

# 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	Pilot Tube	BKK_FS0532	31-Jan-24	31-Jul-24	6
Stack	Total Suspended Particulate	Pilot 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_FS0619	12-Jan-24	11-Jan-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 8 hrs	Sound Calibrator	RYG_FS0215	20-Sep-23	20-Sep-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0024	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0026	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0012	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0019	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0027	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0016	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_FS0627	22-Jan-24	21-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0612	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0438	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0628	22-Jan-24	21-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_FS0022	25-Jan-24	24-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0522	25-Jan-24	24-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0577	15-Jan-24	14-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0220	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0223	12-Jan-24	11-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0220	11-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0223	12-Jan-24	11-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0226	16-Feb-24	15-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0218	15-Feb-24	14-Feb-25	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	pH ISE 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	pH ISE 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	29-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	29-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	29-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	29-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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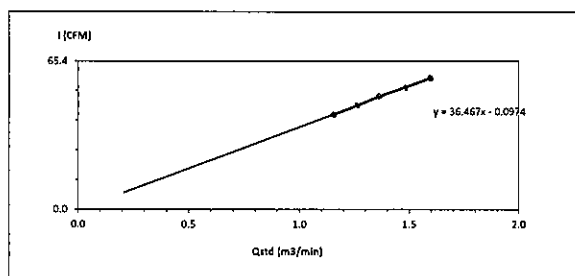
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	ICP-MS	BKK_EL0043	6-Apr-23	6-Oct-24	18
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Arsenic	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 TS3 Co.Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งหิน (โรงโม่หิน) Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0181  
Calibration Sheet No. : C-240524-RYG\_FS0181 High Volume Model : TE-5170D  
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>air</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. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)

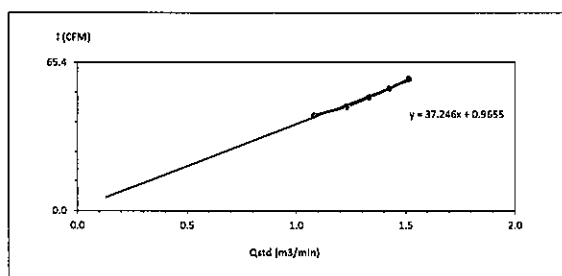
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co.Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งหิน (โรงโม่หิน) Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0661  
Calibration Sheet No. : C-240524-RYG\_FS0661 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>air</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. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)

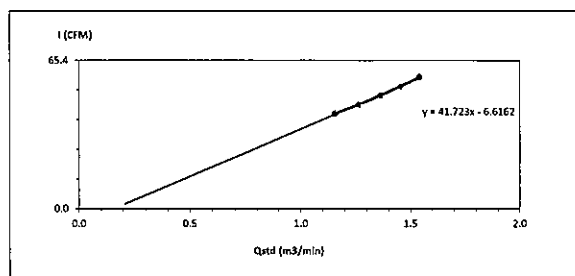
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### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co.Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งหิน (โรงโม่หิน) Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0395  
Calibration Sheet No. : C-240524-RYG\_FS0395 High Volume Model : TE-5170D  
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>air</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. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)

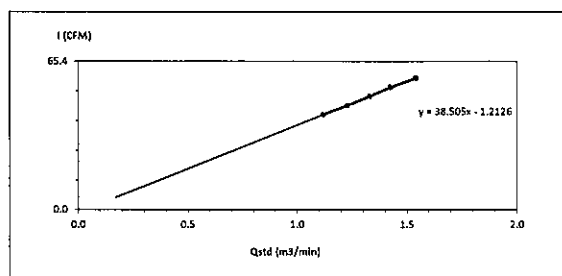
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### High Volume Air Sampler Calibration Worksheet

