Group

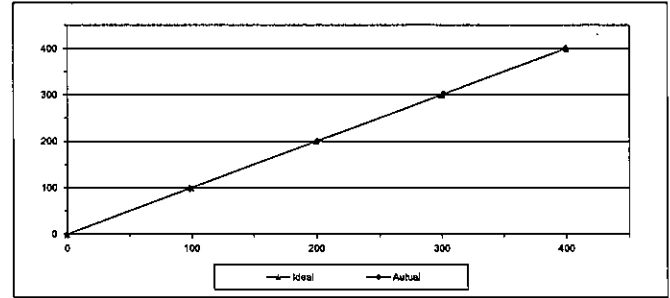
FORM NO.: F-08-056 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	H083D6FA	Equipment ID	RYO_F80454
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Alrgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70
2	200.00	200.80	0.80	0.40
3	300.00	301.90	1.90	0.63
4	400.00	399.70	-0.30	-0.08
AVERAGE (%)				-0.13



Calibrated By

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

Approved By

(Mr.)Barayuth Jitranont  
Assistant General Manager

ALS Laboratory Group

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

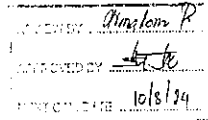


JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.  
33/24 15, 6735-36  
Rachaburi 2, 71, Rd, Wathayak, Bangkok,  
Bangkok 10600 (Thailand)  
Tel: +662-2599453  
Email: jirantee@jirantee.com  
Web site: www.jirantee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
MSC-754-TIS 17025  
CALIBRATION Q367

Air speed measurement laboratory  
Calibration services department.



Certificate Number

CL-020-66

## CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novatec
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-2518
SERIAL NUMBER	: Sensor: - Data logger: AS975 RVC_F80413
ID NUMBER	: Used item
CONDITION AS-RECEIVED	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	: 27 Jan 2023
MEASUREMENT DATE	: 10 Feb 2023
ISSUE DATE	: 10 Feb 2023

ENVIRONMENTAL CONDITIONS:	
Ambient condition in the laboratory are as follows:	
Temperature	: 23.0 ± 0.3 °C
Relative Humidity	: 55.0 ± 15.0 %RH
Atmospheric Pressure	: 1010 ± 10 hPa

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

CALIBRATION CONDITIONS	: Wind Tunnel cross-section area	900 cm <sup>2</sup>
	: Win direction (upstream)	100 cm <sup>2</sup>
	: Diameter of mounting pipe	mm
	: Blockage ratio of test object <sup>1</sup>	0.111 [-]

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

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

Calibrated by:  
Zi Air Soravis Thairat  
Miss Jiraporn Jirapornrat



Approved signature:  
Mr. Panyaporn Jirapornrat  
Calibration Department Manager

Remarks:  
<sup>1</sup> Actual cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio to

Calibration procedure:  
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-02 and pitot tube with precision differential pressure meter model: DP12500 in air flow section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The W-CL-002 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:  
This certificate provides a traceability of the measurement to recognize the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate Number: NIMT-0052-21 and NIMT-0066-21

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

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>3</sup>

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

V <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>UUC</sub> (m/s)	Error (m/s)	U (m/s)
0.584	24.10	24.00	0.7	-0.3	0.16
1.029	23.98	24.00	1.8	-0.3	0.16
1.244	23.96	24.00	2.9	-0.2	0.19
4.136	24.20	24.00	3.8	-0.3	0.20
5.00	23.80	24.00	4.8	-0.2	0.21
5.80	24.24	24.00	5.8	-0.2	0.17
7.05	23.90	24.00	6.9	-0.2	0.19
8.15	24.14	24.00	8.0	-0.2	0.19
9.05	23.88	24.00	8.9	-0.2	0.20
10.09	23.88	24.00	9.8	-0.2	0.19
11.15	23.74	24.00	11.0	-0.2	0.23
12.13	23.82	24.00	12.0	-0.2	0.24
13.19	23.70	24.00	13.0	-0.2	0.22
14.26	23.66	24.00	14.0	-0.3	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

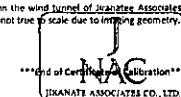
## Remarks:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place<sup>2</sup> Velocity of standard<sup>3</sup> Velocity of Unit Under Calibration

## PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirantee 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.





Page 1 of 2 Pages

**MEASUREMENT ITEM**: Wind Direction Sensor  
**MANUFACTURER**: Novolyns  
**MODEL/TYPE**: Sensor: WS-03F  
Data logger: 200 WS-251B  
**SERIAL NUMBER**: Sensor:-  
Data logger: AS375  
**ID NUMBER**: RVG\_FSD413  
**CONDITION AS-RECEIVED**: Used item  
**CUSTOMER**: ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE**: 27 Jan 2023  
**MEASUREMENT DATE**: 10 Feb 2023  
**ISSUE DATE**: 10 Feb 2023

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

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

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

**Preconditioning**: 24 hours at ambient conditions.  
**Measurement Condition**: The average values during measurement are (23.87) °C, (50.2) %RH and (1012.2) hPa.

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

Calibrated by:  
☒ Mr. Sorawit Thakulrat  
☐ Miss Jitraporn Lertkarnphol



Approved signature: Mr. Parinya Booncharoen  
Calibration Department Manager

**Remarks**:  
1. Nozzle 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 10<sup>-3</sup>

**Calibration procedure**: The wind direction sensor was calibrated against Standard Rotary Encoder, model: AX400975-DIM04-P3-S-10 in on close test section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WS-CL-008 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

**Traceability**: This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

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

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

Page 1 of 2 Pages

**MEASUREMENT ITEM**: Wind Direction Sensor  
**MANUFACTURER**: Novolyns  
**MODEL/TYPE**: Sensor: WS-02F  
Data logger: 110 WS-251D  
**SERIAL NUMBER**: Sensor: WSD-014  
Data logger: AS789  
**ID NUMBER**: RVG\_FSD031  
**CONDITION AS-RECEIVED**: Used item  
**CUSTOMER**: ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

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

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

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

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

**Preconditioning**: 24 hours at ambient conditions.  
**Measurement Condition**: The average values during measurement are (23.6) °C, (46.6) %RH and (1014.5) hPa.

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

Calibrated by:  
☒ Mr. Sorawit Thakulrat  
☐ Miss Jitraporn Lertkarnphol

Approved signature: Mr. Parinya Booncharoen  
Calibration Department Manager

**Remarks**:  
1. Nozzle 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 10<sup>-3</sup>

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

Certificate Number
CL-013-66

Page 2 of 2 Pages

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

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

Air speed m/s	D <sub>ref</sub> Degree (°)	D <sub>meas</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.99	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.001	87	-3	0.74
	135.000	133	-2	0.74
	180.000	180	0	0.74
	225.000	227	2	0.68
	270.000	273	3	0.68
	315.000	318	3	0.74

### Remark:

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

<sup>2</sup> Direction of standard

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



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

Page 2 of 2 Pages

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

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

Air speed m/s	D <sub>ref</sub> Degree (°)	D <sub>meas</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.99	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	227	2	0.74
	270.000	272	2	0.74
	315.000	317	2	0.74

### Remark:

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

<sup>2</sup> Direction of standard

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

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

Certificate Number
CL-013-66

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

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

: Cup anemometer  
: Novalynx  
: Sensor: WS-02F  
: Data logger: 110-WS-25DL-D

### SERIAL NUMBER

: Sensor: WS0-014  
: Data logger: A5789

### ID NUMBER

: RYG\_F50531

### CONDITION AS-RECEIVED

: Used Item

### CUSTOMER

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

### RECEIVED DATE

: 16 Jan 2023

### MEASUREMENT DATE

: 18 Jan 2023

### ISSUE DATE

: 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.9 ± 1.0 hPa

### PLACE OF CALIBRATION

: Efflux-type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITIONS

: Wind tunnel cross-section area: 900 cm<sup>2</sup>

: Win direction: Upward 100 cm<sup>2</sup>

: Diameter of mounting pipe: 10 mm

: Blockage ratio of test object: 0.111 [-]

### Preconditioning

: 24 hours at ambient conditions.

### Measurement Condition

: The average values during measurement are (23.7) °C, (64.5) %RH and (1018.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☐ Mr. Sorawit Thachalad

☐ Miss Jittaporn Lertsomphol

### Remarks:

\* Nozzle cross-section area of the wind tunnel

\* Projected cross-section area of the tested object include mounting pipe

\* Diameter of mounting pipe

\* Ratio 1 to 1

### Approved signature:

Mr. Parinya Booncharoen  
Calibration Department Manager

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

## CERTIFICATE OF CALIBRATION

Cert. No.: CL-006-66  
Page 1 of 2

Equipment Name: Data Logger with Temperature  
Sensor

Manufacturer: Novalynx

Model: 110-WS-25DL-D

Serial No.: A5789

ID No.: RYG\_F50531

### Customer

Name: ALS laboratory group (Thailand) Co., Ltd.

Address: 104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Suan Luang, Khet Suan Luang, Bangkok

10250 Thailand.

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500.

Serial No.: 667682-09, Exp. 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)%

### Traceability

The measurement results are traceable to the

international system of units (SI) through National

Institute of Metrology Thailand (NIMT) Certificate

number: TT-0034-22, Certificate number: ER-0092-

22

### Calibrated by

☐ Mr. Sorawit Thachalad

☒ Miss Jittaporn Lertsomphol

### Approved Signature:

Mr. Parinya Booncharoen  
Calibration Department Manager

Page 2 of 2 Pages

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

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V <sub>std</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>UUC</sub> (m/s)	Error (m/s)	U (m/s)
0.983	23.50	23.70	0.7	-0.3	0.18
2.034	23.74	23.70	1.7	-0.3	0.16
3.044	23.50	23.70	2.9	-0.2	0.18
4.119	23.82	23.70	3.9	-0.2	0.19
5.02	23.50	23.70	4.9	-0.2	0.18
5.99	23.88	23.70	5.8	-0.2	0.18
7.08	23.50	23.70	6.9	-0.1	0.20
8.18	23.58	23.70	8.0	-0.2	0.18
9.11	23.50	23.70	9.0	-0.1	0.19
10.08	23.66	23.70	10.0	-0.1	0.25
11.15	23.32	23.70	11.0	-0.2	0.21
12.14	23.66	23.70	12.0	-0.2	0.20
13.20	23.32	23.70	13.2	0.0	0.25
14.25	23.50	23.70	14.4	-0.1	0.27
15.23	23.30	23.70	15.7	-0.2	0.27
16.29	23.40	23.70	16.2	-0.1	0.23

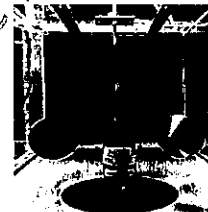
### Remarks:

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

<sup>2</sup> Velocity of standard

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

### PHOTO OF CALIBRATION SET-UP



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

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

Certificate No.: CL-006-66  
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

### Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: T0210901.

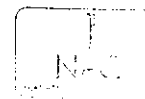
Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.067	19.8	-0.3	0.099
60	25.058	24.6	-0.5	0.099
60	30.052	29.5	-0.6	0.099
60	35.047	34.5	-0.5	0.099
60	40.038	39.3	-0.7	0.099

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



## CERTIFICATE OF CALIBRATION

Calibration No. : RH-0012023  
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novatex  
Model/Type : 110-WS-25DL-D  
Serial Number : A5789  
ID No. : RYG\_PS0531  
Customer : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:  
The measurement was carried out in an ambient temperature of (26.3)°C, and relative humidity of (50±10)%.

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

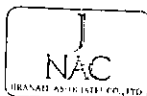
Traceability:  
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the International system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14, 2023.

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

Measurement Results:  
This equipment was connected with indoor air quality probe and Displayed (UUC) on display. Model: HMP60, Serial number: T0211901.  
Calibration was performed in the range of 20%RH to 80%RH.  
The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.03	18.0	-2.0	0.51
50	50.24	47.8	-2.4	0.51
80	80.19	77.3	-2.9	0.51

Performed by  
☐ Mr. Sorawit Thachaisid  
☒ Miss Jitraporn Lertsomphol



Approved Signatory:  
Mr. Pannya Booncharoen,  
Calibration Department Manager

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

Certificate Number

CL-021-66

Page 2 of 2 Pages

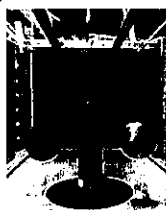
### MEASUREMENT RESULTS<sup>1</sup>

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

V <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>uuc</sub> (m/s)	Error (m/s)	U (m/s)
0.965	24.10	24.10	0.8	-0.2	0.36
2.033	24.10	24.10	1.9	-0.1	0.16
3.040	23.94	24.10	3.0	-0.1	0.23
4.134	24.10	24.10	4.0	-0.1	0.20
4.99	23.93	24.10	4.9	-0.1	0.44
5.98	24.10	24.10	6.0	0.0	0.18
7.05	23.90	24.10	7.0	-0.1	0.36
8.19	24.06	24.10	8.2	0.0	0.26
9.09	23.84	24.10	9.1	0.0	0.24
10.09	23.92	24.10	10.1	0.0	0.28
11.15	23.80	24.10	11.1	0.0	0.45
12.14	23.80	24.10	12.1	0.0	0.31
13.19	23.80	24.10	13.2	0.0	0.47
14.26	23.74	24.10	14.2	0.0	0.42
15.25	23.78	24.10	15.3	-0.1	0.66
16.28	23.70	24.10	16.3	0.0	0.56

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

### PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranate 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. www.jiranate.com



Jiranate Associates Co., Ltd.  
63/14-15, 67/35-36  
Petchhasem 7/71, Rd. Walthapa, Bangkok  
Bangkok 10600 (Thailand)  
Tel: +66(0)2-8680812  
Mobile: +66(0)2-8680860  
E-mail: jnac-calibration@jiranate.com  
Web site: www.jiranate.com

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

Air speed measurement laboratory  
Calibration services department.

REVIEW BY: *Hajakam P.*  
APPROVED BY: *4-67*  
NEXT CAL DATE: 10/8/24

Certificate Number

CL-021-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer  
MANUFACTURER : Novatex  
MODEL/TYPE : Sensor: WS-02F  
Data logger: 200-WS-25LB  
SERIAL NUMBER : Sensor: -  
Data logger: A5376  
ID NUMBER : RYG\_PS0414  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023  
MEASUREMENT DATE : 10 Feb 2023  
ISSUE DATE : 10 Feb 2023

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

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

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

Preconditioning : 24 hours at ambient conditions.  
Measurement Condition : The average values during measurement are (24.1)°C, (47.6) %RH and (1014.7) hPa.

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

Calibrated by:  
☒ Mr. Sorawit Thachaisid  
☒ Miss Jitraporn Lertsomphol



Approved signatory:  
Mr. Pannya Booncharoen,  
Calibration Department Manager

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

Jiranate Associates Co., Ltd.  
63/14-15, 67/35-36  
Petchhasem 7/71, Rd. Walthapa, Bangkok  
Bangkok 10600 (Thailand)  
Tel: +66(0)2-8680812  
Mobile: +66(0)2-8680860  
E-mail: jnac-calibration@jiranate.com  
Web site: www.jiranate.com

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-019-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor  
MANUFACTURER : Novatex  
MODEL/TYPE : Sensor: WS-02F  
Data logger: 200-WS-25LB  
SERIAL NUMBER : Sensor: -  
Data logger: A5376  
ID NUMBER : RYG\_PS0414  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023  
MEASUREMENT DATE : 10 Feb 2023  
ISSUE DATE : 10 Feb 2023

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

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

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

Preconditioning : 24 hours at ambient conditions.  
Measurement Condition : The average values during measurement are (24.0)°C, (49.0) %RH and (1014.3) hPa.

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

Calibrated by:  
☒ Mr. Sorawit Thachaisid  
☒ Miss Jitraporn Lertsomphol



Approved signatory:  
Mr. Pannya Booncharoen,  
Calibration Department Manager

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

MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.68
	90.000	87	-3	0.58
4.99	135.001	132	-3	0.68
	180.000	179	-1	0.74
	225.000	227	2	0.91
	270.001	273	3	0.58
	315.000	318	3	0.74

## Remarks:

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

<sup>2</sup> Direction of standard

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



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

Jirantee Associates Co., Ltd.  
63/14-15, 6/25-15  
Pachkarn 7/71, Rd. Wattana, Bangkok,  
Bangkok 10600 (Thailand)  
Tel: +66(0)25956312  
Mobile: +66(0)25956313  
Email: jnac@jirantee.com  
Web site: www.jirantee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-ITS 1/2025  
CALIBRATION 0167

Air speed measurement laboratory  
Calibration services department.

REVIEW BY: *Pinthorn P.*  
APPROVED BY: *[Signature]*  
PRINTED DATE: 10/8/24  
Certificate Number: CL-019-66

## CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE

Cup anemometer  
Novatys  
Sensor: WS-02F  
Data logger: 200-WS-251B

## SERIAL NUMBER

Sensor: -  
Data logger: AS374

## ID NUMBER

RYG\_150412

## CONDITION AS-RECEIVED

Used item

## CUSTOMER

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

## RECEIVED DATE

27 Jan 2023

## MEASUREMENT DATE

10 Feb 2023

## ISSUE DATE

10 Feb 2023

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITIONS

Wind tunnel cross-section area<sup>1</sup>: 900 cm<sup>2</sup>  
Win direction frontal area<sup>2</sup>: 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup>: mm  
Blockage ratio of test object<sup>4</sup>: 0.113 [-]

## Preconditioning

24 hours at ambient conditions.

## Measurement Condition

The average values during measurement are (23.5) °C, (49.7) %RH and (1010.3) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

☒ Mr. Sorawit Thaisakul  
☒ Miss Jiraporn Lertsomphon



## Approved signature:

Mr. Pinyia Booncharoen

Calibration Department Manager

## Remarks:

<sup>1</sup> Notice collection area of the wind tunnel

<sup>2</sup> Projected cross-section area of the tested object include mounting pipe

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

<sup>4</sup> Ratio "a/b"

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

MEASUREMENT RESULTS<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 3 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>ref</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.981	23.52	23.50	0.8	-0.2	0.15
2.010	23.46	23.50	1.8	-0.2	0.16
3.040	23.50	23.50	2.9	-0.2	0.17
4.144	23.56	23.50	3.9	-0.2	0.20
5.00	23.38	23.50	4.8	-0.2	0.19
5.98	23.56	23.50	5.8	-0.2	0.17
7.05	23.26	23.50	6.9	-0.2	0.18
8.15	23.50	23.50	7.9	-0.2	0.15
9.09	23.10	23.50	8.9	-0.2	0.19
10.09	23.50	23.50	9.9	-0.2	0.20
11.14	23.74	23.50	11.0	-0.2	0.21
12.13	23.36	23.50	12.0	-0.2	0.23
13.18	23.32	23.50	13.0	-0.2	0.23
14.26	23.18	23.50	14.0	-0.2	0.22
15.21	23.30	23.50	14.9	-0.3	0.24
16.28	23.12	23.50	16.1	-0.2	0.24

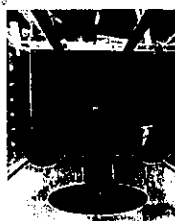
## Remarks:

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

<sup>2</sup> Velocity of standard

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

## PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirantee 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 blurring (green)



Jirantee Associates Co., Ltd.  
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Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-ITS 1/2025  
CALIBRATION 0167

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-017-66

## CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE

Wind Direction Sensor  
Novatys  
Sensor: WS-02F

## SERIAL NUMBER

Data logger: 200-WS-251B  
Sensor: -

## ID NUMBER

RYG\_150412

## CONDITION AS-RECEIVED

Used item

## CUSTOMER

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

## RECEIVED DATE

27 Jan 2023

## MEASUREMENT DATE

10 Feb 2023

## ISSUE DATE

10 Feb 2023

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITION

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

## Preconditioning

24 hours at ambient conditions.