Project Site : Gulf TS3 Co.Ltd. Barometric Pressure (mm Hg) : 755  
Calibrate Location : โรงโม่หินทุ่งหิน (โรงโม่หิน) Temperature (°C) : 30  
Calibrate Date : 24-May-24 High Volume ID : RYG\_FS0179  
Calibration Sheet No. : C-240524-RYG\_FS0179 High Volume Model : TE-5170D  
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>air</sub> (m <sup>3</sup> /min)	I Chart (CFM)	Linear Regression
1	2.8	1.1202	42	Slope : 38.5048 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. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)

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

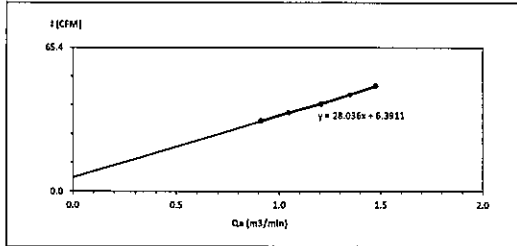




# High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TSI Co., Ltd. Barometric Pressure (mm Hg): 755  
 Calibrate Location: ท่าอากาศยานสุวรรณภูมิ (ท่าอากาศยาน) Temperature (°C): 30  
 Calibrate Date: 24-May-24 High Volume ID: RYG\_FS0183  
 Calibration Sheet No.: C-240524-RYG\_FS0183 High Volume Model: TE-5009X  
 Calibrator ID: RYG\_FS0205 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> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.912	32	Slope: 28.0360 Intercept: 6.3911 Correlation Coefficient: 0.9993
2	2.4	1.050	36	
3	3.2	1.209	40	
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 Juntanapan)  
 Enviro Field Coordinator Scientist (3)

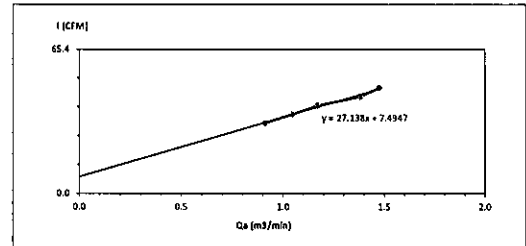
FORM NO.: F 06-074 REVISION NO.: 2 ISSUE DATE: 20/11/23



# High Volume Air Sampler Calibration Worksheet

Project Site: Gulf TSI Co., Ltd. Barometric Pressure (mm Hg): 755  
 Calibrate Location: ท่าอากาศยานสุวรรณภูมิ Temperature (°C): 30  
 Calibrate Date: 24-May-24 High Volume ID: RYG\_FS0400  
 Calibration Sheet No.: C-240524-RYG\_FS0400 High Volume Model: TE-5009X  
 Calibrator ID: RYG\_FS0205 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> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.912	32	Slope: 27.1377 Intercept: 7.4947 Correlation Coefficient: 0.9944
2	2.4	1.050	36	
3	3.0	1.171	40	
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 Juntanapan)  
 Enviro Field Coordinator Scientist (3)

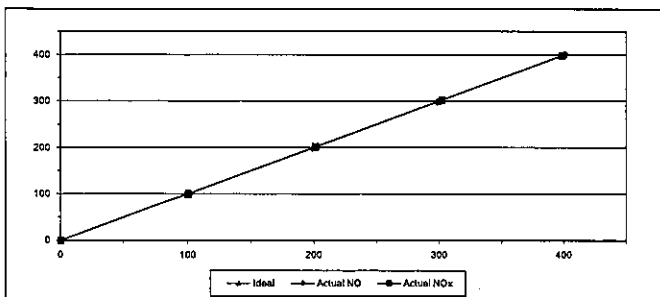
FORM NO.: F 06-074 REVISION NO.: 2 ISSUE DATE: 20/11/23



## MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jan-24 Equipment Name: NOx Analyzer  
 Manufacturer: HORIBA Model: APNA-370  
 Serial No.: 148EH0E0 Equipment ID: BKK\_FS1084  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 847  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: GN0027222  
 Cylinder Pressure (psf): 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. Jirawut Sakam)  
 Field Environmental Scientist (3)