## Measurement Condition

The average values during measurement are (23.9) °C, (50.6) %RH and (1011.8) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

☒ Mr. Sorawit Thaisakul  
☒ Miss Jiraporn Lertsomphon



## Approved signature:

Mr. Pinyia Booncharoen

Calibration Department Manager

## Remarks:

<sup>1</sup> Notice collection area of the wind tunnel

<sup>2</sup> Projected cross-section area of the tested object include mounting pipe

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

<sup>4</sup> Ratio "a/b"

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

MEASUREMENT RESULTS<sup>5</sup>

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

Air speed m/s	D <sub>1</sub> <sup>me</sup> Degree (°)	D <sub>2</sub> <sup>me</sup> Degree (°)	Error Degree (°)	U <sub>1</sub> (%) Degree (°)
4.98	0.000	0	0	0.58
	45.000	41	-4	0.74
	90.000	87	-3	0.74
	135.001	132	-3	0.74
	180.000	178	-2	0.74
	225.000	227	2	0.58
	270.000	274	4	0.58
	315.000	320	5	0.58

Remarks:

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

<sup>2</sup> Direction of standard

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



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



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 31-Jan-24  
Next Cal. Date : 30-Jul-24  
Barometric Pressure (mmHg) : 754  
Relative Humidity (%) : 53.0  
Temperature (°C) : 27.0  
Reference Dry Gas Meter Data  
Reference Dry Gas Meter ID : BKK\_0629  
Serial No. : 1007009  
Correction Factor (%) : 1.0000  
Next Calibration Date : 9-Jun-24

All  (mm H <sub>2</sub> O)	Θ  Minutes	Reference Dry Gas Meter Calibration					Console Control Drygas Meter					Dry Gas Meter Correction Factor (%)	Office Calibration Factor Δt <sub>18</sub>
		V <sub>1</sub> (Liters)			T <sub>1</sub> (°C)	V <sub>2</sub> (Liters)			T <sub>2</sub> (°C)	Avg. T <sub>m</sub> (°C)			
		Final	Initial	Total		Final	Initial	Total					
15	11.62	150.00	0.00	150.00	31.0	60222.0	60208.0	145.00	30.0	30.0	1.0286	41.3111	
25	9.01	150.00	0.00	150.00	31.0	60238.6	60224.0	145.60	30.0	30.0	1.0243	41.9667	
50	6.48	150.00	0.00	150.00	31.0	60259.0	60239.0	145.00	31.0	31.0	1.0295	41.9765	
80	5.04	150.00	0.00	150.00	31.0	60268.8	60251.0	145.80	31.0	31.0	1.0208	41.8122	
120	4.12	150.00	0.00	150.00	31.0	60286.2	60271.0	146.20	31.0	31.0	1.0141	42.0117	
										Avg.		1.0232	41.9916

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

Avg - Office pressure differential that requires to 21.24 in of air @ 25°C and 760 mm of mercury, mmH<sub>2</sub>O : tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 60 APP A METH SEC 5.3.6.7

Calibrated by: Saksit Phaisanphit

Approved by:

Nettapon Jengwareewong

(Mr. Nettapon Jengwareewong)

(Mr. Saksit Phaisanphit)

RYG Field Services Scientist (4)

RYG Field Services Specialist (1)

FORM NO. 1-6-027 REVISION NO. 2 ISSUE DATE: 30 Jan 22



Stopwatch Calibration Test Report

Calibration Date : 31 Jan 24  
Barometric Pressure (mmHg) : 754  
Relative Humidity (%) : 53.0  
Next Cal. Date : 30 Jul 24  
Temperature (°C) : 27.0

Reference Stopwatch Data

Stopwatch ID No. : RYG\_FS0540  
Model : F808  
Serial No. : E18051  
Calibration Date : 9 Dec 22  
Certificate No. : E-2009018

Console Control Meter Data

Dry Gas Meter No. : BKK\_FS0527  
Model : XC-572-V  
Serial No. : 1508053

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:03	5:00	3	0.00005
2	5:00:08	5:00	8	0.00013
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:08	5:00	5	0.00008
6	5:00:06	5:00	6	0.00010
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:09	5:00	9	0.00015
10	5:00:07	5:00	7	0.00012
Average				0.00012
SD				0.00004



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 31 Jan 24		Ambient Temperature (°C) : 27			
Calibration sheet No. : C-310124-BKK_FS0527		Relative Humidity (%) : 53			
Digital Temperature ID : BKK_FS0527		Reference Temperature ID : BKK_FB1144			
Serial No. : 201000000013		Model : Digicon-CC-VT-M9			
Model : XC-572-V		Next Calibrate : 14 Aug 24			
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	-	±3	-
	120	121	-	±3	-
	140	142	-	±3	-
Filter	100	102	2	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	1	1	±3	Pass
	10	9	-1	±3	Pass
	20	20	0	±3	Pass
Meter	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
	50	48	-2	±3	Pass
AUX	0	-1	-1	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrate by: Saksit Phaisanphit

Mr. Saksit Phaisanphit

RYG Field Service Scientist (4)

Approved by: Nettapon Jengwareewong

Mr. Nettapon Jengwareewong

RYG Field Service Specialist (1)

Calibrated by: Saksit Phaisanphit

Mr. Saksit Phaisanphit

RYG Field Services Scientist (4)

Approved by: Nettapon Jengwareewong

Mr. Nettapon Jengwareewong

RYG Field Services Specialist (1)



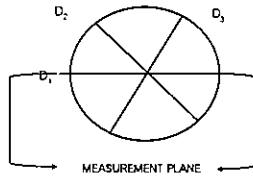
# PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 31 Jan 24	Nozzle Set ID. : BKK_FS0533
Calibration Sheet No. : C-310124-BKK_FS0533	Vernier Caliper ID. : BKK_FS1123

Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo $\Delta D$	$D_{avg}$ $(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$		
1	0.316	0.318	0.316	0.002	0.317
2	0.480	0.475	0.474	0.006	0.476
3	0.635	0.635	0.635	0.000	0.635
4	0.791	0.792	0.791	0.001	0.791
5	0.950	0.952	0.951	0.002	0.951
6	1.088	1.080	1.089	0.009	1.086
7	1.270	1.270	1.270	0.000	1.270
8	1.598	1.600	1.598	0.002	1.599

Where :

- $D_1, D_2, D_3$  = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.  
 $\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.  
 $D_{avg}$  =  $(D_1 + D_2 + D_3) / 3$



Calibrated by : Saksit Phaisanphit Approved by : Nattapon Jengwareewong  
 (Mr. Saksit Phaisanphit) (Mr. Nattapon Jengwareewong)  
 Field Scientist (4) Field Specialist (1)

REVISION NO. 1.001 10/01/2024



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 9-Jan-24	Barometric Pressure (mmHg) : 754.7
Next Cal. Date : 9-Jul-24	Relative Humidity (%) : 55.0
	Temperature (°C) : 27.2
Calibration No. : C-090124-BKK_FS518	Reference Dry Gas Meter ID : BKK_FS1122
Dry Gas Meter ID : BKK_FS0518	Serial No. : A2003240
Serial No. : 1504025	Correction Factor (Y) : 0.9824
Model No. : XC-572-V	Next Calibration Date : 7-Nov-24

$\Delta H$ (mm H <sub>2</sub> O)	$\theta$ Minutes	Reference Dry Gas Meter Calibration				Console Control : Dry Gas Meter				Dry Gas Meter Correction Factor (Y)	Office Calibration Factor (Y)	$\Delta H$ (mm H <sub>2</sub> O)
		Final	Initial	Total	Tr (°C)	Final	Initial	Total	To (°C)			
15	11.07	150.00	0.00	150.00	30.0	55164.6	55154.0	150.60	30.0	0.9771	0.9771	41.9569
25	5.00	150.00	0.00	150.00	31.0	55184.8	55189.0	149.80	30.0	0.9781	0.9781	41.8647
50	6.36	150.00	0.00	150.00	31.0	55254.6	55296.0	145.60	30.0	0.9836	0.9836	41.8126
80	5.02	150.00	0.00	150.00	31.0	55219.2	55248.0	145.20	29.0	0.9802	0.9802	41.8173
120	4.11	150.00	0.00	150.00	30.0	55278.6	55278.0	147.00	28.0	0.9803	0.9803	41.9085
										Avg.	0.9798	41.9216

Y Ratio of reading of reference to dry gas meter : tolerance for individual values  $\pm 0.02$  from average.  
 $\Delta H$  : Office pressure differential that equates to 21.24 mm of air @ 25°C and 760 mm of mercury, metal O-ring tolerance for individual values  $\pm 0.08$  from average.  
 Procedure: 40 CFR (40 APP A) METH SEC 5.3.4.7

Calibrated by : Saksit Phaisanphit Approved by : Nattapon Jengwareewong  
 (Mr. Saksit Phaisanphit) (Mr. Nattapon Jengwareewong)  
 RYG Field Service Scientist (4) RYG Field Service Specialist (1)

FORM NO. 7-001-1 REVISION NO. 2 ISSUE DATE: 28-Jun-22



## Stopwatch Calibration Test Report

Calibration Date : 9 Jan 24	Next Cal. Date : 9 Jul 24
Barometric Pressure (mmHg) : 754.7	Temperature (°C) : 27.2
Relative Humidity (%) : 55.0	

Reference Stopwatch Data	Console Control Meter Data
Stopwatch ID No. : E16061	Dry Gas Meter No. : BKK_FS518
Model : F808	Model : XC-572-V
Serial No. : -	Serial No. : 1504025
Calibration Date : 8 Sep 20	
Certificate No. : E-2009018	

Run No.	Time Actual (m:s.ms)	Time Reading (m:s)	Diff. (ms)	Diff. (min)
1	5:00:03	5:00	3	0.00005
2	5:00:09	5:00	8	0.00013
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:05	5:00	5	0.00008
6	5:00:06	5:00	6	0.00010
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:09	5:00	9	0.00015
10	5:00:07	5:00	7	0.00012
			Average	0.00012
			SD	0.00004

Calibrate by : Saksit Phaisanphit Approved by : Nattapon Jengwareewong  
 Mr. Saksit Phaisanphit Mr. Nattapon Jengwareewong  
 RYG Field Service Scientist (4) RYG Field Service Specialist (1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	9 Jan 24	Ambient Temperature (°C) :	27.2		
Calibration sheet No. :	C-090124-BKK_FS0519	Relative Humidity (%) :	55		
Digital Temperature ID :	BKK_FS0510	Reference Temperature ID :	RYO_FS0601		
Serial No. :	1504025	Serial No. :	201000014918		
Model :	XC-572-V	Model :	Digicon-CC-VI-M3		
		Next Calibrate :	13 Nov 24		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	500	0	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Filter	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
Metar	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Saksit Phaisanphit Approved by : Nattapon Jengwareewong  
 Mr. Saksit Phaisanphit Mr. Nattapon Jengwareewong  
 RYG Field Service Scientist (4) RYG Field Service Specialist (1)

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



PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

Calibration Date : 9 Jan 24	Nozzle Set ID. : BKK_FS0524
Calibration Sheet No. : C-090124-BKK_FS0524	Vernier Caliper ID. : BKK_FS1123

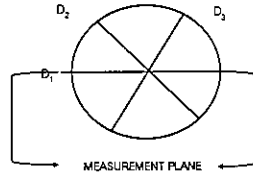
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo $\Delta D$	$(D_1 + D_2 + D_3) / 3$ $D_{avg}$
	$D_1$	$D_2$	$D_3$		
1	0.318	0.318	0.318	0.000	0.318
2	0.472	0.474	0.475	0.003	0.474
3	0.632	0.635	0.634	0.003	0.634
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.091	1.110	1.092	0.019	1.098
7	1.256	1.262	1.262	0.006	1.260
8	1.601	1.598	1.600	0.003	1.600

Where :

$D_1, D_2, D_3$  = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

$D_{avg}$  =  $(D_1 + D_2 + D_3) / 3$



Calibrated by : Saksit Phaisanphisit

(Mr. Saksit Phaisanphisit)  
RYG Field Service Scientist (4)

Approved by : Nattapol Jengwareewong

(Mr. Nattapol Jengwareewong)  
RYG Field Service Specialist (1)

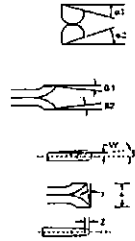
FORM NO. F 06-124 REVISION NO. 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 31-Jan-24  
Pitot ID BKK\_FS0532  
Pitot SN -

Due Date 31-Jul-24  
Inclinometer ID BKK\_FS1131  
Vernier ID RYG\_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	-2.4	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	-1.2	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-2.0	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	1.3	$-5^\circ < \beta 2 < +5^\circ$	OK
$\gamma$	0.3	-	-
$\theta$	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.468	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.91	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/probe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Saksit Phaisanphisit  
(Mr. Saksit Phaisanphisit)  
RYG Field Services Scientist (4)

Approved by : Nattapol Jengwareewong  
(Mr. Nattapol Jengwareewong)  
RYG Field Services Specialist (1)

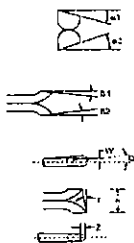
FORM NO. F 06-124 REVISION NO. 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 9-Jan-24  
Pitot ID BKK\_FS0523  
Pitot SN -

Due Date 9-Jul-24  
Inclinometer ID BKK\_FS1131  
Vernier ID RYG\_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	-0.2	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	2.4	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-1.2	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	-1.6	$-5^\circ < \beta 2 < +5^\circ$	OK
$\gamma$	-1.1	-	-
$\theta$	0.2	-	-
$Z = A \tan \gamma$	-0.018	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.308	0.188" to 0.375"	OK
A/2Dt	1.494	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/probe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Saksit Phaisanphisit  
(Mr. Saksit Phaisanphisit)  
RYG Field Services Scientist (4)

Approved by : Nattapol Jengwareewong  
(Mr. Nattapol Jengwareewong)  
RYG Field Services Specialist (1)



Calibration Certificate



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

Instrument description : Flue Gas Analyzer  
Instrument model : Testo 350 New  
Control unit serial no. : 03580098/1121  
Instrument serial no. : 0295047/1121  
ID no. or control no. : RYG\_FS0563  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial no. : -  
Customer name : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
Customer address : 104 Phatthanakan 48, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang Bangkok, 10250 Thailand  
Total pages of certificate : 2 Pages  
Receiving no. : L-240266  
Receiving date : 24-Jan-24  
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.04, 21.02 %vol, Carbon Monoxide 80.14, 302, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)  
Condition of UUC : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory  
Temperature :  $23 \pm 5^\circ C$   
Humidity :  $55 \pm 15\% RH$   
Calibration place : 17/121 Soi Ngenwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture accord ng to calibration Work Instruction no. WI-QI-28-C

REVIEW BY : Handon P  
APPROVED BY : Handon P  
NEXT CAL. DATE : 25/1/25

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition.  
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.  
Calibration certificates without signature and seal are invalid and The results relate only to the items tested/calibrated.  
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).  
Date of calibration : 26-Jan-24

Kwanchoi Khemdoung  
Mrs. Kwanchoi Khemdoung  
Calibration Technician

Wattana Wattana  
Mrs. Nongluck Wongsettee  
Technical Manager



Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide ( CO ) 1003 ppm	2384/23	Linde	10-Sep-25
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	2340/21	Linde	26-Jun-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide ( NO ) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

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

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1017.1 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.50	2.46	-0.04	0.15
O <sub>2</sub> (%Vol)	10.04	9.93	-0.11	0.20
O <sub>2</sub> (%Vol)	21.02	21.09	0.07	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1003	1005	2	12
NO <sub>2</sub> (ppm)	30.34	30.1	-0.24	8.0
NO <sub>2</sub> (ppm)	80.96	81.2	0.24	8.0
NO <sub>2</sub> (ppm)	201.9	200.8	-1.1	12
NO (ppm)	30.01	31	0.99	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO <sub>2</sub> (ppm)	50.36	52	1.64	6.0
SO <sub>2</sub> (ppm)	100.8	102	1.2	6.0
SO <sub>2</sub> (ppm)	600.8	603	2.2	13

Remark : 1 cmol/mol = 1 %Vol, 1 μmol/mol = 1 ppm.

End of Report

Instrument description : Flue Gas Analyzer  
Instrument model : Testo 350 New  
Control unit serial no. : 03580182/1121  
Instrument serial no. : 62985049/1121  
ID no. or control no. : RYG\_FS0564  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial no. : -  
Customer name : ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
Customer address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand  
Total pages of certificate : 3 Pages  
Receiving no. : L-241458  
Receiving date : 11-Apr-24  
Parameter of calibration : Gas Calibration(Oxygen 2.50,10.04,21.02 %Vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,80.96, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)  
Condition of UUC : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory  
Temperature : 23 ± 5 °C  
Humidity : 55 ± 15 %RH  
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND  
Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C  
The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement. Multiplied by coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test. Environmental condition.  
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal are not valid and The results relate only to the items tested/calibrated.  
This calibration certificate documents are traceable to national standards, which realize measurement according to the International System of Units (SI).  
Date of calibration : 24-Apr-24

*Kumchai*  
Mr. Kwanchai Khumchai  
Calibration Technician

*Wongsetee*  
Mrs. Nongluck Wongsetee  
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide ( CO ) 1003 ppm	2384/23	Linde	10-Sep-25
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	2340/21	Linde	26-Jun-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide ( NO ) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.6 °C Humidity : 64.3 %RH Pressure : 1006.6 mbar

Calibration conditions

Gas Temperature : 24 °C Flow rate : 1,200 ml/min Gas pressure : 1019.2 mbar

Calibration Results (Before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.50	2.44	-0.06	0.15
O <sub>2</sub> (%Vol)	10.04	9.92	-0.12	0.20
O <sub>2</sub> (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1001	-2	12
NO <sub>2</sub> (ppm)	30.34	22.8	-7.54	8.0
NO <sub>2</sub> (ppm)	81.32	73.4	-7.92	8.0
NO <sub>2</sub> (ppm)	201.9	191.5	-10.4	12
NO (ppm)	30.01	28	-2.01	8.0
NO (ppm)	151.5	147	-4.5	8.0
NO (ppm)	322.5	308	-14.5	12
SO <sub>2</sub> (ppm)	50.36	52	1.64	6.0
SO <sub>2</sub> (ppm)	100.8	101	0.2	6.0
SO <sub>2</sub> (ppm)	600.8	599	-1.8	13

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.50	2.44	-0.06	0.15
O <sub>2</sub> (%Vol)	10.04	9.92	-0.12	0.20
O <sub>2</sub> (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1001	-2	12
NO <sub>2</sub> (ppm)	30.34	27.6	-2.74	8.0
NO <sub>2</sub> (ppm)	81.32	80.2	-1.12	8.0
NO <sub>2</sub> (ppm)	201.9	201.1	-0.8	12
NO (ppm)	30.01	31	0.99	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO <sub>2</sub> (ppm)	50.36	52	1.64	6.0
SO <sub>2</sub> (ppm)	100.8	101	0.2	6.0
SO <sub>2</sub> (ppm)	600.8	599	-1.8	13

Remark : 1 cmol/mol = 1 %Vol, 1 μmol/mol = 1 ppm.

End of Report



SARTORIUS

# Certificate of Calibration

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073  
Description: Analytical Balance Issued Date: Friday, February 23, 2024  
Serial Number: 0031709552 Reference No.: 229198  
ID No.: RYG\_EN0003  
Manufacturer: Sartorius Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.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.Chonchal Inthana Calibration Procedure No.: This calibration was conducted by Using In-house calibration procedure number (WI-003) Based on UKAS LAB 14: 2010

Calibration Date: Thursday, February 22, 2024

Metrological data: Capacity: 220 g Readability: 0.0001 g  
Ambient Conditions: Temperature: 23.7 °C ± 5.0 °C  
Humidity: 62.0 % RH ± 10.0 % RH  
Pressure: ±

Reasons for calibration: ☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance  
Equipment Condition: ☒ Good Operation ☐ Fair

**Measurement Method** UKAS Publication Ref: Lab 14  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form 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	YCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Balance/Temp. Lutron MHB-382SD	DKSH	C18231845	23-Aug-2024

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

*Mr.Chonchal Inthana*

Mr.Chonchal Inthana(Technical Manager)



SOP FM 33 03 February 2022

SARTORIUS

# Certificate of Calibration

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073  
Description: Analytical Balance Issued Date: Friday, February 23, 2024  
Serial Number: 0031709552 Reference No.: 229198  
ID No.: RYG\_EN0003  
Manufacturer: Sartorius Page No.: 2 of 2

## Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.		The off-center loading error is yielded by the difference between the resultant of the load, 1g, 1/2 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to DIN, R70).	
Nominal Value : (Low Load)	20.0000 200.0001	Nominal value :	100 g
20 g	20.0000 200.0000	Tolerance	0.0004 g
Tolerance	0.0001 g		
Nominal Value : (High Load)	20.0000 200.0001		
200 g	20.0000 200.0001		
Tolerance	0.0001 g		
Standard Deviation	0.00005 0.00005		

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00013
1	1.0000	1.0000	0.0000	0.00013
5	5.0000	5.0000	0.0000	0.00013
10	10.0000	10.0000	0.0000	0.00013
20	20.0000	20.0000	0.0000	0.00013
50	50.0000	50.0000	0.0000	0.00024
100	100.0000	99.9999	-0.0001	0.00018
200	200.0000	199.9999	-0.0001	0.00029

End of Report.