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

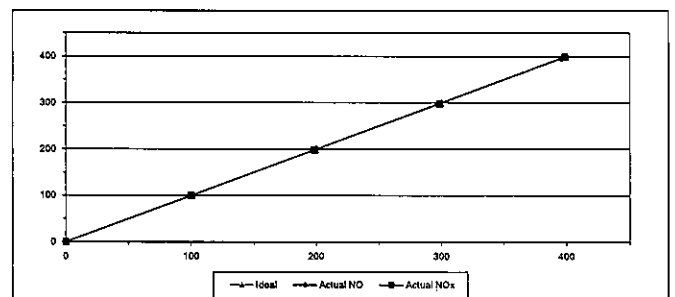
ALS Laboratory Group  
 FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-24 Equipment Name: NOx Analyzer  
 Manufacturer: Teledyne API Model: T200  
 Serial No.: 2197 Equipment ID: RYG\_FS0255  
 Calibrator Manufacturer: Teledyne API Model: 700  
 Serial No.: 847  
 Std. Gas Concentration (PPM): 55.88 Cylinder No.: GN0027222  
 Cylinder Pressure (psf): 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	398.40	-1.60	-0.40	398.50	-1.50	-0.38
AVERAGE (%)				-0.82			-0.27



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

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

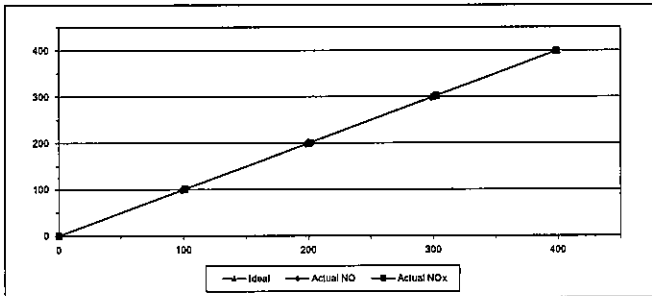
ALS Laboratory Group  
 FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-24 Equipment Name NOx Analyzer  
 Manufacturer Teledyne API Model T200  
 Serial No. 2198 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 Algae Inc.  
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	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. Jirawut Sakam)  
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

ALS Laboratory Group

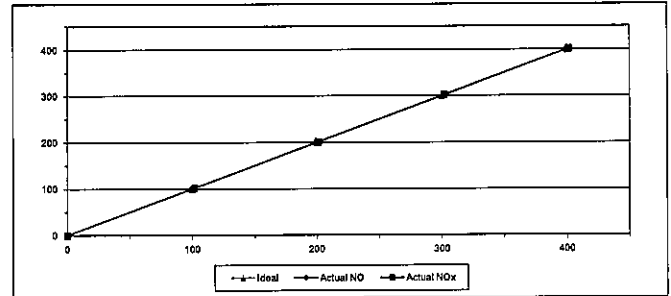
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-24 Equipment Name NOx Analyzer  
 Manufacturer HORIBA Model APNA-370  
 Serial No. ALPOVOWY 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 Algae Inc.  
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.60	-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			0.64



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

ALS Laboratory Group

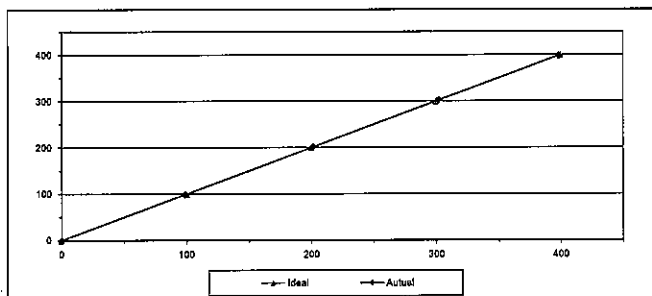
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-24 Equipment Name SO2 Analyzer  
 Manufacturer HORIBA Model APSA-370  
 Serial No. NM3M2D5M Equipment ID RYG\_FS0266  
 Calibrator Manufacturer Teledyne API Model 700  
 Serial No. 947  
 Std. Gas Concentration (PPM) 58.3 Cylinder No. GN0027222  
 Cylinder Pressure (psi) 1800 Certified By Algae Inc.  
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-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. Jirawut Sakam)  
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