SOP FM 33 03 February 2022



Lot No. 2444103-1

## ANALYZER CALIBRATION DATA

Client : Gulf TS4 Co., Ltd. Location : Udon HRSG 11  
Date : 28 May 24 Test Operator : Saketh P.

O<sub>2</sub> ANALYZER Model : TELEDYNE API 200EH Serial No. : 774  
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.03	-0.01	0.08
Low-Level Gas	8.00	7.97	7.99	0.08
Span Gas	16.00	15.97	15.99	0.08

NO<sub>x</sub> ANALYZER Model : TELEDYNE API 200EH Serial No. : 774  
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.15	-0.02	0.07
Low-Level Gas	82.39	82.24	82.37	0.07
Span Gas	164.40	164.35	164.38	0.02

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.08	0.01	0.03
Low-Level Gas	76.75	76.81	76.76	0.02
Span Gas	153.50	153.55	153.51	0.03

CO ANALYZER Model : TELEDYNE API 300EH 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	-0.05	-0.01	0.01
Low-Level Gas	76.46	76.43	76.47	0.01
Span Gas	407.40	407.35	407.38	0.01

Calibrated by

*Saketh P.*

(Mr.Saketh Phalaenphit)

Environmental Field Scientist (4)



Lot No. 2444103-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf TS4 Co., Ltd. Location : Udon HRSG 11  
Date : 28 May 24 Test Operator : Saketh P.

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

	O <sub>2</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.03	-0.03	0.00	-0.01	0.05	0.08
Upscale Gas	15.97	15.97	0.00	15.99	0.08	0.08

NO<sub>x</sub> ANALYZER Cylinder Conc. (ppm) : 184.40 Span (ppm) : 200

	NO <sub>x</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.15	-0.15	0.00	-0.02	0.09	0.07
Upscale Gas	164.35	164.35	0.00	164.38	0.02	0.02

SO<sub>2</sub> ANALYZER Cylinder Conc. (ppm) : 159.90 Span (ppm) : 200

	SO <sub>2</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.08	0.08	0.00	0.01	0.03	0.03
Upscale Gas	159.98	159.98	0.00	159.91	0.03	0.03

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	-0.05	-0.05	0.00	-0.01	0.01	0.01
Upscale Gas	407.35	407.35	0.00	407.38	0.01	0.01

Calibrated by

*Saketh P.*

(Mr.Saketh Phalaenphit)

Environmental Field Scientist (4)



## EMISSION TEST RESULT

Client	Gulf T&E Co., Ltd.	Run #	1
Date	28 May 24	Location	Uddee HRSG 11
Start Time	13:40	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	14:00
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:40	14.07	3.89	14.55	0.19	0.87	
13:41	14.07	3.88	14.51	0.19	0.87	
13:42	14.08	3.89	14.37	0.17	0.76	
13:43	14.08	3.89	14.33	0.18	0.72	
13:44	14.08	3.89	14.25	0.18	0.68	
13:45	14.04	3.90	14.35	0.35	0.90	
13:46	14.07	3.90	14.32	0.37	0.80	
13:47	14.06	3.90	14.39	0.35	0.96	
13:48	14.07	3.89	14.31	0.35	0.83	
13:49	14.07	3.89	14.43	0.35	0.84	
13:50	14.07	3.89	14.49	0.35	0.55	
13:51	14.07	3.89	14.50	0.35	0.58	
13:52	14.08	3.89	14.48	0.32	0.62	
13:53	14.08	3.88	14.43	0.32	0.56	
13:54	14.08	3.87	14.43	0.31	0.64	
13:55	14.08	3.90	14.50	0.30	0.58	
13:56	14.05	3.91	14.54	0.31	0.58	
13:57	14.07	3.90	14.39	0.30	0.59	
13:58	14.07	3.89	14.41	0.29	0.50	
13:59	14.07	3.88	14.28	0.29	0.53	
14:00	14.04	3.90	14.55	0.28	0.45	
Average	14.08	3.89	14.42	0.29	0.60	

Sakait P.

(Mr. Sakait Phaisanphaisit)

Environmental Field Scientist (4)

FORM NO. F 06-000 REVISION NO. 1 ISSUE DATE 18/01/24

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## EMISSION TEST RESULT

Client	Gulf T&E Co., Ltd.	Run #	2
Date	28 May 24	Location	Uddee HRSG 11
Start Time	14:01	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	14:21
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
14:01	14.05	3.90	14.54	0.25	0.51	
14:02	14.07	3.88	14.57	0.27	0.51	
14:03	14.08	3.89	14.50	0.27	0.47	
14:04	14.08	3.88	14.57	0.28	0.45	
14:05	14.05	3.89	14.63	0.25	0.50	
14:06	14.05	3.81	14.57	0.25	0.51	
14:07	14.07	3.81	14.58	0.24	0.43	
14:08	14.09	3.89	14.59	0.24	0.43	
14:09	14.08	3.89	14.61	0.22	0.39	
14:10	14.08	3.88	14.48	0.22	0.39	
14:11	14.05	3.89	14.68	0.23	0.39	
14:12	14.09	3.89	14.75	0.23	0.41	
14:13	14.09	3.89	14.84	0.22	0.37	
14:14	14.08	3.88	14.88	0.23	0.38	
14:15	14.11	3.88	14.91	0.37	0.42	
14:16	14.11	3.88	14.82	0.36	0.34	
14:17	14.10	3.87	14.68	0.37	0.45	
14:18	14.13	3.88	14.68	0.36	0.40	
14:19	14.13	3.88	14.79	0.36	0.40	
14:20	14.12	3.90	14.69	0.35	0.41	
14:21	14.13	3.89	14.68	0.34	0.40	
Average	14.09	3.88	14.85	0.28	0.43	

Sakait P.

(Mr. Sakait Phaisanphaisit)

Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf T&E Co., Ltd.	Run #	3
Date	28 May 24	Location	Uddee HRSG 11
Start Time	14:22	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	14:42
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
14:22	14.13	3.88	14.81	0.33	0.35	
14:23	14.11	3.89	14.69	0.34	0.35	
14:24	14.13	3.89	14.73	0.31	0.34	
14:25	14.13	3.88	14.81	0.31	0.31	
14:26	14.12	3.89	14.89	0.32	0.37	
14:27	14.12	3.88	14.83	0.31	0.39	
14:28	14.14	3.88	14.78	0.29	0.37	
14:29	14.15	3.87	14.93	0.29	0.32	
14:30	14.14	3.88	15.03	0.29	0.31	
14:31	14.15	3.87	15.10	0.29	0.34	
14:32	14.14	3.87	15.18	0.28	0.31	
14:33	14.12	3.88	15.15	0.30	0.29	
14:34	14.12	3.89	15.08	0.28	0.32	
14:35	14.11	3.90	14.88	0.28	0.29	
14:36	14.13	3.88	14.73	0.27	0.23	
14:37	14.12	3.88	14.67	0.27	0.31	
14:38	14.13	3.87	14.53	0.28	0.30	
14:39	14.17	3.87	14.95	0.26	0.28	
14:40	14.16	3.88	15.01	0.26	0.24	
14:41	14.14	3.89	15.02	0.26	0.35	
14:42	14.15	3.88	15.05	0.26	0.29	
Average	14.13	3.88	14.82	0.28	0.32	

Sakait P.

(Mr. Sakait Phaisanphaisit)

Environmental Field Scientist (4)

FORM NO. F 06-000 REVISION NO. 1 ISSUE DATE 18/01/24

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## ANALYZER CALIBRATION DATA

Lot No. 2444164-1

Client	Gulf T&E Co., Ltd.	Location	Uddee HRSG 12
Date	28 May 24	Test Operator	Sathaporn T.

O <sub>2</sub> ANALYZER		Serial No.	
Model	HORIBA PO-350		TDBAROKP
Span (%)	25		

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	8.10	8.20	8.22	0.08
Span Gas	15.07	15.08	15.10	0.04

NO <sub>x</sub> ANALYZER		Serial No.	
Model	HORIBA PO-350		TDBAROKP
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.01
Low-Level Gas	54.96	54.95	54.95	0.00
Span Gas	82.51	82.50	82.48	0.02

SO <sub>2</sub> ANALYZER		Serial No.	
Model	TELEDYNE API 100EH		410
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	65.65	65.63	65.62	0.01
Span Gas	78.76	78.75	78.75	0.00

CO ANALYZER		Serial No.	
Model	HORIBA PO-350		TDBAROKP
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.50	0.01	0.01	0.50
Low-Level Gas	54.84	54.83	54.81	0.02
Span Gas	78.74	78.73	78.71	0.02

Calibrated by

Sathaporn T.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F 06-002 REVISION NO. 4 ISSUE DATE 18/01/24

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Lot No. 2444184-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: Gulf T&S Co., Ltd. Location: Ulae HRSG 12  
Date: 28 May 24 Test Operator: Sathaporn T.

	O <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.02	0.04	0.02	0.04	0.00
Upscale Gas	15.03	15.12	0.12	15.14	0.20	0.08

NO<sub>x</sub> ANALYZER  
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO <sub>x</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.02	0.01	0.02	0.01	0.00
Upscale Gas	82.50	82.45	0.02	82.45	0.05	0.03

SO<sub>2</sub> ANALYZER  
Cylinder Conc. (ppm) : 79.78 Span (ppm) : 100

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

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

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.02	0.01	0.02	0.01	0.00
Upscale Gas	79.73	79.71	0.02	79.70	0.03	0.01

Calibrated by  
**Sathaporn.T**  
(Mr.Sathaporn Thakaw)  
Environmental Field Scientist (3)

FORM NO. F-08-003 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group



## EMISSION TEST RESULT

Client	Gulf T&S Co., Ltd.	Location	Ulae HRSG 12
Date	28 May 24	Test Operator	Sathaporn T.
Start Time	13:00	Finish Time	13:30
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO <sub>2</sub> /O <sub>2</sub> Analyzer Model	HORIBA PG-350	Serial No.	TDAARGKP
CO/CO <sub>2</sub> Analyzer Model	HORIBA PG-350	Serial No.	TDAARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:00	13.55	3.87	13.04	0.24	0.51	
13:01	13.45	3.81	10.52	0.24	0.54	
13:02	13.55	3.87	10.75	0.25	0.56	
13:03	13.62	3.83	11.25	0.29	0.56	
13:04	13.66	3.81	12.75	0.29	0.53	
13:05	13.63	3.83	13.35	0.29	0.51	
13:06	13.61	3.90	12.65	0.29	0.54	
13:07	13.58	3.95	12.60	0.29	0.51	
13:08	13.44	3.94	11.49	0.28	0.51	
13:09	13.48	3.91	10.69	0.28	0.59	
13:10	13.61	3.89	10.84	0.28	0.54	
13:11	13.63	3.89	11.37	0.28	0.54	
13:12	13.61	3.90	11.59	0.28	0.58	
13:13	13.63	3.88	11.62	0.28	0.54	
13:14	13.52	3.89	11.58	0.28	0.56	
13:15	13.50	3.90	11.40	0.28	0.58	
13:16	13.52	3.89	11.64	0.27	0.56	
13:17	13.54	3.88	11.60	0.27	0.58	
13:18	13.61	3.89	11.98	0.27	0.58	
13:19	13.54	3.85	11.72	0.27	0.58	
13:20	13.55	3.87	11.62	0.27	0.58	
Average	13.52	3.88	11.79	0.27	0.57	

**Sathaporn.T**  
(Mr.Sathaporn Thakaw)  
Environmental Field Scientist (3)

FORM NO. F-08-003 REVISION NO. 1 ISSUE DATE: 18/01/24

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## EMISSION TEST RESULT

						Run #	2
Client	Gulf T&S Co., Ltd.					Location	Ulae HRSG 12
Date	28 May 24					Test Operator	Sathaporn T.
Start Time	13:31					Finish Time	13:41
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH					Serial No.	410
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	HORIBA PG-350					Serial No.	TDAARGKP
CO/CO <sub>2</sub> Analyzer Model	HORIBA PG-350					Serial No.	TDAARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:31	13.53	3.89	11.91	0.27	0.62	
13:32	13.59	3.85	11.59	0.27	0.54	
13:33	13.53	3.88	12.34	0.27	0.58	
13:34	13.54	3.87	11.93	0.27	0.58	
13:35	13.50	3.90	12.36	0.27	0.58	
13:36	13.56	3.87	11.84	0.27	0.58	
13:37	13.53	3.88	12.19	0.27	0.58	
13:38	13.56	3.87	11.87	0.27	0.58	
13:39	13.54	3.87	12.06	0.27	0.54	
13:40	13.55	3.86	12.02	0.29	0.54	
13:41	13.52	3.88	12.82	0.29	0.59	
13:42	13.54	3.88	12.37	0.28	0.54	
13:43	13.62	3.86	12.44	0.28	0.58	
13:44	13.55	3.86	12.13	0.28	0.56	
13:45	13.55	3.85	12.39	0.28	0.87	
13:46	13.55	3.85	12.69	0.28	0.52	
13:47	13.58	3.85	12.66	0.28	0.68	
13:48	13.54	3.87	12.90	0.28	0.58	
13:49	13.55	3.86	12.47	0.25	0.56	
13:50	13.54	3.87	12.78	0.25	0.56	
13:51	13.53	3.87	12.64	0.25	0.56	
Average	13.54	3.87	12.26	0.28	0.57	

**Sathaporn.T**  
(Mr.Sathaporn Thakaw)  
Environmental Field Scientist (3)

FORM NO. F-08-003 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group



## EMISSION TEST RESULT

						Run #	3
Client	Gulf T&S Co., Ltd.					Location	Ulae HRSG 12
Date	28 May 24					Test Operator	Sathaporn T.
Start Time	13:42					Finish Time	14:02
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH					Serial No.	410
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	HORIBA PG-350					Serial No.	TDAARGKP
CO/CO <sub>2</sub> Analyzer Model	HORIBA PG-350					Serial No.	TDAARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:42	13.54	3.87	12.01	0.25	0.51	
13:43	13.54	3.87	12.57	0.25	0.54	
13:44	13.51	3.89	12.89	0.25	0.52	
13:45	13.56	3.89	12.30	0.25	0.58	
13:46	13.52	3.89	12.94	0.25	0.57	
13:47	13.57	3.85	12.39	0.25	0.54	
13:48	13.53	3.87	13.01	0.25	0.54	
13:49	13.55	3.87	12.83	0.25	0.49	
13:50	13.53	3.88	12.90	0.25	0.57	
13:51	13.58	3.86	12.80	0.25	0.59	
13:52	13.55	3.88	12.78	0.25	0.54	
13:53	13.55	3.87	12.89	0.25	0.59	
13:54	13.53	3.87	12.87	0.24	0.51	
13:55	13.52	3.88	13.00	0.24	0.57	
13:56	13.55	3.87	12.48	0.24	0.54	
13:57	13.57	3.89	12.47	0.24	0.54	
13:58	13.54	3.87	12.81	0.24	0.54	
13:59	13.53	3.87	13.10	0.24	0.57	
14:00	13.53	3.87	13.05	0.24	0.54	
14:01	13.54	3.87	12.82	0.24	0.54	
14:02	13.55	3.86	12.93	0.24	0.54	
Average	13.54	3.87	12.77	0.25	0.54	

**Sathaporn.T**  
(Mr.Sathaporn Thakaw)  
Environmental Field Scientist (3)

FORM NO. F-08-003 REVISION NO. 1 ISSUE DATE: 18/01/24

ALS Laboratory Group

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE  
(THAILAND) LTD  
Part Number: E04N199E3HA0002  
Cylinder Number: GN0027210  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12022  
Gas Code: CO,NO,NOX,SO2,BALN  
Reference Number: 160-402340013-1  
Cylinder Volume: 247.2 CF  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 660  
Certification Date: Feb 11, 2022  
Expiration Date: Feb 11, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-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. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.38 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/22
CARBON MONOXIDE	80.00 PPM	78.48 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022, 02/11/22
NITRIC OXIDE	80.00 PPM	82.38 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/22
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/22
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	00010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 15, 2024
NTRM	200610-15	CC733138	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	CC703044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 05, 2026
GMIS	124206889139	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Aug 03, 2024
NTRM	11010419	KAL004813	98.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

Instrument/Make/Model	Analytical Principle	Last Multi-Point Calibration
Nicotel ISSO FTIR AUP2010245 CO	FTIR	Feb 03, 2022
Nicotel ISSO FTIR AUP2010245 NO	FTIR	Feb 10, 2022
Nicotel ISSO FTIR AUP2010245 NO2	FTIR	Jan 27, 2022
Nicotel ISSO 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: E04N199E15A021C  
Cylinder Number: CC709609  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12021  
Gas Code: CO,NO,NOX,SO2,BALN  
Reference Number: 160-402020199-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
Certification Date: Feb 22, 2021  
Expiration Date: Feb 22, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-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. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.96 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.84 PPM	G1	+/- 0.7% NIST Traceable	02/15/2021
NITRIC OXIDE	55.00 PPM	54.88 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.58 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14080753	CC434455	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200011-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Feb 02, 2025
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

Instrument/Make/Model	Analytical Principle	Last Multi-Point Calibration
Nicotel ISSO FTIR AUP2010245 CO	FTIR	Feb 04, 2021
Nicotel ISSO FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicotel ISSO FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicotel ISSO FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request  
NOTES:  
Gross Weight: 28.6 Kg  
Net Weight: 4.6 Kg



*Michael A. Fisher*  
Approved for Release

Page 1 of 160-402020199-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E3HA0065  
Cylinder Number: ND11223  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12021  
Gas Code: CO,NO,NOX,SO2,BALN  
Reference Number: 160-402138464-1  
Cylinder Volume: 247.2 CF  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 660  
Certification Date: Jul 15, 2021  
Expiration Date: Jul 15, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-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. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	56.17 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	55.00 PPM	54.24 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	55.00 PPM	56.17 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	55.00 PPM	55.51 PPM	G1	+/- 1.1% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004538	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200610-60	CC733426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15010224	KAL003838	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

Instrument/Make/Model	Analytical Principle	Last Multi-Point Calibration
Nicotel ISSO FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicotel ISSO FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicotel ISSO FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicotel ISSO FTIR AUP2010245 SO2	FTIR	Jul 09, 2021

Triad Data Available Upon Request  
NOTES:  
Gross Weight: 47.9 Kg  
Net Weight: 7.8 Kg



*Michael A. Fisher*  
Approved for Release

Page 1 of 160-402138464-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E3HA0002  
Cylinder Number: ND11222  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12021  
Gas Code: CO,NO,NOX,SO2,BALN  
Reference Number: 160-402138455-1  
Cylinder Volume: 247.2 Cubic Feet  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 660  
Certification Date: Jul 15, 2021  
Expiration Date: Jul 15, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-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. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	52.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	55.00 PPM	50.74 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	55.00 PPM	52.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	55.00 PPM	79.78 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004538	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200610-60	CC733426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15010224	KAL003838	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

Instrument/Make/Model	Analytical Principle	Last Multi-Point Calibration
Nicotel ISSO FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicotel ISSO FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicotel ISSO FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicotel ISSO FTIR AUP2010245 SO2	FTIR	Jul 09, 2021

Triad Data Available Upon Request  
NOTES:  
Gross Weight: 48.0 Kg  
Net Weight: 7.8 Kg



*Michael A. Fisher*  
Approved for Release

Page 1 of 160-402138455-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E02N182E3HA0000 Reference Number: 82-401018725-1  
Cylinder Number: ND80018 Cylinder Volume: 248.4 CF  
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2214 PSIG  
PGVP Number: B52017 Valve Outlet: 590  
Gas Code: O2,BALN Certification Date: Oct 23, 2017  
Expiration Date: Oct 23, 2025