ALS Laboratory Group

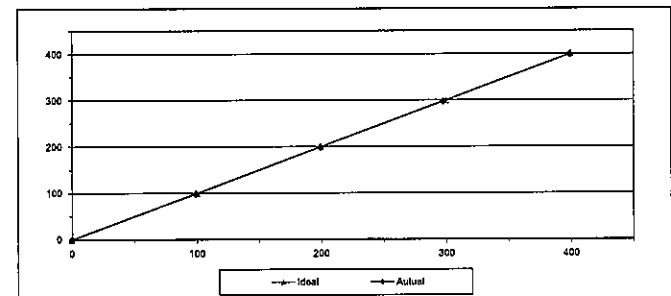
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## 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 Algae Inc.  
 Certified Date 9-Feb-22 Expiry 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. Jirawut Sakam)  
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)  
Assistant General Manager

ALS Laboratory Group

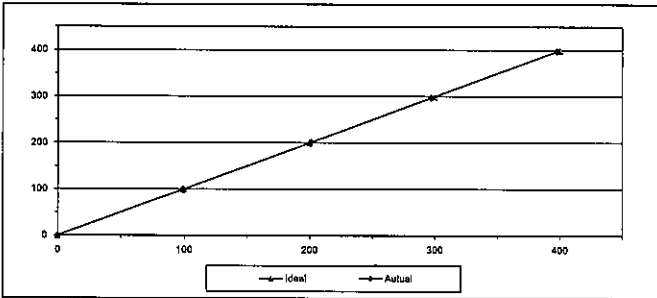
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1773	Equipment ID	RYG_FS0251
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	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

Approved By

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

(Mr.Sarayuht Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

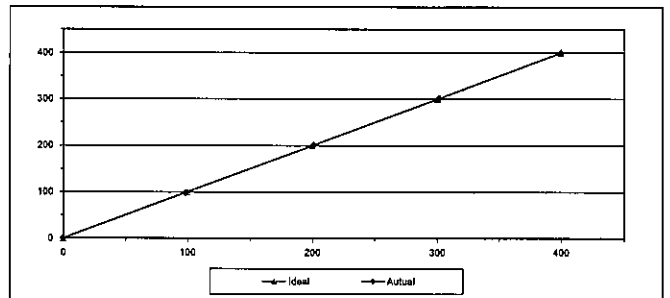
FORM NO.: F 06-058 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	H083D8FA	Equipment ID	RYG_FS0454
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	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

Approved By

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

(Mr.Sarayuht Jitrantorn)  
Assistant General Manager

ALS Laboratory Group

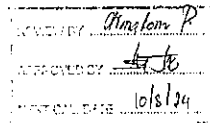
FORM NO.: F 06-058 REVISION NO.: ISSUE DATE: 02/04/12



Jirantorn Associates Co., Ltd.  
61/74 11, 67/35-36  
Pattana 7/71, Rd. Wuthi Yai, Bangkok  
Bangkok 10600 (Thailand)  
Tel.: 02-60648051  
Mobile: +6683999453  
E-mail: jnac@jirantorn.com  
Web site: www.jirantorn.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
RSC:75575 17035  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.



Certificate Number

CL-020-66

Certificate Number

CL-020-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novatys
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-2518
SERIAL NUMBER	: Sensor: AS375 Data logger: AS375
ID NUMBER	: RYG_FS0413
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phraethanon Rd., Phraethanon Rd., Khwaeng Soan 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 Jirantorn Associates Co., Ltd.

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

Preconditioning : 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:  
☒ Mr. Sorawit Thachalad  
☒ Miss Jiraporn Jirantorn



Approved signature:  
Mr. Pannya Booncharoen  
Calibration Department Manager

Remarks:  
<sup>1</sup> Needle 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  $\frac{A}{A_0}$

Calibration procedure:  
The cup anemometer was calibrated against Standard air velocity transducer model: 8435-512 and pilot tube with precision differential pressure meter model: DPM1500 in an effel test-section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The MW-1-007 based on IEC 61400-12-2, Wind energy generation systems - Part 12-2: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:  
This certificate provides a traceability of the measurements to recognized the national standards and to evaluation of the International system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>5</sup>

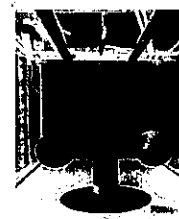
The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pilot tube with precision differential 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 2 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{meas}$ (m/s)	Error (m/s)	$\frac{V}{V_{ref}}$ (m/s)
0.584	24.10	24.00	0.7	-0.1	0.16
2.029	23.98	24.00	1.8	-0.3	0.16
3.044	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
5.98	24.24	24.00	5.8	-0.2	0.17
7.05	23.90	24.00	6.9	-0.2	0.19
8.19	24.14	24.00	8.0	-0.2	0.19
9.00	23.88	24.00	8.9	-0.2	0.20
10.09	23.88	24.00	9.8	-0.2	0.19
11.16	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

Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place<sup>6</sup> Velocity of standard<sup>7</sup> Velocity of Unit Under Calibration

## PHOTO OF CALIBRATION SET-UP



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



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-018-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novolyte  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-251B  
**SERIAL NUMBER** : Sensor: -  
Data logger: AS375  
**ID NUMBER** : RYG\_F50413  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasarn 40, Phatthanasarn 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 Jiranatee 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 (23.8)°C, (50.2) %RH and (1012.2) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thaisakul  
☒ Miss Jiraporn Lertsamphol



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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

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

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	D <sub>1</sub> °	D <sub>2</sub> °	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
0.000	0	0	0	0.58
45.000	45	45	-4	0.58
90.001	90	87	-3	0.74
135.000	135	133	-2	0.74
180.000	180	180	0	0.74
225.000	225	227	2	0.68
270.000	270	273	3	0.68
315.000	315	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\*\*\*

Certificate Number

CL-013-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novolyte  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-250L-D  
**SERIAL NUMBER** : Sensor: WSD-014  
Data logger: AS769  
**ID NUMBER** : RYG\_F50531  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasarn 40, Phatthanasarn 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 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 Jiranatee 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 (23.8)°C, (46.6) %RH and (1014.9) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thaisakul  
☒ Miss Jiraporn Lertsamphol

Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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

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

Certificate Number

CL-018-66

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	D <sub>1</sub> °	D <sub>2</sub> °	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
0.000	0	0	0	0.58
45.000	45	48	-2	0.74
90.000	90	88	-2	0.74
135.000	135	133	-2	0.74
180.000	180	179	-1	0.74
225.000	225	227	2	0.74
270.000	270	272	2	0.74
315.000	315	317	2	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\*\*\*

## CERTIFICATE OF CALIBRATION

Page 1 of 7 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalyx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-014  
Data logger: AS789  
**ID NUMBER** : RYG\_F50531  
**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** : 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 ± 10 hPa

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

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area 900 cm<sup>2</sup>  
Win direction (typical) area 100 cm<sup>2</sup>  
Diameter of mounting pipe 12 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, (44.5) %RH and (1018.3) hPa.