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, 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 volumetric basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	8.000 %	8.000 %	G1	+/- 0.4% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRMplus	09080258	OC282337	8.951 % OXYGEN/NITROGEN	+/- 0.3%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
Merab MPA 510-Q2-771WJ041	Paramagnetic		Sep 28, 2017	

Triad Data Available Upon Request

NOTES:  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 2000.02

*[Signature]*  
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Page 1 of 82-401018725-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD Reference Number: 160-402830555-1  
Part Number: E02N184E3HA0001 Cylinder Volume: 250.0 CF  
Cylinder Number: GN0029535 Cylinder Pressure: 2214 PSIG  
Laboratory: 124 - Plumsteadville - PA Valve Outlet: 590  
PGVP Number: A12023 Certification Date: Sep 05, 2023  
Gas Code: O2,BALN Expiration Date: Sep 05, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	16.00 %	16.00 %	G1	+/- 0.4% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	08010205	K001515	23.2 % OXYGEN/NITROGEN	+/- 0.4%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Aug 16, 2023	

Triad Data Available Upon Request

NOTES: Gross Weight: 50.0 Kg

Net Weight: 8.4 Kg



*[Signature]*  
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Page 1 of 1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E02N182E3HA0000 Reference Number: 160-401048144-1  
Cylinder Number: GN0025086 Cylinder Volume: 248.4 CF  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG  
PGVP Number: A12020 Valve Outlet: 590  
Gas Code: O2,BALN Certification Date: Nov 11, 2020  
Expiration Date: Nov 11, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	8.000 %	8.168 %	G1	+/- 0.3% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	10010602	1038055	8.987 % OXYGEN/NITROGEN	+/- 0.3%
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Oct 26, 2020	

Triad Data Available Upon Request

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



*[Signature]*  
Approved for Release

Page 1 of 160-401048144-1



## CERTIFICATE OF ANALYSIS

Customer Detail: ALS Laboratory Group (Thailand)		Production Order Number: 90137389 Material Number: 557200-J-44 Certification Date: 24-Sep-2016 Expiry Date: 24-Sep-2024	
Cylinder Description: STEEL 47 L		The measurement of this reference material is traceable to SI through NIST. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/531 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.	
Certificate Number: 2857/16		Analyst:  THIRAT LOYRAT	
Cylinder Number: 363075		Approve:  SUKANYA KANUTHARAT	
Nominal Cylinder Content: 6.560 M <sup>3</sup>		To Re-Order Please Quote: 557200-J-44	
Nominal Pressure: 145.0 Bar			
Valve Outlet: CGA 590 BRASS			
Comment:	<ul style="list-style-type: none"><li>It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig.</li><li>Other impurities that detect by analytical certification of this mixture shall be report if it is more than 10% of minimum minor component.</li><li>Keep and use in well-ventilated and secure area.</li></ul>		

Page 1 of 2

## CERTIFICATE OF ANALYSIS

## Analytical Result

Component	Repeat Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	16.0 %	16.0 %	+/- 3% relative	(2) I-PB-354	24-Sep-2016

## Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expiry Date
Oxygen in Nitrogen	2436255C	25.08 ± 0.13 %	19-Aug-2017

## Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multinomial Calibration
Servotest 4100 O2 Analyzer	Paramagnetic	24-Sep-2016

Method of Analysis  
 1. Gas Chromatography  
 2. Paramagnetic Oxygen Analyzer  
 3. Microchemical Oxygen Analyzer  
 4. Electrochemical Moisture Analyzer  
 5. Trawl Hydrocarbon Analyzer  
 6. Other specified

Cylinder Number: 2436255C  
 Production Order Number: 90137389

Certification Date: 24-Sep-2016  
 Expiration Date: 24-Sep-2024

Page 2 of 2

## Linda (Thailand) Public Company Limited

Head Office  
 35 Mu 3 Tambon Khlong Hu, Amphoe Khlong Luang,  
 Changwat Pathumthani 12120, Thailand  
 Tel: (66) 0 2577 9000  
 Fax: (66) 0 2577 9003  
 E-mail: info@linda.or.th Website: www.linda.or.th

## Linde (Thailand) Public Company Limited

Head Office  
 15 Mu, Bangpa-In Road A, 2/3 Mu 14, Bangpa-In Road, Bangkok  
 Bangkok, Thailand 10260, Thailand  
 Tel: (66) 0 2331 4100 Fax: (66) 0 2331 4103  
 Bangkok Plant: 105 Mu 5, Bangpa-In Road, Bangkok, Thailand 10260  
 Thailand, Tel: (66) 0 28 570 478 Fax: (66) 0 28 570 323



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292 MTC No. EEL. BP. 83/0267

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

Nominal Output of Unit Under Test = 94 dB re 20  $\mu$ Pa at 1000 Hz

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

## 1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC 60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	94.01	0.01	± 0.10	± 0.40 dB

## 2. Frequency

Standard Microphone	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC 60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1003.1	3.1	± 1.5	± 1.0%

## 3. Total Distortion

Standard Microphone	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC 60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.80	± 0.50	± 3.0%

Note: 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from nominal.

Calibrated by: *Mr. Weerachai Deechaiyay*

Approved by: *Mr. Weerachai Deechaiyay*

Date of Calibration : 28 Feb. 2024  
 Date of Issue : 29 Feb. 2024

Electrical and Electronic Standards Laboratory  
 Industrial Metrology and Testing Service Centre

Ref: 2011267021900719001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM/BLMTC.002 Rev.5

Head Office  
 35 Mu 3 Tambon Khlong Hu, Amphoe Khlong Luang,  
 Changwat Pathumthani 12120, Thailand  
 Tel: (66) 0 2577 9000  
 Fax: (66) 0 2577 9003  
 E-mail: info@linda.or.th Website: www.linda.or.th

Office/Laboratory  
 15 Mu, Bangpa-In Road A, 2/3 Mu 14, Bangpa-In Road,  
 Amphoe Muang, Changwat Samutprakan 10260, Thailand  
 Tel: (66) 0 2331 4100 Fax: (66) 0 2331 4103  
 Fax: (66) 0 2331 4103  
 E-mail: info@linda.or.th

Office  
 196 Phanomyothin Road, Chachabak, Bangkok 10260  
 Thailand  
 Tel: (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
 Fax: (66) 0 2579 1121-30  
 E-mail: info@linda.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

## CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
 Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250.  
 Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,  
 Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment  
 Description : Sound Calibrator Temperature : (23 ± 3) °C  
 Manufacturer : Rion Relative Humidity : (50 ± 15) %  
 Model : NC-74 Ambient Pressure : (101.325 ± 1.500) kPa  
 Serial No. : 34178121 (ID: RYG\_FS0213)  
 Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 123037.  
 2. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.  
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.  
 4. Digital Multimeter Agilent 34401A S/N MY44005560.  
 5. Pressure Transmitter Vaisala PTD202AD S/N T0650001.  
 6. Audio Analyzer Keithley 2015-P S/N 4106495.  
 7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

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

1 / 2

The results relate only to the items tested/calibrated or value assigned.  
 Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM/BLMTC.002 Rev.5

Head Office  
 35 Mu 3 Tambon Khlong Hu, Amphoe Khlong Luang,  
 Changwat Pathumthani 12120, Thailand  
 Tel: (66) 0 2577 9000  
 Fax: (66) 0 2577 9003

Office/Laboratory  
 658 Mu 2 Tambon Bangpa-In, Amphoe Muang Samutprakan,  
 Changwat Samutprakan 10260, Thailand  
 Tel: (66) 0 2331 4100 Fax: (66) 0 2331 4103  
 Fax: (66) 0 2331 4103  
 E-mail: info@linda.or.th Website: www.linda.or.th

Office  
 196 Phanomyothin Road, Chachabak, Bangkok 10260, Thailand  
 Tel: (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
 Fax: (66) 0 2579 1121-30

SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY

451-451/1 Sathorn Road, Bangbunma, Bangplud, Bangkok, 10200 Thailand  
 Tel: +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN ASSOCIATES



Cert. No.: ACL24093  
 Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
 Manufacturer : RION  
 Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
 Serial No.: 00734225 / 145272 / 34370  
 ID No.: RYG\_FS0030

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisurpaian

Approved by : *Thanakul 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.



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

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



Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 300266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 290266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 310266	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).

*T. Petch.*

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

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



Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
21.4

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.9
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	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-0.9	-0.9	± 5.0

*T. Petch.*

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

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



Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 3 of 8

**Summary of Measurement Result :**

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

*T. Petch.*

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

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



Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long-term stability**

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

*T. Petch.*

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

45/-45/1 Sirinthorn Road, Bangbunmu, Bangkok, 10700 Thailand  
Tel : +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	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	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

*T. Petchur*

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Cert. No. : ACL24093  
Job No. : VC67AC0058  
Pages : 7 of 8

**8. Level linearity including the level range control**

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

**9. Tone burst response**

Time Weighting	Tone burst duration, T <sub>b</sub> (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	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 <sub>cpk</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±3.0

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

*T. Petchur*

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Job No. : VC67AC0058  
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**11. Overload Indication**

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.8	0.2	±1.5

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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

45/-45/1 Sirinthorn Rd, Bangbunmu, Bangkok 10700 THAILAND.  
Tel: 0-2435-8900 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23196  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preampifier NI-24  
Serial No. : 00734223 / 169439 / 72460  
ID No. : RYG\_FS0029

Condition As Found : GOOD

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

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

Received Date : 15 JUNE 2023  
Calibration Date : 20-22 JUNE 2023  
Date of Issue : 23 JUNE 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.

## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
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)
14.3

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	17.0
Flat	22.8

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.1	-2.1	-2.1	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
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	✓	-	0.1	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long-term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighing network response with relative to 1 kHz

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

## 5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	132.9	-0.1	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	24.9	-0.1	±1.1

## Continuation of Calibration Certificate

Cert. No. : ACL23196  
Job No. : VC66AC0066  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±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		
89.6	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 Srinthorn Road, Bangbunru, Bangkok, Bangkok 10700 Thailand  
Tel : +66 2433 8331 Email : calibration@sithiporn.comCert. No. : ACL24036  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00623395 / 198642 / 26423  
ID No.: RYG\_FS0620

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2024  
Calibration Date : 12-15 JANUARY 2024  
Date of Issue : 16 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch  
( Thanakul Petchursi )

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

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T. Petch

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

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

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Cert. No. : ACL24036  
Job No. : VC67AC0052  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

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

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

3.1 National Institute of Metrology (Thailand).

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

*Signature*

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

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

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Cert. No. : ACL24036  
Job No. : VC67AC0052  
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 )
14.2

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

Frequency Weighting	Measured value ( dB )
A - weight	9.9
C - weight	16.5
Flat	22.3

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.8	±5.0

*Signature*

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Pages : 3 of 8

**Summary of Measurement Result :**

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

*Signature*

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Job No. : VC67AC0052  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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

*Signature*

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**CALIBRATION LABORATORY**

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



Cert. No. : ACL24036  
Job No. : VC67AC0052  
Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

*T. Petchur*

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Cert. No. : ACL24036  
Job No. : VC67AC0052  
Pages : 7 of 8

**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

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

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

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Cert. No. : ACL24036  
Job No. : VC67AC0052  
Pages : 8 of 8

**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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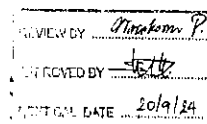
451-451/1 Sirinthorn Rd, Bangbunru, Bangkok 10700 THAILAND  
Tel. 0-2435-8800 Fax. 0-2433-1679 e-mail: cal-center@sithiphorn.com http://www.sithiphorn.com



Cert. No. : ACC23029  
Pages : 1 of 3

**Calibration Certificate**

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No. : 34178123  
ID No. : RYQ\_FS0215



Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTANAKAN 40, PHATTANAKAN ROAD,  
KHWAENG PHATTANAKAN, KHEET 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 SEPTEMBER 2023  
Calibration Date : 20 SEPTEMBER 2023  
Date of Issue : 20 SEPTEMBER 2023

Calibrated by : Natchorn Pisulpaisan

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

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

## Continuation of Calibration Certificate

Cert. No. : ACC23029  
Job No. : VC66AC0100  
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-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL.BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL.BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL.BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EF-0012-23	10-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

## Continuation of Calibration Certificate

Cert. No. : ACC23029  
Job No. : VC66AC0100  
Pages : 3 of 3

## Result of calibration :

## 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	94.1	0.10	0.14	0.40

## 2. Frequency

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

## 3. Total distortion

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

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Tel. +66 2433 8331 Email: calibration@sithiporn.comSITHIPORN  
associatesCert. No. : ACL24072  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01122578 / 143842 / 22771  
ID No. : RYG\_FS0017

Condition As Found : GOOD

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

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

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

Calibrated by : Natlakorn Pisutpaisan

Approved by :

T. Petchum  
( Thanakul Petchumi )

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QP-TS12-04-04-020664

T. Petchum

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Tel. +66 2433 8331 Email: calibration@sithiporn.comSITHIPORN  
associatesCert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

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Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 3 of 8

**Summary of Measurement Result :**

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

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Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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	94.1	0.1	± 0.3

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Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
16.7

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.4

**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	0.4	0.4	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	0.1	0.1	±5.0

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Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 6 of 8

**7. Level linearity on the reference level range**

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

*T. Petch...*

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

7. Petchur

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01222724 / 143486 / 22620  
ID No. : RYG\_FS0023

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

7. Petchur  
( Thanakul Petchurai )

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## 11. Overload Indication

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

## 12. High level stability

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

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

End of Calibration Certificate

7. Petchur

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand),

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

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**CALIBRATION LABORATORY**

451-451/1 Sirinthorn Road, Bangbunmu, Bangplud, Bangkok, 10700 Thailand  
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Cert. No. : ACL24071  
Job No. : VC67AC0054  
Pages : 3 of 8

**Summary of Measurement Result :**

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

*7. Reten*

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Cert. No. : ACL24071  
Job No. : VC67AC0054  
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**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

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

*7. Reten*

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Job No. : VC67AC0054  
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**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
17.3

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

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

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

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

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

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**7. Level linearity on the reference level range**

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

*7. Reten*

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**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

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

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

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Cert. No. : ACL24094  
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**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preampifier NH-24  
Serial No. : 01222723 / 143841 / 22770  
ID No. : RYG\_FS0022

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWAENG 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 : 19 JANUARY 2024  
Calibration Date : 25-26 JANUARY 2024  
Date of Issue : 29 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

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Cert. No. : ACL24094  
Job No. : VC67AC0058  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.  
3. This certificate is traceable to the international system of unit maintained at :

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

*T. Petchur*

**Summary of Measurement Result :**

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

*T. Petch*

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long-term stability**

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

*T. Petch*

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.4
Flat	24.1

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.7	0.8	0.7	±5.0

*T. Petch*

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.1	0.1	±1.1
27.0	27.1	0.1	±1.1
26.0	26.2	0.2	±1.1
25.0	25.1	0.1	±1.1

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**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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**Calibration Certificate**

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01222716 / 143832 / 22763  
**ID No.:** RYG\_FS0020

**Condition As Found :** GOOD

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

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

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

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchur )

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

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Job No. : VC67AC0058  
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**11. Overload Indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.8	89.6	-0.2	±1.5

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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Cert. No. : ACL24075  
Job No. : VC67AC0054  
Pages : 2 of 8

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

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchur*

**Summary of Measurement Result :**

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

*T. Petch*

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

*T. Petch*

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.6

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

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

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

*T. Petch*

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

*T. Petch*



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Cert. No. : ACL24075  
Job No. : VC67AC0054  
Pages : 7 of 8

**8. Level linearity including the level range control**

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

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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 <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±3.0

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

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Cert. No. : ACL24073  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01122379 / 172172 / 74022  
ID No.: RYG\_FS0018

Condition As Found : GOOD

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

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

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

Calibrated by : Natchorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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

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Job No. : VC67AC0054  
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**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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Cert. No. : ACL24073  
Job No. : VC67AC0054  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighing 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	MY53202742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAL	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

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Job No. : VC67AC0054  
Pages : 3 of 8

**Summary of Measurement Result :**

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

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Job No. : VC67AC0054  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighing network response with relative to 1 kHz.

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

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Cert. No. : ACL24073  
Job No. : VC67AC0054  
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
16.6

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

Frequency Weighting	Measured value (dB)
A - weight	14.2
C - weight	19.2
Flat	25.9

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	3.3	3.4	3.4	±5.0

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Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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Cert. No. : ACL24073  
Job No. : VC67AC0054  
Pages : 7 of 8

**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±3.0
One	136.4	136.4	0.0	±3.0

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

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



Cert. No. : ACL23262  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NI1-24  
Serial No. : 00572561 / 170398 / 72899  
ID No. : RYG\_FS0300

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTIANAKAN 40, PHATTIANAKAN ROAD,  
KHUANG PHATTIANAKAN, 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 : 23 AUGUST 2023  
Calibration Date : 01 SEPTEMBER 2023  
Date of Issue : 04 SEPTEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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

**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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**Continuation of Calibration Certificate**

Cert. No. : ACL23262  
Job No. : VC66AC0094  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

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

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

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

*T. Petchur*

## Continuation of Calibration Certificate

Cert. No. : ACL23262  
Job No. : VC66AC0094  
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. : ACL23262  
Job No. : VC66AC0094  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
16.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.2
Flat	24.0

## 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	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.3	0.4	0.4	±5.0

QF-TS12-04-04-020664

T. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACL23262  
Job No. : VC66AC0094  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency Weighting	S.L.M Display at initial (dB)	S.L.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. : ACL23262  
Job No. : VC66AC0094  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

T. Petch.

## Continuation of Calibration Certificate

Cert. No. : ACT23262  
Job No. : VC66AC0094  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

## Continuation of Calibration Certificate

Cert. No. : ACT23262  
Job No. : VC66AC0094  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.1	137.0	0.1	±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

QT-TS12-04-04-020664

QT-TS12-04-04-020664



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

## CALIBRATION CERTIFICATE

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

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Sri 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Ambient Environment

Description : Sound Calibrator

Temperature : (23 ± 3) °C

Manufacturer : Rion

Relative Humidity : (50 ± 15) %

Model : NC-74

Ambient Pressure : (101.325 ± 1.500) kPa

Serial No. : 34178121 (ID:RYG\_FS0213)

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTJ202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 19 Feb. 2024

Date of Calibration : 28 Feb. 2024

1/2

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FMBL/MTC.002 Rev.5

Head Office  
35 Mu 3 Tambon Nong Mak, Amphoe Nong Mak, Chongchot Pattana, 12120, Thailand  
Tel: (66) 0 2577 9056  
Fax: (66) 0 2577 9009

Office/Laboratory  
665 Mu 2 Tambon Bangpoo Industrial Estate, Muang, Samutprakan, 10280, Thailand  
Tel: (66) 0 2577 1121-33 ext. 5219, 5225, 5217  
(66) 0 2577 9009  
E-mail: info@stiporn.co.th, Web: www.stiporn.co.th

Office  
196 Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250, Thailand  
Tel: (66) 0 2577 1121-33 ext. 5219, 5225, 5217  
(66) 0 2577 9009



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. DP. 83/0267

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

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

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

## 1. Sound Pressure Level

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

## 2. Frequency

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

## 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjær 4180	1.80	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by :

Approved by :

(Mr. Weerachai Deechaiyae)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref: 2011267021900719001

End of Certificate

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Head Office  
35 Mu 3 Tambon Nong Mak, Amphoe Nong Mak, Chongchot Pattana, 12120, Thailand  
Tel: (66) 0 2577 9056  
Fax: (66) 0 2577 9009  
E-mail: info@stiporn.co.th, Web: www.stiporn.co.th

Office/Laboratory  
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road, Areehae Muang, Chongchot Pattana, 10280, Thailand  
Tel: (66) 0 2577 1121-33 ext. 5219, 5225, 5217  
Fax: (66) 0 2577 9009  
E-mail: info@stiporn.co.th

Office  
196 Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250, Thailand  
Tel: (66) 0 2577 1121-33 ext. 5219, 5225, 5217  
Fax: (66) 0 2577 9009  
E-mail: info@stiporn.co.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

## CALIBRATION CERTIFICATE

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

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

## Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900072 (ID:RYG\_FS0493)

Microphone : UC-52 No.188465

Preamplifier : NH-24 No.01734

## Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistophone Rion NC-72 S/N D0402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Jan. 2024

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

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Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : tistr@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri IC, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 9165  
E-mail : mtc@tistr.or.th

Office  
199 Phatthanakan Road, Chulachak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

## 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.91	114.0	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.8 dB.