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

**Calibrated by:**  
☒ Mr. Sarawit Thachalad  
☒ Miss Jitraporn Lertsomphol

**Remarks:**  
1. Measle cross-section area of the wind tunnel  
2. Projected cross-section area of the tested object include mounting pipe  
3. Diameter of mounting pipe  
4. Ratio "a" to "b"

**Approved signatory:**

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

63/14-15, 67/35-36, Sol Petchkasem 7/71, Petchkasem Rd,  
Wattana, Bangkokhyai, Bangkok 10600 Thailand.  
Tel: (+66) 02-8680812 Fax: (+66) 02-8680860 www.jiranatee.com



## CERTIFICATE OF CALIBRATION

Certificate No.: CL-006-66  
Page 3 of 2

**Equipment Name:** Data Logger with Temperature Sensor

**Manufacturer:** Novalyx  
**Model:** 110-WS-25DL-D  
**Serial No.:** AS789  
**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, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DTI-1000-A MK  
II, Serial No.: 671407-00591, Due date: 22 July 2023

### Calibration Procedure

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

### Traceability

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

**Calibrated by:**  
☒ Mr. Sarawit Thachalad  
☒ Miss Jitraporn Lertsomphol

**Approved Signatory:**

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 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 <sub>95</sub> (m/s)
0.583	23.60	23.70	0.7	-0.3	0.18
2.024	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	-0.1	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	13.3	0.0	0.25
14.25	23.50	23.70	14.3	-0.1	0.27
15.23	23.30	23.70	15.1	-0.2	0.27
16.29	23.40	23.30	16.2	-0.1	0.23

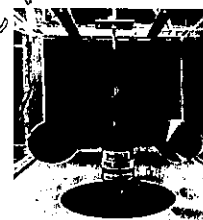
### Remark:

<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 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. Remark: The proportion of the set-up is not true to scale due to imaging geometry.

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

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

### Functions:

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 ★





MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	43	-4	0.58
	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\*\*\*

Jiranatee Associates Co., Ltd.  
63/14-15, 67/35-36  
Petchkasem 27/1, Rd. Watthana, Bangkok,  
Bangkok 10600 (Thailand)  
Tel: +6683599453  
Mobile: +6683599453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TS1-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

REVIEW BY: <i>Kingkorn R.</i>
APPROVED BY: <i>[Signature]</i>
NEXT CAL. DATE: 10/8/24

Certificate Number
CL-019-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE

: Cup anemometer  
: Novalyntx  
: Sensor: WS-02F  
: Data logger: 200-WS-25LB

## SERIAL NUMBER

: Sensor: -  
: Data logger: AS374

## ID NUMBER

: RYG\_F50412

## 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:

: 23.0 ± 3.0 °C  
: 55.0 ± 15.0 %RH  
: 1010 ± 10 hPa

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITIONS

: Wind tunnel cross-section area<sup>1</sup> 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 (23.5) °C, (49.7) %RH and (1010.3) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

☒ Mr. Sorawit Thairakul  
☐ Miss Jitraporn Lertsomphol



## Approved signatory:

*[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

## Remarks:

<sup>1</sup> Nozzle 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 "a"/"b"

**Calibration procedure:**  
The cup anemometer was calibrated against standard air velocity transducer model: 8455-22 and pilot tube with precision differential pressure meter model: DP24500 in on close test-section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WS-02F based on IEC 61400-12-1. Wind energy generation system - 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: MW-0057-21 and MW-0066-22

**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

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 pilot 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>meas</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.981	23.52	23.50	0.8	-0.2	0.15
2.059	23.46	23.50	1.8	-0.2	0.16
3.040	23.50	23.50	2.9	-0.2	0.17
4.144	23.58	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	0.19
9.09	23.30	23.50	8.9	-0.2	0.18
10.09	23.50	23.50	9.9	-0.2	0.20
11.14	23.24	23.50	11.0	-0.2	0.21
12.13	23.36	23.50	12.0	-0.2	0.21
13.18	23.32	23.50	13.0	-0.2	0.21
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

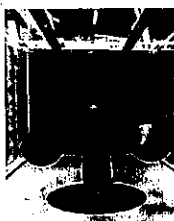
## Remarks:

<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 Jiranatee 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 flying geometry.



Jiranatee Associates Co., Ltd.  
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Mobile: +6683599453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TS1-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number
CL-017-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE

: Wind Direction Sensor  
: Novalyntx  
: Sensor: WS-02F  
: Data logger: 200-WS-25LB

## SERIAL NUMBER

: Sensor: -  
: Data logger: AS374

## ID NUMBER

: RYG\_F50412

## 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:

: 23.0 ± 3.0 °C  
: 55.0 ± 15.0 %RH  
: 1010 ± 10 hPa

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITION

: Wind tunnel cross-section area<sup>1</sup> 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 Thairakul  
☐ Miss Jitraporn Lertsomphol



## Approved signatory:

*[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

## Remarks:

<sup>1</sup> Nozzle 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 "a"/"b"

**Calibration procedure:**  
The wind direction sensor was calibrated against Standard Rotary Encoder, model: A1400975-DNA09-03-U-01 in an close test-section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WS-02F based on IEC 61400-12-1. Wind energy generation system - 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 0063-22

**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

Certificate Number
CL-017-66

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 counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D <sub>1m</sub> Degree (°)	D <sub>2m</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.000	87	-3	0.74
4.98	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

#### 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\*\*\*

#### 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. : 1607009  
 Correction Factor (Y) : 1.0000  
 Next Calibration Date : 9-Jun-24

ΔH (mm H <sub>2</sub> O)	Θ Minutes	Reference Dry Gas Meter Calibration						Console Control Drygas Meter						Dry Gas Meter Correction Factor (V)	Office Calibration Factor ΔH <sub>g</sub>
		V <sub>1</sub> (L/min)			T <sub>1</sub>			V <sub>m</sub> (L/min)			T <sub>m</sub>				
		Final	Initial	Total	Final	Initial	Total	Final	Initial	Total	Final	Initial	Total		
15	11.62	150.00	0.00	150.00	31.0	150.00	31.0	60227.0	60232.0	145.00	30.0	30.0	30.0	1.0296	41.9111
25	9.01	150.00	0.00	150.00	31.0	150.00	31.0	60236.6	60241.0	145.00	30.0	30.0	30.0	1.0293	41.9907
50	6.38	150.00	0.00	150.00	31.0	150.00	31.0	60259.0	60264.0	145.00	31.0	31.0	31.0	1.0286	41.9765
80	5.94	150.00	0.00	150.00	31.0	150.00	31.0	60266.8	60271.0	145.00	31.0	31.0	31.0	1.0288	41.9727
120	4.12	150.00	0.00	150.00	31.0	150.00	31.0	60361.2	60371.0	146.20	31.0	31.0	31.0	1.0141	42.0117
														1.0237	41.9818

Y Ratio of reading of reference to dry gas meter; tolerance for individual values ± 0.02 from average.

ΔHg - Office pressure differential that equates to 21.24 m of air @ 25°C and 760 mm of mercury; tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 60 APP A, METH. SEC 5.3 & 7

Calibrated by: Saksit Phaisanphit

(Mr. Saksit Phaisanphit)

RYG Field Services Scientist(4)

Approved by: Nattapon Jangwareewong

(Mr. Nattapon Jangwareewong)

RYG Field Services Specialist(1)

FORM NO. F-06-027 REVISION NO. 2 ISSUE DATE: 30-Jun-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. : E18061  
 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	5:00:09	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	

#### 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_FS1144			
Serial No. : 2010900000103					
Model : XC-572-V		Model : Digicon-CC-VT-MS			
Next Calibrate : 14 Aug 24					
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	300	0	±3	Pass
Probe	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	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: Nattapon Jangwareewong  
 Mr. Nattapon Jangwareewong  
 RYG Field Service Specialist (1)

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

Approved by: Nattapon Jangwareewong  
 (Mr. Nattapon Jangwareewong)  
 RYG Field Services Specialist (1)