## 2. Self-generated noise

## 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	11.3	0.10	N/A
C-Weight	17.0	0.10	N/A
Flat	23.4	0.10	N/A

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

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Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : tistr@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri IC, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 9165  
E-mail : mtc@tistr.or.th

Office  
199 Phatthanakan Road, Chulachak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

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

10. Speaker Tannoy Limited, Great Britain British Patent No. 2153300.

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

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

## Calibration Procedure :

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

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

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

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

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

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Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : tistr@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri IC, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 9165  
E-mail : mtc@tistr.or.th

Office  
199 Phatthanakan Road, Chulachak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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## 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.3	0.4	0.4	1.5	0.45	0.6
1 000	-0.2	-0.2	-0.2	1.0	0.45	0.6
8 000	-0.4	-0.5	-0.5	5.0	0.45	0.7

## 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.0	2.0	0.20	0.6
4 000	-0.1	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

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

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Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : tistr@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri IC, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 9165  
E-mail : mtc@tistr.or.th

Office  
199 Phatthanakan Road, Chulachak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

## 5. Long-term stability

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

## 6. Frequency and time weightings at 1 kHz

## 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	class 2 (±dB)	(±dB)	(±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

## 6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	class 2 (±dB)	(±dB)	(±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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

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Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpaga@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang Chiang Mai, Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9155  
E-mail : mtc@tistr.or.th

Office  
195 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumaleed@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

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

Anticipated value	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
(dB)	(dB)	(dB)	class 2 (±dB)	(±dB)	(±dB)
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

## 8. Level linearity including the level range control

At reference sound level on the reference level range

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

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

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FM.BI.MTC.002 Rev.4

Head Office  
35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpaga@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang Chiang Mai, Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9155  
E-mail : mtc@tistr.or.th

Office  
195 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumaleed@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

## 7. Level linearity on the reference level range

Anticipated value	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
(dB)	(dB)	(dB)	class 2 (±dB)	(±dB)	(±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.1	0.1	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3

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

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35 Mu 3 Tambon Klong Luang, Amphoe Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
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Office/Laboratory  
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
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Office  
195 Phahonyothin Road, Chatuchak, Bangkok 10900,  
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Fax. (66) 0 2579 8592  
E-mail : sumaleed@tistr.or.th



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 177/0167

## 8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	(dB)	class 2 (±dB)	(±dB)	(±dB)
30-130	35.0	35.0	0.0	1.1	0.30	0.3

## 9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	109.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
	0.25	120.0	0.0	±1.0	0.20	0.3
SEL	200	100.0	0.0	+1.0; -2.5	0.20	0.3
	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.9	-0.1	+1.5; -5.0	0.20	0.3

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

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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	12.6
C - weight	19.2
Flat	24.8

3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.0	1.1	1.1	±5.0

T. Retun.

7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	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	26.8	-0.2	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Retun.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Retun.

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

T. Retun.

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

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

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Cert. No. : ACL24012  
Job No. : VC67AC0044  
Pages : 8 of 8

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Cert. No. : ACL24010  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623388 / 198635 / 26416  
ID No. : RYG\_FS0613

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PIATTHANAKAN 40, PIATTHANAKAN 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 : 19 DECEMBER 2023  
Calibration Date : 05-08 JANUARY 2024  
Date of Issue : 09 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

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

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

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**CALIBRATION LABORATORY**

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

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Cert. No. : ACL24010  
Job No. : VC67AC0044  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

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

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

3.1 National Institute of Metrology (Thailand),

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

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**CALIBRATION LABORATORY**

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

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Cert. No. : ACL24010  
Job No. : VC67AC0044  
Pages : 3 of 8

**Summary of Measurement Result :**

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

**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	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	0.3	0.3	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.0	1.1	1.1	± 5.0

*7. Return*

**7. Level linearity on the reference level range**

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	48.9	-0.1	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

*7. Return*

**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	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

*7. Return*

**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.3	-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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

*7. Return*

**SITHIPORN ASSOCIATES CO., LTD.**  
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451-451/1 Srinthorn Road, Bangbunru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com

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Cert. No. : ACL24010  
Job No. : VC67AC0044  
Pages : 8 of 8

**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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Cert. No. : ACL24011  
Job No. : VC67AC0044  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

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

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

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

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

*T. Petchur*

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Cert. No. : ACL24011  
Pages : 1 of 8

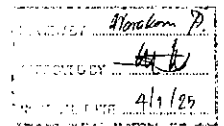
**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RJON  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623389 / 198636 / 26417  
ID No. : RYG\_FS0614

Condition As Found : GOOD

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

Location : -  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %  
Received Date : 19 DECEMBER 2023  
Calibration Date : 05-08 JANUARY 2024  
Date of Issue : 09 JANUARY 2024



Calibrated by : Nithakorn Pisutpoisan

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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Cert. No. : ACL24011  
Job No. : VC67AC0044  
Pages : 3 of 8

**Summary of Measurement Result :**

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

*T. Petchur*

**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)
14.2

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

Frequency Weighting	Measured value (dB)
A-weight	9.9
C-weight	16.7
Flat	22.5

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

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

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

*T. Petch*

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long-term stability**

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

*T. Petch*

**7. Level linearity on the reference level range**

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

*T. Petch*

**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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

*T. Petch*

Cert. No. : ACL24011  
Job No. : VC67AC0044  
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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 176/0167

## CALIBRATION CERTIFICATE

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

## Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900071 (ID:RYG\_FS0492)

Microphone : UC-52 No.188464

Preamplifier : NH-24 No.01733

## Ambient Environment

Temperature :  $(23 \pm 3) ^\circ\text{C}$ Relative Humidity :  $(50 \pm 15) \%$ Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$ 

## Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Jan. 2024

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

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The results relate only to the items tested/calibrated or value assigned.  
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Head Office  
35 Mu 3 Tambon Khlong No. Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpap@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sai IC, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10960,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5215, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

## Calibration Procedure :

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

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

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

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

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

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Office/Laboratory  
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E-mail : sumalee@tistr.or.th

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## 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.94	113.7	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.2 dB.

## 2. Self-generated noise

## 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	12.4	0.10	N/A
C-Weight	18.1	0.10	N/A
Flat	23.9	0.10	N/A

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

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Head Office  
35 Mu 3 Tambon Khlong No. Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpap@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sai IC, Bangpoo Industrial Estate, Sukhumvit Road,  
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Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10960,  
Thailand  
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E-mail : sumalee@tistr.or.th

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## 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.2	0.2	1.5	0.45	0.6
1 000	-0.1	-0.1	-0.1	1.0	0.45	0.6
8 000	0.3	0.3	0.2	5.0	0.45	0.7

## 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	0.0	2.0	0.20	0.6
4 000	0.0	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

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

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## Head Office

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Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpap@tistr.or.th Website: www.tistr.or.th

## Office/Laboratory

Soi 10, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mt@tistr.or.th

## Office

196 Phrayothai Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumakorn@tistr.or.th

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Request No. 21-67/0232

MTC No. EEL. BP. 176/0167

## 7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3

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

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Tel. (66) 0 2577 9000  
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Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumakorn@tistr.or.th

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MTC No. EEL. BP. 176/0167

## 5. Long-term stability

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

## 6. Frequency and time weightings at 1 kHz

## 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

## 6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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

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The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

## Head Office

35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpap@tistr.or.th Website: www.tistr.or.th

## Office/Laboratory

Soi 10, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mt@tistr.or.th

## Office

196 Phrayothai Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumakorn@tistr.or.th

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## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 176/0167

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.8	-0.2	1.1	0.30	0.3

## 8. Level linearity including the level range control

## At reference sound level on the reference level range

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

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

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Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

## Head Office

35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpap@tistr.or.th Website: www.tistr.or.th

## Office/Laboratory

Soi 10, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mt@tistr.or.th

## Office

196 Phrayothai Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumakorn@tistr.or.th

FM.BI.MTC.002 Rev.4



## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 176/0167

## 8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35.0	35.0	0.0	±1.1	0.30	0.3

## 9. Tone burst response

Time Weighing	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
	200	120.0	0.0	±1.0	0.20	0.3
SEL	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.8	-0.2	+1.5; -5.0	0.20	0.3

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

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The results relate only to the items tested/calibrated at value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office  
35 Km.3 Tambon Klong Luang, Amphur Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (661) 0 2577 9000  
Fax. (661) 0 2577 9009  
E-mail : kumpag@tistr.go.th Website: www.tistr.go.th

Office/Laboratory  
Soi 1C, Bangpro Industrial Estate, Sukhumvit Road,  
Amphur Bangpro, Changwat Samutprakan 10280, Thailand  
Tel. (661) 0 2323 1672-80 ext. 115, 116  
Fax. (661) 0 2323 9165  
E-mail : mtc@tistr.go.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (661) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (661) 0 2579 8592  
E-mail : sumalee@tistr.go.th

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## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 176/0167

## 10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

## 11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
135.0	135.0	0.0	1.5	0.20	0.25

## 12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Towikiat Iamsamran)

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011267012400347006

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

Date of Issue : 1 Mar. 2024

End of Certificate

9/9

The results relate only to the items tested/calibrated at value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMILMTC.002 Rev.4



J NAC  
JIRANATTE ASSOCIATES CO., LTD.  
35 Km.3 Tambon Klong Luang, Amphur Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (661) 0 2577 9000  
Fax. (661) 0 2577 9009  
E-mail : kumpag@tistr.go.th Website: www.tistr.go.th

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS1-TIS 17025  
CALIBRATION 0367

Temperature measurement laboratory  
Calibration services department.



J NAC  
JIRANATTE ASSOCIATES CO., LTD.  
35 Km.3 Tambon Klong Luang, Amphur Klong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (661) 0 2577 9000  
Fax. (661) 0 2577 9009  
E-mail : kumpag@tistr.go.th Website: www.tistr.go.th



Continuation of Certificate of Calibration Number CDT-032-67

Page 2 of 2 Pages

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: 21001215.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	WUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.035	20.1	0.1	0.099
60	25.051	25.2	0.1	0.099
40	30.044	30.2	0.2	0.099
20	35.036	35.2	0.2	0.099
10	40.031	40.2	0.2	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001244.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	WUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.035	20.0	0.0	0.099
110	25.051	25.0	-0.1	0.099
110	30.044	30.0	0.0	0.099
110	35.035	35.0	0.0	0.099
110	40.031	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001790.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	WUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.035	20.1	0.1	0.099
75	25.051	25.0	-0.1	0.099
75	30.044	29.9	-0.1	0.099
75	35.035	34.8	-0.2	0.099
75	40.031	39.7	-0.3	0.16

UUC: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

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



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-032-67

Page 1 of 2 Pages

## MEASUREMENT ITEM

: Heat Stress Monitor

## MANUFACTURER

: Delta OHM

## MODEL/TYPE

: HD332.2

## SERIAL NUMBER

: Z0032249

## ID NUMBER

: RVG\_150254

## CONDITION AS-RECEIVED

: Used item

## CUSTOMER

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

## RECEIVED DATE

: 24 Jan 2024

## MEASUREMENT DATE

: 26 Jan 2024

## ISSUE DATE

: 30 Jan 2024

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

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

## TABULATION OF RESULTS:

The table on next page give the measured values.

REVIEWED BY: *[Signature]*  
APPROVED BY: *[Signature]*  
EVALUATION DATE: 26/1/24

## Calibration procedure:

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

## Traceability:

The measurement results are traceable to the  
international system of units (SI) through  
National Institute of Metrology Thailand (NIMT)  
Certificate number: TT-0038-23. Certificate  
number: ER-0101-23

## Reference Used During Calibration:

1. Standard Temperature Probe  
Model: STS-100 AS00, Serial No.: 667682-09,  
Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000 A/MC1, Serial No.: 071407,  
00591 Due date: 14 Sep 2024

## Uncertainty of Measurement:

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

Calibrated by:  
☒ Mr. Sorawit Thachalard  
☒ Miss Jittaporn Lertsunphol  
☒ Miss Ruangrumpa Phoommit

Approved signatory:

*[Signature]*  
Mr. Pannya Booncharoen  
Calibration Department Manager



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-031-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 20032243  
**ID NUMBER** : RYG\_FSD523  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasikan 40, Phatthanasikan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 14 Jan 2024  
**MEASUREMENT DATE** : 16 Jan 2024  
**ISSUE DATE** : 30 Jan 2024

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

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

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

**Traceability:**  
The measurement results are traceable to the  
international system of units (SI) through  
National Institute of Metrology Thailand (NIMT)  
Certificate number: TT-0038-23, Certificate  
number: TR-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS00, Serial No.: 667682-09,  
Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-  
00591 Due date: 14 Sep 2024

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

REVIEW BY : *[Signature]*  
APPROVED BY : *[Signature]*  
NEXT CAL. DATE : 29/1/25



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

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

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 21001219.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.056	19.9	-0.1	0.16
80	25.047	25.0	0.0	0.099
80	30.041	30.0	0.0	0.099
80	35.032	35.0	0.0	0.099
80	40.023	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 22023935.  
Dimension: Diameter 3.3 mm. Length 205 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	30.040	30.1	0.1	0.099
110	35.033	35.0	0.0	0.099
110	40.023	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001786.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.056	20.1	0.0	0.099
75	25.047	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.033	34.9	-0.1	0.099
75	40.023	39.9	-0.1	0.099

UUC\*: Unit Under Calibration  
Remark: The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor  $k=2.21$   
providing a level of confidence of approximately 95%.

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



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-010-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006711  
**ID NUMBER** : RYG\_FSD117  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasikan 40, Phatthanasikan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 05 Jan 2024  
**MEASUREMENT DATE** : 08 Jan 2024  
**ISSUE DATE** : 09 Jan 2024

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

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

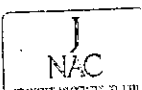
**Calibration procedure:**  
The temperature calibration was done by C-  
In-House calibration method as WI-CI-001  
according to comparison method with standard  
digital temperature indicator and standard  
temperature probe. The temperature scale use  
was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the  
international system of units (SI) through  
National Institute of Metrology Thailand (NIMT)  
Certificate number: TT-0038-23, Certificate  
number: TR-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS00, Serial No.: 667682-09,  
Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-  
00591 Due date: 14 Sep 2024

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

REVIEW BY : *[Signature]*  
APPROVED BY : *[Signature]*  
NEXT CAL. DATE : 9/1/25



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

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

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008206.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.059	20.2	0.1	0.099
80	25.051	25.2	0.1	0.099
80	30.047	30.2	0.2	0.099
80	35.039	35.2	0.2	0.099
80	40.035	40.2	0.2	0.099

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

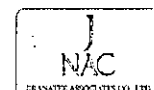
Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.2	0.1	0.099
110	25.052	25.2	0.1	0.099
110	30.047	30.2	0.2	0.099
110	35.039	35.2	0.2	0.099
110	40.035	40.2	0.2	0.099

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

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.2	0.1	0.099
75	25.052	25.1	0.0	0.099
75	30.047	29.9	-0.1	0.099
75	35.040	34.8	-0.2	0.099
75	40.036	39.7	-0.3	0.099

UUC\*: Unit Under Calibration

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



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-016-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta DHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006716  
**ID NUMBER** : RYG\_F50221  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 11 Jun 2024  
**MEASUREMENT DATE** : 11 Jun 2024  
**ISSUE DATE** : 17 Jun 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

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

**Traceability:**  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: ER-0102-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 A500, Serial No.: 667682-09,  
Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000-A MKII, Serial No.: 571407-00591 Due date: 14 Sep 2024

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

### Function:

**Table 1:** This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009587.  
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.1	0.1	0.099
80	25.042	25.1	0.1	0.099
80	30.040	30.0	0.0	0.099
80	35.035	35.0	0.0	0.099
80	40.026	40.0	0.0	0.099

**Table 2:** This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15015967.  
Dimension: Diameter 3.3 mm, Length 205 mm.

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

**Table 3:** This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015492.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.049	20.2	0.2	0.099
75	25.042	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.034	34.9	-0.1	0.099
75	40.026	39.9	-0.1	0.099

UUC\*: Unit Under Calibration

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

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



Approved signature: \_\_\_\_\_  
Mr. Paringya Booncharoen  
Calibration Department Manager

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## CERTIFICATE OF CALIBRATION

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

**Equipment Name:** Heat Stress Monitor  
**Manufacturer:** Delta DHM  
**Model:** HD32.2  
**Serial No.:** 22016391  
**ID No.:** RYG\_F50591

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

**Received date:** 11 Jul 2023  
**Calibration date:** 20 Jul 2023  
**Issue date:** 20 Jul 2023

**Reference Used During Calibration**  
1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

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

### Calibration Procedure

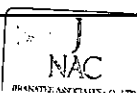
The temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

### Traceability

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

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

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



Approved Signature: \_\_\_\_\_  
Mr. Paringya 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: 22025583.  
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	19.9	-0.2	0.099
80	25.050	24.9	-0.2	0.099
80	30.045	29.9	-0.1	0.099
80	35.038	34.8	-0.2	0.099
80	40.030	39.8	-0.2	0.099

**Table 2:** This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 22023943.  
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.0	-0.1	0.099
110	25.051	25.0	-0.1	0.099
110	30.045	30.0	0.0	0.099
110	35.038	35.0	0.0	0.099
110	40.030	40.0	0.0	0.099

**Table 3:** This equipment was connected with temperature probe Model: TP3207.2 S/N: 22025054.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.053	20.0	-0.1	0.099
75	25.051	24.9	-0.2	0.099
75	30.045	29.8	-0.2	0.099
75	35.038	34.8	-0.2	0.099
75	40.030	39.7	-0.3	0.099

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-055-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006714  
**ID NUMBER** : RYG\_FS0219  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 12 Feb 2024  
**MEASUREMENT DATE** : 15 Feb 2024  
**ISSUE DATE** : 20 Feb 2024

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follows:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

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

**Calibration procedure:**  
The temperature calibration was done by in-house calibration method (GUM-CL-003) according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the International System of Units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: TR-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 ASDQ, Serial No.: 667582-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 22033263.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.063	20.4	0.3	0.099
80	25.054	25.4	0.3	0.099
80	30.040	30.4	0.4	0.099
80	35.026	35.4	0.4	0.099
80	40.018	40.4	0.4	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17023217.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.064	20.3	0.2	0.099
110	25.054	25.3	0.2	0.099
110	30.040	30.3	0.3	0.099
110	35.027	35.3	0.3	0.099
110	40.018	40.3	0.3	0.099

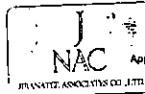
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015491.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.5	0.4	0.099
75	25.054	25.4	0.4	0.099
75	30.041	30.4	0.4	0.099
75	35.026	35.3	0.3	0.099
75	40.018	40.2	0.2	0.099

UUC: Unit Under Calibration

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

Calibrated by:  
☐ Mr. Soyawit Thachalad  
☐ Miss Jitraporn Lertsomphol  
☒ Miss Ruangsungkul Phoommit



Approved signatory: Mr. Patsinya Booncharoen  
Calibration Department Manager



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## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-042-66

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15036021  
**ID NUMBER** : BOK\_FS0679  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 26 Oct 2023  
**MEASUREMENT DATE** : 27 Oct 2023  
**ISSUE DATE** : 27 Oct 2023

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follows:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

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

**Calibration procedure:**  
The temperature calibration was done by in-house calibration method (GUM-CL-003) according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the International System of Units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: TR-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 ASDQ, Serial No.: 667582-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008209.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.057	20.0	-0.1	0.099
80	25.049	24.9	-0.1	0.099
80	30.042	29.9	-0.1	0.099
80	35.039	34.9	-0.1	0.099
80	40.032	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008203.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.057	20.1	0.0	0.099
110	25.050	25.1	0.1	0.099
110	30.042	30.3	0.1	0.099
110	35.038	35.1	0.1	0.099
110	40.032	40.1	0.1	0.099

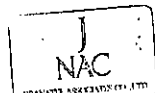
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15037322.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.057	20.1	0.0	0.099
75	25.050	24.9	-0.1	0.099
75	30.042	29.7	-0.3	0.099
75	35.038	34.6	-0.4	0.099
75	40.032	39.5	-0.5	0.099

UUC: Unit Under Calibration

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

Calibrated by:  
☐ Mr. Soyawit Thachalad  
☐ Miss Jitraporn Lertsomphol  
☒ Miss Ruangsungkul Phoommit



Approved signatory: Mr. Patsinya Booncharoen  
Calibration Department Manager



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## Certificate of Calibration

Certificate No.: 23PH628  
Page: 1 of 2

Cert. No.: 23PH628  
Page.: 2 of 2

Equipment: Lux Meter  
Manufacturer: PEAK METER  
Model: PM6012L  
Serial No.: H12A-D18324  
ID No.: RYG\_FS0530  
Condition As-Received: Used Item  
Received Date: 27 November 2023  
Calibration Date: 26 November 2023  
Reference: 2311-0889WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 90 ± 15 ) %

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Corporate Services 3: Equipment Calibration and Testing Services.

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

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

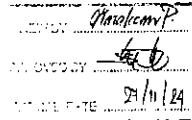
Procedure used: Calibration were conducted using calibration procedure No. CP-PH01 based on inverse square law technique.

### Condition of this result of calibration

1. Reference standards Instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9.6 m	120RC003	DL-0064-22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1473	TP-1025-23	14 Feb 2024

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: 18221394 ).  
4. Test Equipment: Illuminance Meter ( Model: 51002, S/N: 080129 ).  
5. The certificate is valid only to the item calibrated on date and place of calibration.  
6. This Certification is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology Thailand (NIMT)  
- National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144



Calibrated by: Nival Nilas  
Issue Date: 30 November 2023

Approved Signatory:  
[ ] Pholinee Prabpaijal  
[ ] Chalchawan Khunpluek  
[x] Nuntawat Khanchai

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## Certificate of Calibration

Certificate No.: 24PH145  
Page: 1 of 2

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

Equipment: Lux Meter  
Manufacturer: Tenmars  
Model: TM-201L  
Serial No.: 190702499  
ID No.: RYG\_FS0471  
Condition As-Received: Used Item  
Received Date: 12 March 2024  
Calibration Date: 14 March 2024  
Reference: 2403-0392WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %

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Corporate Services 3: Equipment Calibration and Testing Services.

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

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

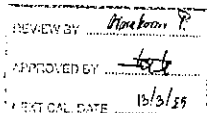
Procedure used: Calibration were conducted using calibration procedure No. CP-PH01 based on inverse square law technique.

### Condition of this result of calibration

1. Reference standards Instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9.6 m	120RC003	DL-0064-22	20 Jul 2025
2) Luminous intensity standard lamp	OL-FEL-U	F-1543	TP-1030-23	08 Jun 2024

2. This result of calibration was made on requested at the point specified by customer.  
3. Test Equipment: Programmable Voltage/Current Source ( Model: OL83A, S/N: 18221394 ).  
4. Test Equipment: Illuminance Meter ( Model: 51002, S/N: 080129 ).  
5. The certificate is valid only to the item calibrated on date and place of calibration.  
6. This Certification is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology Thailand (NIMT)  
- National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144



Calibrated by: Nival Nilas  
Issue Date: 18 March 2024

Approved Signatory:  
[ ] Pholinee Prabpaijal  
[ ] Wanlop Larpkem  
[x] Nuntawat Khanchai

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

Function: Illuminance Measurement		Range:		Autorange	
Before Adjust		After Adjust			
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>	
( lx )	( lx )	( lx )	( lx )	( ± lx )	
0	0.00	0.00	0.00	-	
15	-	14.79	-0.21	0.20	
100	-	99.2	-0.8	1.3	
500	-	500	0	6.5	
1000	775	1005	5	13	
2000	-	2013	13	26	
3000	-	3030	30	39	
4000	-	4040	40	52	
5000	3900	5050	50	85	

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: L1 = 0.090

After adjustment light source factor setting mode: L1 = 1.284

UUC\* = Unit Under Calibration.

-000-

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

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

Function: Illuminance Measurement	Range:	2000	lx
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
( lx )	( lx )	( lx )	( ± lx )
200	199	-1	2.6
500	499	-1	6.5
1000	1000	0	13
1500	1501	1	20
1900	1901	1	25

Function: Illuminance Measurement	Range:	20000	lx
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
( lx )	( lx )	( lx )	( ± lx )
2000	1990	-10	26
3000	3000	0	39
4000	4000	0	52
5000	5000	0	85

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

UUC\* = Unit Under Calibration.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-29 FAX: 0-2719-9484



Cert. No.: 23CH915  
Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2Go S2  
Serial No. : C129171496  
ID No. : RYG\_FS0550  
Condition As-Received: Used Item  
Received Date : 21 July 2023  
Calibration Date : 24 July 2023  
Reference : 2307-0713DSC-3  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CHS by direct measurement with standard  
voltage calibrator and direct measurement  
with certified reference material (CRM)  
Calibrated by : Warakorn Lomgagitrakul  
Approved by :   
( ) Malee Butkruea  
(✓) Sathip Meangmal  
( ) Warakorn Lomgagitrakul  
Issue Date : 26 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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Cert. No.: 23CH915  
Page.: 2 of 2



## Condition of this calibration result

### 1. Reference Standard Instrument :-

Instrument Serial No. ID No. Cert. No. Due Date  
1) Document Process Calibrator 54030049 130RC116 22E2769 24 Aug 2023

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

### 2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1635

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

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

## Calibration Results

### Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: C129171496	pH 4.008	177.48	177	4.00	0.58	2.00
	pH 6.986	0.00	0	7.00	0.58	2.00
	pH 10.010	-177.48	-177	10.00	0.58	2.00

### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 3184175	4.008	4.01	185	0.0078	2.00
	6.986	6.99	12	0.011	2.00
	10.010	10.01	-166	0.0095	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-29 FAX: 0-2719-9484



Cert. No.: 23LM126  
Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter with Sensor  
Manufacturer : Mettler Toledo  
Model : Seven2Go S2  
Serial No. : C129171496  
ID No. : RYG\_FS0550  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 26 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
AC Line Voltage : (220 ± 22) V  
Calibrated by : Preecha Hahib  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
(✓) Suwit Imjai  
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0053617



Equipment : pH Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2307-0713DSC-4

Cert. No.: 23LM126  
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 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.: 3184175

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.007	25.3	0.293	0.16	2.00
30.0	100	30.004	30.4	0.396	0.16	2.00
40.0	100	40.005	40.4	0.395	0.16	2.00
50.0	100	50.009	50.4	0.391	0.16	2.00

UUC\* : Unit Under Calibration

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

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a 1159514



## Certificate of Calibration

Certificate No.: 23E3924  
Page: 1 of 2

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 08 December 2023  
Calibration Date: 14 December 2023

This certificate may not be reproduced other than in full,  
except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2312-0151DSC Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 10 ) %  
818/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand

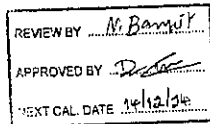
Procedure used: Calibration were conducted using calibration procedure No. CP-E17 according to EURAMET cg-15.

### Condition of this result of calibration

#### 1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435802	EE-0041-23	25 Apr 2024

2. This result of calibration was made on requested at the point specified by customer.  
3. The certificate is valid only to the item calibrated on date and place of calibration.  
4. This Certification is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology Thailand (NIMT)



Calibrated by: Napachanok Prasomsosiri  
Issue Date: 15 December 2023

Approved Signatory:  
☐ Phalinee Prabpaijai  
☒ Nuntawat Khamchai  
☐ Pongsagorn Boonyaporn

B 0331106

a 1193422



Cert.No.: 23CH1574  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 08 December 2023  
Calibration Date: 15 December 2023  
Reference: 2312-0151DSC-3  
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
818/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Ambient Temperature: (25 ± 2.5) °C  
Relative Humidity: (50 ± 15) %  
Calibration Procedure: In-house method:  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH5 by comparison with standard thermometer

Calibrated by: Warakorn Lemgagrakul

Approved by:   
Approved Signatory

☐ Sathip Meangmai  
☐ Warakorn Lemgagrakul  
☒ Ponpan Palpin

Issue Date: 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.



### Condition of this calibration result

#### 1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

### Calibration Results

#### Function: mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement (µmV)	Coverage factor k
		pH	mV	mV	pH		
pH Meter S/N.: B834291445	4.000		177.48	177.3	4.000	0.058	2.00
	7.000		0.00	-0.1	7.000	0.058	2.00
	10.000		-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 23CH1574  
Page.: 3 of 3

#### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 3225368	4.008 6.985 9.997	4.013 6.998 10.002	184.1 8.7 -164.7	0.0045 0.0084 0.0088	2.00 2.00 2.11

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM

- Serial No. : 3225368

Dimension of probe;

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.003	24.3	-0.703	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1193851

Sartorius (Thailand) Co., Ltd.  
128 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310  
Tel: +66 2643 8361-8 Fax: +66 2643 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU  
Description : Analytical Balance  
Serial Number : 0026207038  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius

Certificate No. : 24BCI0069  
Issued Date : Friday, February 23, 2024  
Reference No. : 228196  
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 results under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001	0.0001	Difference		
0.0001 g	20.0000	199.9999	1	-	-
	20.0001	200.0000	2	-0.0001	-
Nominal Value : (High Load)	19.9999	200.0000	3	-0.0001	-
200 g	20.0000	200.0000	4	0.0000	-
Tolerance	0.0001	0.0001	5	-0.0001	-
	19.9999	200.0001	6	-	-
	19.9999	200.0000			
Standard Deviation	0.00007	0.00006			

#### Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00018
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.  
128 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310  
Tel: +66 2643 8361-8, e-mail: service.thailand@sartorius.com



MSC-TIS-103 1/2025  
CALIBRATION 0008

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU  
Description : Analytical Balance  
Serial Number : 0026207038  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius

Certificate No. : 24BCI0069  
Issued Date : Friday, February 23, 2024  
Reference No. : 228196  
Page No. : 1 of 2

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

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

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

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14: 2019

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

#### Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realize 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 1kg - 5000g E2.YCS011-522-00	TCS	M2308187S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lulron MHB-382SD	DKSH	C1923184S	23-Aug-2024

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

Mr.Chonchai Inthana (Technical Manager)

SOP FM 33 03 February 2022



Sartorius (Thailand) Co., Ltd.  
128 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310  
Tel: +66 2643 8361-8 Fax: +66 2643 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU  
Description : Analytical Balance  
Serial Number : 0026207038  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius

Certificate No. : 24TM632  
Issued Date : Friday, February 23, 2024  
Reference No. : 228196  
Page No. : 1 of 3

#### Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical results under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001	0.0001	Difference		
0.0001 g	20.0000	199.9999	1	-	-
	20.0001	200.0000	2	-0.0001	-
Nominal Value : (High Load)	19.9999	200.0000	3	-0.0001	-
200 g	20.0000	200.0000	4	0.0000	-
Tolerance	0.0001	0.0001	5	-0.0001	-
	19.9999	200.0001	6	-	-
	19.9999	200.0000			
Standard Deviation	0.00007	0.00006			

#### Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00018
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 2717-3000-29 FAX: 0-2719-9484



## Certificate of Calibration

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

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UFE 500  
Serial No. : G511.1572  
ID No. : RYG\_EN0010  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
618/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand  
Location : Oven Room  
Received Order : 21 March 2024  
Calibration Date : 21 March 2024  
Ambient Temperature : (28 ± 1) °C  
Relative Humidity : (50 ± 3) %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :  
( ) Pomsittha Tamayakul  
( ) Unnopphol Harachai  
(x) Suwit Imjai  
Issue Date : 22 March 2024

REVIEW BY : Thanitak.  
APPROVED BY :  
NEXT CAL DATE : 21/09/25

The Uncertainty are for a confidence probability of approximately 95%  
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Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2403-0563OC-1

Cert. No.: 24TM532  
Page : 2 of 3

#### Procedure Used :-

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

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

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

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

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

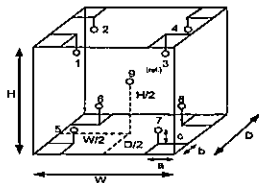
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- ( ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



#### Probe Installation Details : Dimension of Chamber :

a = 5.0 cm	D = 0.40 m
b = 5.0 cm	W = 0.56 m
c = 5.0 cm	H = 0.48 m
	Capacity = 0.11 m <sup>3</sup>

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

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



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

Cert. No.: 24TM532  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

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

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES : EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2171-3000 FAX. 0-2171-9484

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

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Received Date : 21 July 2023  
Test Date : 24 July 2023  
Reference : 2307-0713DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5, T.Mae Nam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Laboratory Condition : Temperature (25 ± 5) °C  
Humidity (50 ± 20) %  
Test Procedure : In-house method : CP-CH9  
by Comparison Technique with Azide Modification Method

REVIEW BY : *N. Bangs*  
APPROVED BY : *D. Sathip*  
NEXT CAL. DATE : 24/01/25

Tested by : Walalak Sinithean

Approved by :

*Sathip*  
Approved Signatory

( ) Maloe Butkruea  
(✓) Sathip Meangmal  
( ) Warakom Lerngagrakul

Issue Date : 26 July 2023



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

#### Condition of this result of calibration

##### 1. Reference Standard Instruments :

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

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

##### 2. Standard Material :-

Material	Manufacturer	Lot No.	Assay
Sodium Thiosulfate pentahydrate	Morck	AM1783316	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)
6.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full without written approval of the laboratory

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*Sathip*





Cert. No.: 23LM125  
Page: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T, Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 25 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
AC Line Voltage :  $(220 \pm 22) \text{ V}$   
Calibrated by : Preecha Hiahib  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
(x) Suwit Imjai  
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0053616



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

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

### Procedure Used :-

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard Instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	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 ( $^{\circ}\text{C}$ )	Immersion Depth (mm)	Standard Temperature ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Error ( $^{\circ}\text{C}$ )	Uncertainty ( $\pm$ $^{\circ}\text{C}$ )	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 %.

-00-

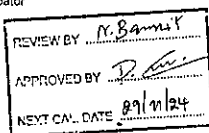
a 1159515



Cert. No.: 23TM062  
Page: 1 of 3

## Certificate of Calibration

Equipment : Low Temp. Incubator  
Manufacturer : Mommert  
Model : IPP750  
Serial No. : V818.0084  
ID No. : RYG\_EN0154  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
616/10 Moo 5 T, Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand  
Location : BOD Room  
Received Order : 29 May 2023  
Calibration Date : 29 May 2023  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
(x) Suwit Imjai  
Issue Date : 7 June 2023



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0896OC-2

Cert. No.: 23TM062  
Page: 2 of 3

### Procedure Used :-

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MYS7013711	22LM93	02 Jul 2023

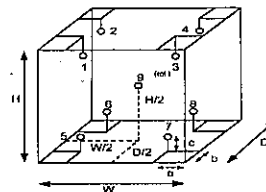
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This certification is traceable to the International System of Unit.

### Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( $^{\circ}\text{C}$ )	23	23
REL.Humid. ( % )	54	56
AC Supply ( Volt )	223	222



#### Probe Installation Details :

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

#### Dimension of Chamber :

D = 0.60 m  
W = 1.0 m  
H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0054967

a 1165130





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2403-05630C-4  
Procedure Used :-

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

## Certificate of Calibration

Cert. No.: 24TM635  
Page : 1 of 3

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNB22  
Serial No. : L513.0648  
ID No. : RYG\_EN0061

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

Location : Wet Chemistry Lab

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

Calibrated by : Man Pattanapongpalboon

Approved by :   
Approved Signatory

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

Issue Date : 23 March 2024

REVIEW BY   
APPROVED BY   
NEXT CAL DATE: 21/09/25

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard instrument-

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

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

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

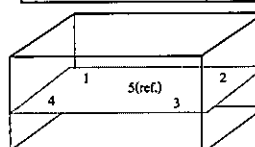
Remark : TPA : Technology Promotion Association ( Thailand - Japan )

Result of Calibration : ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Heat transfer medium used : Water

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



Front

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

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

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2403-05630C-4  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

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



## Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.  
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100  
Bangkok Tel : +668 9205 6851 , +669 8247 2360  
Website : www.scieco.co.th E-Mail : calibrate@scg.com



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.Plunkdaeng, 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

REVIEW BY   
APPROVED BY   
NEXT CAL DATE: 20/09/24

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )					Uncertainty ( ± °C )
			Position					
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.428	84.474	84.489	84.507	84.477	0.18

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

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

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC\* : Unit Under Calibration

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

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

-000-

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.

Certificate No. T230116

Page 2 of 4

## Calibration Report

Equipment : Chamber (Cooling Room)  
Date of Calibration : 25 January 2023  
Environment : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).  
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

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

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant ☐ 1 Hour ☒ Minute At ☐ 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

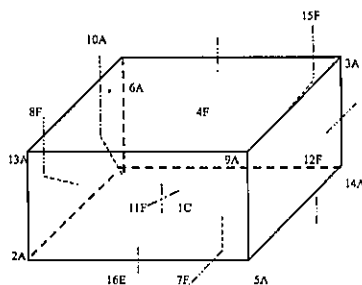
Approved By: *[Signature]*

FM-L15 117-15-05-63

Certificate No. T230116

Page 3 of 4

## Calibration Report



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

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

Approved By: *[Signature]*

FM-L15 117-15-05-63

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
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24
	TN153	TN154	TN155	TN156							
	3.28	3.22	3.28	3.21							

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min, Max	Average				
3.0	2.8, 4.1	3.5	1.20	1.20	1.00	2.07

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By: *[Signature]*

FM-L15 117-15-05-63

## Certificate of Calibration

Equipment: SPECTROPHOTOMETER  
Model: DR6000  
Serial No. (or ID.): 1627845 (RYG\_EN0037)  
Manufacturer: HACH  
Condition: In Condition  
Certificate No.: C06230441  
Issued Date: 19 September 2023  
Job No.: WO-00005382  
Page: 1 of 3

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

Environment Condition: Temperature 23.9 °C ± 0.2  
Humidity 65.3 %RH ± 1.4 %RH  
REVIEW BY: *[Signature]*  
APPROVED BY: *[Signature]*  
NEXT CAL. DATE: 18/12/25

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. Nattapal Rungueang  
Calibration Date: 18 September 2023  
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04  
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Slama Scientific Limited.  
The standard for Wavelength Certificate No. 111583 and 111584  
The standard for Photometric Certificate No. 9114984 and 111588  
The standard for Stray light Certificate No. 111586 and 111585  
The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapal Rungueang)  
Person in charge

(Mr. Nittun Srihawan)  
Authorized signatory

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

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Phone: +66 2639 1030 Email: info@dksh.com Website: www.dksh.com/thailand/bangkok

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CAL-FM-C06-16: 12 Sep 2022

Calibration Results:  
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.3	0.31	0.13	
536.66	536.6	0.06	0.13	
637.98	638.3	-0.32	0.13	
748.48	748.7	-0.22	0.13	
807.03	807.4	-0.37	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2830	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.026	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2518	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9468	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2694	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

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CAL-FM-C06-15: 12 Sep 2022

Calibration Results:  
Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	0.737	-0.0015	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2854	0.290	-0.0038	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Sirey light *				
Standard: cut-off		UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)
260.62 +/- 0.11 nm		260.5	1.3	1.886
391.44 +/- 0.11 nm		391.4	1.3	1.886
Spectral Resolution *				
Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	268.69	1.36	2.00
UUC: Wavelength (nm)	268.2	268.1		
Std Absorbance (A)	0.4566	0.2780		
Absorbance (A)	0.413	0.300		

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

The End of Certificate

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Phone: +66 2638 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CAL-FM-C06-15: 12 Sep 2022

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

ตรวจสอบ (วัน)		รายการตรวจเช็ค		ตรวจสอบ (ครั้ง)		หมายเหตุ
18 Sep 2023				18 Sep 2023		
ปกติ	ไม่ปกติ			ปกติ	ไม่ปกติ	
		General				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1.	ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2.	ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3.	สวิตซ์ เปิด – ปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4.	ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5.	หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Spectrophotometer				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6.	แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7.	ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8.	ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	*
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8.	แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	9.2 Hours
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	10.	แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	741.5 Hours
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	11.	ช่องใส่หลอดตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		pH Meter and Conductivity Meter				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	12.	อิเล็กโทรด ( Electrode and Connection Cable )	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	13.	ระดับสารละลายใน Electrode (Level KCl )	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	14.	ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	15.	ขาจับอิเล็กโทรด (Stand)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Turbidimeter				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	16.	ค่าความขุ่นที่ต่ำสุด (No Sample)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	17.	ระดับการส่องสว่างของแสง (>= 2.5 ไมล์ 3.0)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Automatic titrator				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	18.	สลัก Piston Burettes	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	19.	Function Rinsing and Dosing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	20.	ระบบท่อสายยางและอุปกรณ์ประกอบ	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

เซ็นเซอร์อุณหภูมิ: \*656.1nm=656.1nm  
\*486.0nm=485.5nmMr.Nattapat Rungrueang  
Service Engineer

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Prachinburi 10260  
Phone: +66 2638 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CAL-FM-R31-03: 20 Jul 2022

## Certificate of Calibration

Represent to Certificate of Calibration No. C29240007

Equipment:	Block Digestion Unit	Certificate No.:	C29240011
Model:	KT-20s	Issued Date:	22 March 2024
Serial No. (or ID):	5720210009/5770200073	Job No.:	WO-00020429
Manufacturer:	Gerhardt	Page:	1 of 4
Condition:	In Condition	Digestion Block:	20 holes.

Customer: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand.Environment Condition: Temperature: 25 °C ± 0.7 °C  
Humidity: 54 %RH ± 4.1 %RH  
Voltage: 225 VAC ± 1.7 VAC

REVIEW BY: *N. Punt*  
APPROVED BY: *D. Srichana*  
NEXT CAL. DATE: 11/12/25

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
(Wet Chemistry Lab)  
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand.Calibration By: Mr. Thanathorn Phunook  
Calibration Date: 11 March 2024  
The Method used: In house method, base on by comparison with standard  
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)  
Certificate No.: TC22/0080

*Thanathorn Phunook*  
(Mr. Thanathorn Phunook)

*Udon Srichana*  
(Mr. Udon Srichana)

Person in charge

Authorized signatory

This certificate is issued for the purpose of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
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Phone: +66 2638 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C20-07: 20 Jul 2022

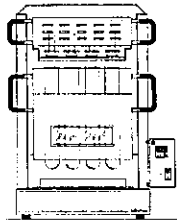
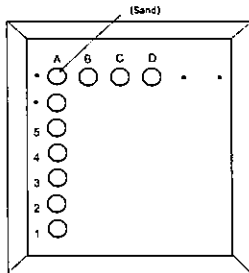


Fig. 1.: Front view



Location of standard

Fig 2 : Digestion block

Definitions

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

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

Calibration Results:

Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	401.5	21.5	1.5
A2				401.2	21.2	1.5
A3				399.1	19.1	1.5
A4				397.8	17.8	1.5
A5				395.1	15.1	1.5
B1				396.6	16.6	1.5
B2				396.1	16.1	1.5
B3				392.9	12.9	1.5
B4				391.6	11.6	1.5
B5				390.7	10.7	1.5
C1				395.3	15.3	1.5
C2				395.6	15.6	1.5
C3				392.8	12.8	1.5
C4				391.7	11.7	1.5
C5				390.3	10.3	1.5
D1				397.5	17.5	1.5
D2				398.6	18.6	1.5
D3				395.0	15.0	1.5
D4				394.2	14.2	1.5
D5				393.6	13.6	1.5

Calibration Results:

Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	365	365	382.5	17.5	1.5
A2				382.4	17.4	1.5
A3				382.1	17.1	1.5
A4				379.7	14.7	1.5
A5				378.3	13.3	1.5
B1				360.1	15.1	1.5
B2				360.1	15.1	1.5
B3				378.5	13.5	1.5
B4				378.3	13.3	1.5
B5				379.1	14.1	1.5
C1				360.1	15.1	1.5
C2				380.1	15.1	1.5
C3				376.9	13.9	1.5
C4				378.2	13.2	1.5
C5				377.3	12.3	1.5
D1				380.5	15.5	1.5
D2				380.6	15.6	1.5
D3				378.1	13.1	1.5
D4				378.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00020429

ชนิดเครื่องมือ: Block Digestion Unit รุ่น: KT-20s

หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
11 Mar 2024	รายการตรวจสอบ	11 Mar 2024		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>

ข้อแนะนำ :

Mr. Thanathorn Phunook  
Service Engineer



## Agilent CrossLab Start Up Services

### Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY	Theresa B.
APPROVED BY	Sarah K. M.
NEXT CAL. DATE	21/02/2025

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

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

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



## Introduction

### Customer Information

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



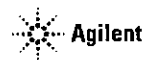
### Important Customer Web Links

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



### Service Engineer's Responsibilities

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



## Instrument Maintenance

### System Information

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

Instrument System Name and ID	G9010A / M116010005
Instrument System Site and Location	ALS Laboratory Group (Thailand) Co., LTD.

List System Component Product Numbers	List the Serial Numbers of each Component
1. G9010A	M116010005
2. S410A	N01544-0764
3. S347 - 30201	2005 - 00159
4.	
5.	
6.	
7.	
8.	
9.	

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

### Preparation

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

## Preventive Maintenance Procedures

### Record Pre-PM instrument performance

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

### Clean and inspect ICP-OES system

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

### Agilent Water Recirculator

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

### SPS 3 Auto Sampler

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

### SPS 4 Auto sampler

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

### AVS 4, 6, 7 Advanced Valve System

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



## ICP-OES adjustment

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

## Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following instrument tests

- ☒ Subsystem Communications Test
- ☒ Air Flow
- ☒ Water Flow
- ☒ Gas Flows
- ☒ RF Generator
- ☒ Camera Test
- ☒ Optics Test
- ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

## Restore Instrument

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

## Service Review

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

## Test Results

## Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial*	Radial	Axial*
Zn 213.857 nm SRR	1531.2	3+44.5	1530.0	3+21.8
Mn 257.610 nm SRR	1554.1	1555.1-5	1554.5	1555.1-3
Al 396.152 nm SRR	2.2	15.0	5.4	10.5
K 766.491 nm SRR	5.3	6+0	5.4	12.2

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

## Instrument Test Results Table

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

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

## ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Main Voltage	213.33.1	VAC	215.13.5	VAC
Main Current	0.04L	A	0.113	A
Instrument Temperature	11.3	°C	25.2	°C
RF Air Flow (sensor speed)	19.0	Hz	23.0	Hz
Plasma Exhaust Temperature	No measurement		50.1	°C
Water Flow Oscillator	No measurement		1.20	L/min
Water Flow Detector	1.14	L/min	1.09	L/min
Water Inlet Temperature	22.5	°C	15.6	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-40.1	°C	-40.0	°C
Thermal Stabilizer	31.3	°C	34.4	°C
Argon Supply Pressure	6.14.3+	kPa	55.2.30	kPa
Purge Gas Supply Pressure*1	6.10.61	kPa	5.74.30	kPa
Option Gas Supply Pressure*1	—	kPa	—	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		274.06	kPa
Plasma Gas Flow	No measurement		11.89	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1199.4	W
RF Supply Current	No measurement		9.64+	A
RF Supply Voltage	No measurement		154.40.1	V

\*1 If option installed

## Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	GB010-68014	GB010A, GB011A, GB014A/GB015A	1
Radial Pre-Optic Window	GB010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	1
Purge Gas Filter	GB010-60136	All	1
Air inlet filter	GB000-68002	All	1
High Capacity Air Filter	GB010-60169	Optional	-
Rotor seal for 6-7 port valve for AV56/7	GB494-60002	GB494A/GB495	-
Rotor seal for 4 port valve for AV54	GB493-60002	GB493A	-
Rinse solution to rinse station 2.5mm id x 1m	GB410-80123	SPS 4	1
Barb connector 2.5mm 1.5mm ID	GB410-80124	SPS 4	1
PVC waste tubing 8mm od x 5mm id, 2m	GB410-80122	SPS 4	1
<b>Additional Parts may be required from engineer's stock:</b>			
X axis drive belt	5410047500	SPS 3	-
Z axis drive belt	5410047400	SPS 3	-
Peristaltic pump tubing, PVC Solvaflex, 3 bridge	3710049000	SPS 4	-

## Consumed Parts Reference

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

☒ Section Not Applicable.

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

## Signature Page

## Service Engineer Comments (optional)

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

## Service Verification

Service Request Number

65016 02534

Service Engineer Name

Nelson Lueangjanyan

Service Engineer Signature

Nelson L.

Total number of pages in this document:

14

Date Service Completed

Feb 19, 2024

Customer Name

Customer Signature



**Metrological Center**  
 SCI ECO Services Company Limited  
 33/2 Moo 3, T.Banpa, A.Kaengkhoei, Saraburi 18110  
 Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109  
 Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



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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

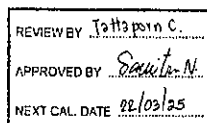
Date of Receipt : 13 September 2023

Calibrated By : Sane Musikawan ( Site Calibration Manager )

Approved By :  / Sujjar Naknakred ( Site Calibration Manager )

Date of Issue : 26 SEP 2023

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



Certificate No. T231676

Page 2 of 6

## Calibration Report

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

## Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

## 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024

## 3. This certificate is traceable to :

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

## 4. Condition of calibrated item : good

## Equipment Description :

Time Constant 2 Hour 20 Minute At 95 °C  
 Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

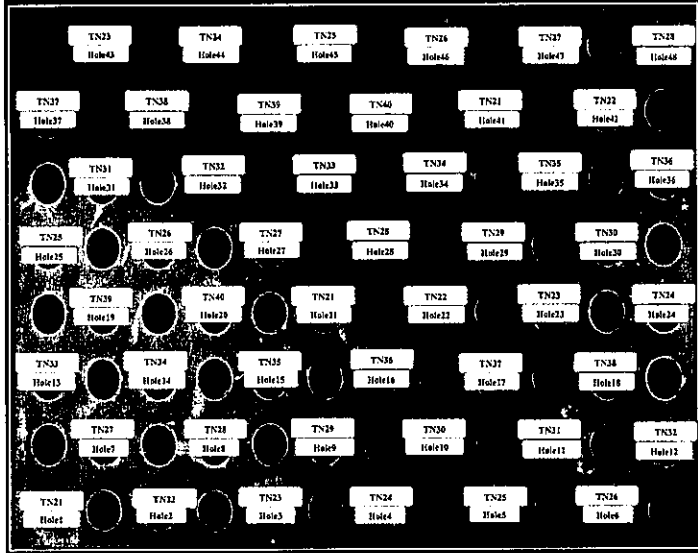
## 5. Adjustment :

( ) without adjustment

( X ) after adjustment

Approved By : 

### Calibration Report



**FRONT CONTROL**

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

### Calibration Report

Measurement Results		Average Standard Reading at each position (°C)					
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26
R1 Hole1-Hole6	CAL POINT						
	Max	105.23	104.32	105.43	105.25	104.44	105.27
	Min	104.94	103.95	105.15	105.04	104.11	104.96
	Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12	CAL POINT						
	Max	105.30	105.12	105.18	105.22	105.12	105.16
	Min	105.11	104.92	104.96	105.00	104.92	104.97
	Average	105.20	105.02	105.07	105.11	105.02	105.06
R3 Hole13-Hole18	CAL POINT						
	Max	105.37	105.63	105.02	104.80	104.69	105.19
	Min	105.17	105.37	104.75	104.59	104.50	105.00
	Average	105.27	105.50	104.88	104.69	104.60	105.09
R4 Hole19-Hole24	CAL POINT						
	Max	105.31	104.43	106.41	104.71	105.63	105.82
	Min	105.08	104.22	106.15	104.41	105.37	105.56
	Average	105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30	CAL POINT						
	Max	104.95	106.26	103.34	105.78	105.59	105.87
	Min	104.67	105.96	103.08	105.56	105.36	105.68
	Average	104.81	106.11	103.21	105.67	105.48	105.77
R6 Hole31-Hole36	CAL POINT						
	Max	104.75	104.86	104.80	105.20	104.50	104.39
	Min	104.54	104.62	104.59	105.00	104.32	104.18
	Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42	CAL POINT						
	Max	104.30	104.90	104.85	104.65	104.88	104.85
	Min	104.09	104.72	104.66	104.49	104.63	104.52
	Average	104.19	104.81	104.75	104.57	104.76	104.68
R8 Hole43-Hole48	CAL POINT						
	Max	105.71	105.85	105.39	105.61	105.42	105.19
	Min	105.45	105.61	105.14	105.27	105.18	104.94
	Average	105.58	105.73	105.27	105.44	105.30	105.07

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

### Calibration Report

Measurement Results		Average Standard Reading at each position (°C)					
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26
R1 Hole1-Hole6	CAL POINT						
	Max	95.01	94.41	95.20	95.41	94.51	95.17
	Min	94.57	93.95	94.75	94.92	94.00	94.72
	Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12	CAL POINT						
	Max	95.36	95.43	95.19	95.16	95.35	94.97
	Min	94.94	94.95	94.72	94.71	94.90	94.57
	Average	95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18	CAL POINT						
	Max	95.37	95.50	95.22	95.21	95.33	95.31
	Min	94.99	95.09	94.78	94.82	94.88	94.96
	Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24	CAL POINT						
	Max	95.59	94.42	94.32	94.24	94.63	94.67
	Min	95.21	94.66	94.13	93.88	94.28	94.27
	Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30	CAL POINT						
	Max	95.19	95.38	92.93	95.30	95.14	95.03
	Min	94.83	95.03	92.56	94.95	94.79	94.70
	Average	95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36	CAL POINT						
	Max	94.63	94.90	94.77	94.31	94.24	93.87
	Min	94.24	94.55	94.44	93.98	93.92	93.56
	Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42	CAL POINT						
	Max	94.30	94.44	94.04	93.81	94.89	95.35
	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						
	Max	95.99	95.63	95.28	95.29	95.45	94.87
	Min	95.57	95.15	94.82	94.84	94.99	94.48
	Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

### Calibration Report

#### Measurement Results:

HEATING BLOCK		Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)
	Min, Max	Average	
100.0	100.3, 100.5	100.4	0.26
107.0	107.0, 107.1	107.1	0.19

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57



## Metrology

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 2360  
Website : www.scieco.co.th E-Mail : calibrate@scg.com



## Metrology

SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T232160

Page 1 of 4

### Certificate of Calibration

Equipment : Chamber ( Cooling Room )  
Manufacturer : KOLDTECH  
Model : KM 320  
Serial No. : TBN-1012061/05  
Customer Code : BKK\_EN0167  
ID No. : T2463A3  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phanthanakan 40, Phanthanakan Rd., Khwaeng Phanthanakan,  
Khet Suan Luang, Bangkok 10250  
Customer Location : Laboratory  
Date of Receipt : 29 November 2023  
Calibrated By : Atiphong Rongrat ( Technician )  
Approved By : Boonchai Suriyawong (Site Calibration Manager)  
Date of Issue : 09 JAN 2024

REVIEW BY [Signature]  
APPROVED BY [Signature]  
NEXT CAL. DATE 06/01/25

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 118/18-08-66

Certificate No. T232160

Page 2 of 4

### Calibration Report

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 6 December 2023  
Environment : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

#### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

#### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

#### 3. This certificate is traceable to :

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

#### 4. Condition of calibrated item : good

##### Equipment Description :

Time Constant ☐ 1 Hour ☐ 30 Minute At ☐ 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

#### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

Approved By. [Signature]

FM-L15 118/18-08-66



## Metrology

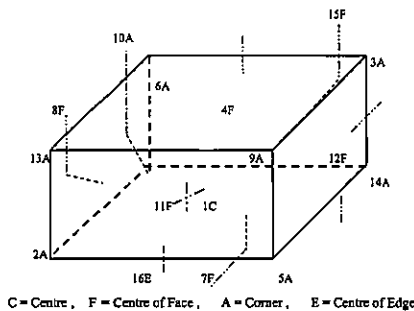
SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T232160

Page 3 of 4

### Calibration Report



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

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

Approved By. [Signature]

FM-L15 118/18-08-66



## Metrology

SCI ECO Services Company Limited  
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Certificate No. T232160

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### Calibration Report

#### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)										
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170	TN171
3.0	2.83	3.34	2.95	3.46	3.45	3.76	3.25	3.46	3.39	3.50	3.58
	TN172	TN174	TN175	TN176							
	3.33	3.39	3.15	3.43							

Chamber ( Cooling Room )			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min	Max					
3.0	2.8	4.1	3.5	3.36	1.10	2.00	1.90

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By. [Signature]

FM-L15 118/18-08-66



# Certificate of Calibration

ICS-2100: Anion (ID#659)

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

ICS-2100 S/N: 15010977

AS-HV S/N: 5450A36659

For

ALS Laboratory Group (Thailand) Co., Ltd.



Operator Signature: Nutdanai Date: Jan 12, 2024

(Mr. Nutdanai Laekhwan)

Application Chemist

REVIEW BY Aulchaisawan S.  
APPROVED BY Tammy Tormel  
NEXT CAL. DATE 12 Jan 2025

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Agilent CrossLab Compliance Services

## Certificate of System Qualification

GC-OQ + GCMS-OQ

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

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

REVIEW BY Suchada T.  
APPROVED BY Nut Sot  
NEXT CAL. DATE 25 Jan 24

CDS Logon Verification - GC

Logon: SESSIONNAME

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890  
Front MMI

Setpoint Status: Pass

Setpoint Actual  
Inlet Pressure: 25.0 psi 24.9 psi

Accuracy: 0.1 psi

Agilent Recommended: <= 1.2

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

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890  
Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual  
Temperature: 230.0 230.0 °C  
Accuracy: 0.0 °C  
Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)  
<= 1.0 % setpoint in K (5.0 °C)

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

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890  
Setpoint Status: Pass  
Setpoint/Average  
Temperature: 100.0 100.0333 °C  
Stability: 0.1 °C  
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

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

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Agilent CrossLab Compliance Services

Tune EI

Tested Combination1 Front MMI / External TO  
Name: 7890A  
Setpoint Status: Pass  
Filament: 1  
Setpoint Status: Pass  
Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1 Front MMI / External TO  
Injection Tower  
Name: 7893A  
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 TO  
Injection Tower  
Name: 7893A  
Source: EI - Extractor

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

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Setpoint Status:	Pass
Injection Volume on Column:	1.0 <input type="text"/> µL
Minimum RSD:	10.58 %
Agilent Recommended:	≤ 12.00 %
Status:	Pass
Instrument Detection Limit:	3.69562 <input type="text"/> fg
Agilent Recommended:	≤ 4.03800 <input type="text"/>
Status:	Pass

## Overall Instrument Detection Limit Test Status

Pass

## Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	7693A			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0 <input type="text"/> µL			
RSD:	3.22 %	Mass Ratio	14.08 %	
Agilent Recommended:	≤ 15.00 %		≤ 15.00 %	
	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	CN18160003
Firmware Revision	A.11.02
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

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

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Sampler 2	
Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN18170137
Firmware Revision	A.11.03
Val Heator	Not Installed
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7690
Model Number	G3442B
Serial Number	CN18153060
Firmware Revision	B.02.05
Oven Type	Standard
Inlet 1	
Manufacturer	Agilent Technologies
Name	7690
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7690
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

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

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Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	TQ
Name	70000
Serial Number	US1828U106
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	CFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extactor
Number of Filaments	2

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

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## Electronic Signature

## Purpose

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

## Details

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

## Regulatory Disclaimer

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

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User Name: natapal.hengcharoen  
Host Name: ASB-KW285

System ID: GM-10  
Print Date: May 25, 2023 11:05:09 AM

## ALS\_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:02:30 PM	Audit	Session Created	Session	None
May 22, 2023 1:02:53 PM	Start	Configuration	Session	None
May 22, 2023 1:32:39 PM	Audit	Enrollment	License	User is Field Engineer and does not require an unlock code
May 22, 2023 1:37:48 PM	Audit	ExpLoaded	Session	EQP details for primary technique [04] - File path: [ProtocolPath\GcrConfig\lms\02_02_03_03_03.msp] EQP File Name: [02_02_03.msp], EQP Name: [AgilentRecommended,ProtocolRevision [01.02.03]] EQP details for hybridated sample [56M] - File path: [ProtocolPath\GcrConfig\lms\02_02_03_03_03.msp] EQP File Name: [02_02_03.msp], EQP Name: [AgilentRecommended]
May 22, 2023 1:37:52 PM	End	Configuration	Session	None
May 22, 2023 1:37:56 PM	Start	Qualification	Session	QC
May 22, 2023 1:37:56 PM	Start	Execution	QC Login Verification - QC : - Qualitative test	None
May 22, 2023 1:37:57 PM	Start	Execution	QC Login Verification - QC : - Qualitative test	None
May 22, 2023 2:02:37 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TIC - Source: EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None

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

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User Name: natapal.hengcharoen  
Host Name: ASB-KW285

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

## ALS\_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:02:37 PM	Start	Execution	QC Login Verification - QC : - Qualitative test	None
May 22, 2023 2:03:33 PM	End	Execution	QC Login Verification - QC : - Qualitative test	Run Count: 1
May 22, 2023 2:34:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No subpoints associated	None
May 22, 2023 2:35:02 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No subpoints associated	Run Count: 1
May 22, 2023 2:35:17 PM	Start	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - 8: 25.0 psi - L: <= 1.2 psi	None
May 22, 2023 2:35:22 PM	End	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - 8: 25.0 psi - L: <= 1.2 psi	Run Count: 1
May 22, 2023 2:36:24 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 230.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:38:49 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 230.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 25, 2023 1:38:54 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 230.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1

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

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User Name: natapal.hengcharoen  
Host Name: ASB-KW285

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

## ALS\_GM-10 Transaction Log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:38:55 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:58:06 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TIC - Source: EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 3:08:04 PM	Start	Execution	Booiling Run - Injection Tower, Front MM, TIC - Source: EI - Extraction Part of GC/MS System Preparation	None
May 22, 2023 3:10:34 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TIC - Source: EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 3:12:51 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TIC - Source: EI - Extractor - L (P80): <= 5.00%	None
May 22, 2023 3:17:49 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:17:50 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:18:05 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - 8: 100.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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

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User Name: natlapejhegchareon  
Hostname: ASBKKW205

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 9:18:07 PM	End	Execution	GC Oven Temperature Accuracy - 7500 - Temperature : Oven - E: 100.0°C - L: >= <1.0 AND <= 1.0 % setpoint in K	Run Count: 1
May 22, 2023 9:59:07 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 9:59:10 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - 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: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 4:03:06 PM	Start	Execution	GC Oven Temperature Stability - 7500 - Temperature : Oven - E: 100.0°C - L: <= 0.5°C	None
May 22, 2023 4:03:52 PM	Audit	Data	GC Oven Temperature Stability - 7500 - Temperature : Oven - E: 100.0°C - L: <= 0.5°C	Manual Data Entry
May 22, 2023 4:03:54 PM	End	Execution	GC Oven Temperature Stability - 7500 - Temperature : Oven - E: 100.0°C - L: <= 0.5°C	Run Count: 1
May 23, 2023 5:58:15 PM	Audit	AcqClosed	Session	None
May 24, 2023 4:03:10 PM	Audit	AcqRestarted	Session	None
May 24, 2023 4:14:45 PM	Audit	AcqClosed	Session	None
May 25, 2023 10:13:07 AM	Audit	AcqRestarted	Session	None
May 25, 2023 10:27:12 AM	Audit	SessionReloaded	Session	None

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

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User Name: natlapejhegchareon  
Hostname: ASBKKW205

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

## ALS\_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:27:12 AM	Start	Qualification	Session	QC
May 25, 2023 10:27:16 AM	Start	Execution	Tube EI - 7500D TQ: - Source: - Note EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:43 AM	Start	Execution	Tube EI - 7500D TQ: - Source: - Note EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:56 AM	End	Execution	Tube EI - 7500D TQ: - Source: - Run Count: 1 EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:57 AM	Start	Execution	Tube EI - 7500D TQ: - Source: - Note EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
May 25, 2023 10:28:07 AM	End	Execution	Tube EI - 7500D TQ: - Source: - Run Count: 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
May 25, 2023 10:28:08 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - Part of GCMS System Preparation	None
May 25, 2023 10:28:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 10:28:30 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - Part of GCMS System Preparation	None

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

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User Name: natlapejhegchareon  
Hostname: ASBKKW205

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 10:28:56 AM	Audit	Data	Scouting Run - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - Part of GCMS System Preparation	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_01.D
May 25, 2023 10:29:34 AM	End	Execution	Scouting Run - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - Part of GCMS System Preparation	Run Count: 1
May 25, 2023 10:30:25 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_001.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_002.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_003.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_004.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_005.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_006.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_007.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_008.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_009.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_010.D
May 25, 2023 10:30:19 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - 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: natlapejhegchareon  
Hostname: ASBKKW205

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

## ALS\_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_009.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_004.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_007.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_008.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_009.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_009.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_009.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMS1\data_VaghenKOQ_2023\NOV_010.D
May 25, 2023 10:30:19 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ: - Source: - E1 - 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: natipap.bangcharnen  
Username: ASB0000235System ID: GM-10  
Print Date: May 25, 2023 11:05:18 AM

ALB\_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 23, 2023 10:30:22 AM	Start	Execution	Mass Ratio Prediction - Injection	None
			Tower, Front MM, TQ:-	
			Source: EI - Extractor - L (RSD):	
			<= 5.00%	
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_01.D <= 5.00%
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_02.D <= 5.00%
May 27, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_03.D <= 5.00%
May 28, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_04.D <= 5.00%
May 29, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_05.D <= 5.00%
May 29, 2023 10:30:49 AM	Audit	Data	Mass Ratio Prediction - Injection	Data File Path: Tower, Front MM, TQ:- D:\MassHunter\GCMS\data Source: EI - Extractor - L (RSD): VaghenMOO_2023MRP_06.D <= 5.00%
May 29, 2023 10:30:49 AM	End	Execution	Mass Ratio Prediction - Injection	Run Count: 1
			Tower, Front MM, TQ:-	
			Source: EI - Extractor - L (RSD):	
			<= 5.00%	
May 25, 2023 10:31:02 AM	End	Qualification	Session	CO

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

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User Name: natipap.bangcharnen  
Username: ASB0000235System ID: GM-10  
Print Date: May 25, 2023 11:05:18 AM

ALB\_GM-10 Transaction log:

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

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

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Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor 7 Ramad Road  
Siom Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-367/23  
Equipment UVVis Spectrophotometer  
Model UV-1800  
Manufacturer Shimadzu  
Serial No. A11454908533CD  
ID No. BKK\_END0018  
Date of receipt 15 September 2023  
Date of calibration 15 September 2023  
Date of issue 22 September 2023

Customer name ALS Laboratory Group (Thailand) Co., Ltd  
Address 104 Soi Phattanakon 40, Phattanakon Road, Phattanakon, Suan Luang, Bangkok 10250

Temperature (23.4 - 24.7) °C (On site)  
Humidity (55.5 - 61.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Prop

Calibration Procedure In-house method: WI-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  
Sray Light is traceable to certificate No. 95908  
The above certificate are traceable to SI unit through Stama Scientific Ltd.  
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janioey

REVIEW BY *Sirak P.*  
APPROVED BY *LL AL*  
NEXT CAL. DATE 15/9/2024

Approved by

Mr. Kanchit Choothep  
Technical Manager

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968 U Chu Liang Building Floor 7 Ramad Road  
Siom Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Page(s) 2 of 3

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.07	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.99	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7487	0.7480	-0.0007	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8646	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2908	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6429	0.6415	-0.0014	0.0075

\*CNR = Customer not request

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868 U Chu Liang Building Floor 7 Rama 4 Road  
Siam Bangkok Bangkok Thailand 10500  
Tel: 02-6324300 Fax: 02-63754967  
www.barscientific.com



# Certificate of Calibration

Certificate No. BSCC-UV-36723

Number of Page(s)

3 of 3

Calibration Results:

3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000 0.5783 0.7528 1.0205	0.0000 0.5793 0.7624 1.0216	0.0000 0.0010 -0.0004 0.0010	0.0042 0.0042 0.0042 0.0042
440.0	0.0000 0.5821 0.7455 0.9985	0.0000 0.5825 0.7452 0.9989	0.0000 -0.0004 -0.0003 0.0004	0.0042 0.0042 0.0042 0.0042
465.0	0.0000 0.5227 0.6880 0.9487	0.0000 0.5229 0.6873 0.9486	0.0000 0.0002 -0.0007 -0.0001	0.0042 0.0042 0.0042 0.0042
546.1	0.0000 0.5267 0.6973 0.9959	0.0000 0.5211 0.6960 0.9944	0.0000 0.0004 -0.0013 -0.0015	0.0042 0.0042 0.0042 0.0042
500.0	0.0000 0.5544 0.7253 1.0942	0.0000 0.5538 0.7236 1.0925	0.0000 -0.0008 -0.0017 -0.0017	0.0042 0.0042 0.0042 0.0042
635.0	0.0000 0.5616 0.6927 1.0581	0.0000 0.5612 0.6908 1.0866	0.0000 -0.0004 -0.0018 -0.0015	0.0042 0.0042 0.0042 0.0042

\*CNR = Customer not request

4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration (UUC) Wavelength (nm)	Transmission (%)	Absorbance (A)
200 9650.11nm	200.55	0.9770	2.0104

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A  
\*Stray Light not NSC-ONS 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 above results are valid exclusively for the calibrated item(s) as mention in this report / certificate  
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FM-UV-708-02 Rev 01 (23/01/63)

Agilent Technologies

Agilent Technologies (Thailand) Limited  
U CHU LIANG BLDG. 22/F UNIT A.D  
868 RAMA 4 ROAD, SIAM, BANGKOK  
Bangkok 10500 Thailand

Tel: +662 637 5343  
Fax: +662 637 4334  
Email: ccc-sm@agilent.com  
Website: www.agilent.com/thai

Customer Contact:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan  
TAX ID : 0105540004659  
bounced-inchomchanattagarn@alsglobal.com  
227158760519

## SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 6006068207	Service Confirmation: 6904837520

Invoice To:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

REVIEW BY: Anchal K.  
APPROVED BY: *[Signature]*  
NEXT CAL DATE: 06/10/2024

Delivery Site:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

Location:

Room  
Bldg  
Lab  
Dept

Direct Inquiries to:

Contact Name: Customer Contact Center  
Contact E-mail: ccc-sm@agilent.com  
Contact Telephone: +662 637 6353  
Contact Fax: +662 632 4334

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U Chu Liang Bldg. 22/F Unit A.D  
868 Rama 4 Road, Siam, Bangkok,  
Bangkok 10500 Thailand  
Tax ID : 010554208218

Orbank N.A. Bangkok Branch  
389 Inurchange 21 Building, Sukhumvit Road, Klongtoey New  
Sub-District, Wattana District, Bangkok 10110 Thailand  
Acc. No: 012-4455307  
1100 Song Thai Bank TEL  
Siam Square Bldg. 416/1-2 Rama 1 Rd, Pathumwan, BKK 10330  
Thailand

Page 1 of 3

Service Confirmation Number: 6904837520  
Service Confirmation Date: 06.04.2023

Service Confirmation Number: 6904837529  
Service Confirmation Date: 06.04.2023

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7900	ICPMS 7900 System			
G8410A	SPS 4 Autosampler	AU15430222	ICP MS 7900	SYS-IM-7900
G8411A	ISIS 3 for Agilent 7850/7900/8900	JP16510227	ICP MS 7900	SYS-IM-7900
G3292A	PSC 6105T Chiller	2U15A1948	ICP MS 7900	SYS-IM-7900
G8403A	Agilent 7900 ICP-MS	JP15471169	ICP MS 7900	SYS-IM-7900

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQG	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	06.04.2023	06.04.2023
1010	5185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement - 100 % covered		

Additional Information:

Service Information:

Problem Description:  
WU-S-DG-ICP MS 7900-5001143313

Service Provided:  
Test OQ control of instrument ICPMS = BKK\_EL0043. After done all instrument test all Pass.

Service Overview Code:  
Reason Code: Scheduled Service  
Diagnosis Code: Scheduled Service  
Resolution Code: Scheduled Service

Reported Hours: 5.0  
Travel Hours: 1.0

Customer Field Service Representative Name: Panthep Kurasaethai  
Customer Field Service Representative Signature: *[Signature]*  
Date: 06 Apr 2023

Customer Name: Anchal Khamjan  
Customer Signature: *[Signature]*  
Date: 06 Apr 2023

Additional Comments:



Device parameter	nominal value	actual value
<b>Analytical parameters Fluorescence cell</b>		
Conditions: max.conc.: 10 µg/L PMT-voltage: ...360.....V  Blank-solution without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int...0.00024... Int...0.00172... RSD 9.48.....%
Conditions: max.conc.: 1.7 µg/L PMT-voltage: ...352.....V  Blank-solution with enrichment / FBR 30 ng/L  Fok.- factor ( Int <sub>5</sub> / Int <sub>4</sub> )	Int > 0.008 RSD < 3 %  > 3.5	Int...0.00370... Int...0.01959... RSD 5.35.....%  6.16
<b>Analytical parameters Absorption cell</b>		
Blank-solution  without enrichment / FBR 100 ng/L	Ext > 0.0012 RSD < 5 %	Ext 0.00093  Ext 9.90449... RSD 2.95.....%
<b>Comments</b>		

Sridhar Pavan.  
Signature Technician

24 May 2023

Place, Date (DD/MM/YYYY)

Orawan T.  
Signature Custodian

Signature Customer \_\_\_\_\_

24 May 2023

Place, Date (DD/MM/YYYY)

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6:

## Service Report

[illegible]

Services are subject to the General Terms and Conditions of Analytic Jena AG, which will be sent on request.

5/24/2023 12:45 Page 1/4

5/24/2023 12:46 Page 2/4

**Mercur**

Report file:	C:\WinAAS\TMP\2023\May\Pro_032			
Program version:	4.7.10.0	Printed on:	5/24/2023	12:46
		Recording started on	5/24/2023	12:35 GMT+7.0
Operator:	PSU,OTA			
Laboratory:	ALS-BKK			
Cbde:	II_Hg095_2023			
Remarks:				
Food/water				

### Method parameters

Method Without enrichment / FBR 30ng/L\_PM24052023  
Created on 5/24/2023 Time 12:27  
Program ---

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	30 s
PMT	360 V		
AZ time	5 s	Peak smoothing	8/5
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	
Pump speed	3	Soaking time	
Sample load time	10 s	Gas load time	5 P
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 P

Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		

### Dilution

Hg

**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%		
QC std. act.	flag + continue		
Expect. blank obs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal factor	Off

### Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	ug/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
Confid. level	95.4 %	Blind cycles
Grubbs stat.	---	

### Calibration standards

Ha

No	Name	State	Pos	Conc / ng/L	Ints	SD	RSD%
1	Cal-Zero	(-)	79	0.000	H: 0.000249 A: 0.004274	0.000132 0.001698	53.13 39.72
2	Cal-Std1	(-)	80	30.000	H: 0.001720 A: 0.02172	0.030097 0.000023	0.469 0.107

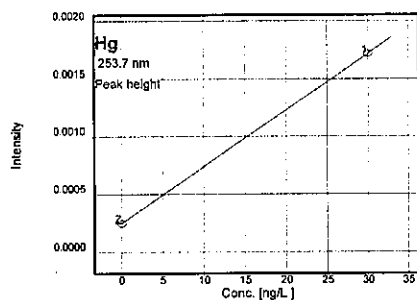
## Calibration function 1 5/24/2023 12:44 Calibration (Peak height)

Inls=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		0.000007997	0.459		12:44	
Calibration	Calibration function: 01							12:44

Mercur

Mercur

## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro\_033  
 Program version: 4.7.10.0 Printed on: 5/24/2023 14:01  
 Recording started on: 5/24/2023 13:37 GMT+7.0  
 Operator: PSU.OTA  
 Laboratory: ALS-BKK  
 Code: Hg\_095\_2023

Remarks:  
 Food,water

## Method parameters

Method: Enrichment / FBR 30ng/L PM\_24052023  
 Created on: 5/24/2023 Time: 13:35  
 Program: --

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V	Peak smoothing	12/11
AZ time	5 s		
Delay	0 s		
Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	off	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	10 s	Gas AZ wait	10 NL/h
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	20 s		
Heat.time coll.1	20 s	Cool. time coll.1	30 s

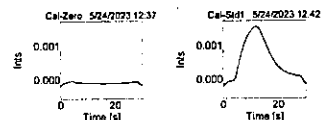
Hg

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## Peak plots

Hg



## 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%		
QC std. act.	flag + continue	Reaction	flag + continue
Expect. blank abs.	0.0100s 0.0100		
QC precision	off	Reaction	off
		QC Recal.factor	Off

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	--	Standard prop.	Premixed
		Blank correct.	--
		Recalib. std. no.	--
		Conversion fac.	1000
Output unit	µg/L	Meas. cycles	3
Calib. stat.	Mean	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

Hg

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	0.000263 0.002769	2.386 4.136

## Calibration function 1 6/24/2023 14:00 Calibration (Peak height)

Ints=k1+k2\*conc

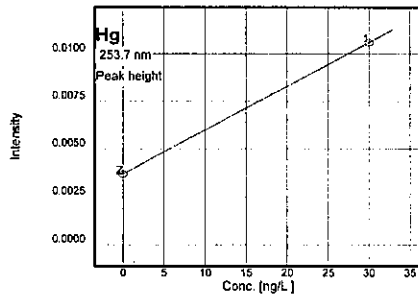
k1=0.003700

k2=0.000230

Recal. factor:

---

Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
scd	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

Hg ID	Enrichment / FER	30ng/L PM_24052023	5/24/2023 13:37
Conc.	Ints	BG	SD
Cal-Zero	0.003702		
	0.003866		
	0.003840		
	0 ng/L	0.003700	0.000081090 2.182
Cal-Std1	0.009498		
	0.008333		
	0.008861		
	30.00ng/L	0.008831	0.0005830 6.528
Cal-Std1	0.01031		
	0.01074		
	0.01076		
	30.00ng/L	0.01060	0.0002530 2.386
Calibration	Calibration function: 01		14:00

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## Mercur

Report file: C:\WinAAS\TMP\2023\MayPro\_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

Method Without enrichment / Abs / FBR 100ng/L\_PM 24052023

Created on 5/24/2023 Time 14:18

Program ---

Parameters Mercur Technique: Hg absorption

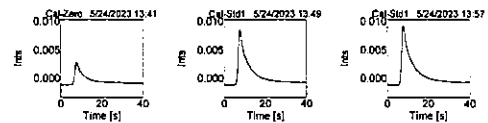
Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	225 V		
AZ time	5 s	Peak smoothing	2/5
Delay	8 s		
	---		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	5 NL/h
Reaction 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

Hg

Mercur

## Peak plots

Hg



## QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(100.00 ng/L)	QC std.2 no.	1(100.00 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 0.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		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	0.000138 0.005208	14.88 17.28
2	Cal-Std1	(-)	##	100.00	H: 0.004494 A: 0.081268	0.000116 0.001275	2.588 2.082

Hg

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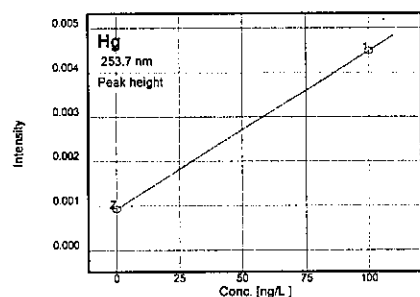
## Calibration function 1 5/24/2023 14:33 Calibration (Peak height)

Abs=k1+k2\*conc

k1=0.000932 k2=0.000036

Recal. factor: ---

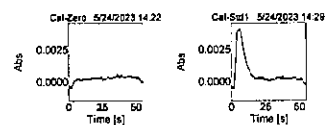
Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

Without enrichment / Abs / FBR 100ng/L_PM 24052023						
Hg ID	Conc.	Abs	BG	SD	RSD/%	Int. type
Cal-Zero		0.001039				PkH
		0.000775				
		0.000981				
	0ng/L	0.000932		0.00013672	14.88	
Cal-Std1		0.004528				PkH
		0.004364				
		0.004588				
	100.ng/L	0.004494		0.0001623	2.586	
Calibration	Calibration function: 01					

## Peak plots



Hg

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