FORM NO.: F-06-027 REVISION NO.: 2 ISSUE DATE: 16/2/23



# PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

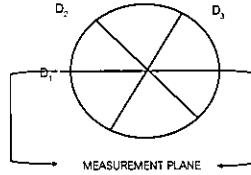
Calibration Date : 31 Jan 24			Nozzle Set ID : BKK_FS0533		
Calibration Sheet No. : C-310124-BKK_FS0533			Vernier Caliper ID : BKK_FS1123		
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	ΔD	D <sub>avg</sub>
1	0.316	0.318	0.316	0.002	0.317
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

(Mr. Saksit Phaisanphit)  
Field Scientist (4)

Approved by : Nattapon Jangwareewong

(Mr. Nattapon Jangwareewong)  
Field Specialist (1)

RYG FIELD SERVICE SPECIALIST (1) (Mr. Nattapon Jangwareewong) (Date: 31 Jan 24)



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration Date : 9-Jan-24	Barometric Pressure (mmHg) : 754.7
Next Cal. Date : 9-Jul-24	Relative Humidity (%) : 55.0
	Temperature (°C) : 27.2
Reference Dry Gas Meter Data	
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) : 0.9924
Model No. : XC-572-V	Next Calibration Date : 7-Nov-24

RODENT NO.	$\Delta H$ (mm-H <sub>2</sub> O)	$\Theta$ Radians	Reference Dry Gas Meter Calibration					Console Control Dry Gas Meter					Dry Gas Meter Correction Factor	Office Calibration Factor $\Delta H$	
			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	Total	Avg	Final	Initial	Total	Total	Avg			
	15	11.57	150.00	0.00	150.00	30.0	551624.6	551624.6	150.50	30.0	30.0	30.0	0.9781	41.5569	
	25	9.00	150.00	0.00	150.00	31.0	551843.8	551843.8	149.80	30.0	30.0	30.0	0.9781	41.8647	
	50	6.36	150.00	0.00	150.00	31.0	552544.6	552544.6	148.60	30.0	30.0	30.0	0.9836	41.8126	
	80	5.02	150.00	0.00	150.00	31.0	552196.2	552196.2	149.20	29.0	29.0	29.0	0.9692	41.8173	
	120	4.11	150.00	0.00	150.00	30.0	552376.6	552376.6	147.60	28.0	28.0	28.0	0.9603	41.9805	
														41.8716	

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

ΔAvg. Office pressure differential; net squares to 71.24 in. of air @ 25°C and 760 mm of mercury;  $\pm 0.0130$  tolerance for individual values  $\pm 5.08$  from average.

Procedure: 40 CFR 60 APP A METH SEC 5.3 & 7

Calibrated by : Saksit Phaisanphit

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

Approved by :

Nattapon Jangwareewong  
(Mr. Nattapon Jangwareewong)  
RYG Field Service Specialist (1)

FORM NO. : F 68-027 REVISION NO. : 2 ISSUE DATE : 30 Jan 22



## Stopwatch Calibration Test Report

Calibration Date : 9 Jan 24	Next Cal. Date : 9 Jul 24
Barometric Pressure (mmHg) : 764.7	Temperature (°C) : 27.2
Relative Humidity (%) : 55.0	

### Reference Stopwatch Data

Stopwatch ID No. : E18061
Model : F808
Serial No. : -
Calibration Date : 8 Sep 20
Certificate No. : E-2009018

### Console Control Meter Data

Dry Gas Meter No. : BKK_FS518
Model : XC-572-V
Serial No. : 1504025

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	5:00:09	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

Mr. Saksit Phaisanphit

RYG Field Service Scientist (4)

Approved by :

Nattapon Jangwareewong

Mr. Nattapon Jangwareewong

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_FS0519		Reference Temperature ID : RYG_FS0081			
Serial No. : 1504026		Serial No. : 201006014918			
Model : XC-572-V		Model : Digicon-CG-VT-M8			
		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
Probe	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	500	0	±3	Pass
	100	100	0	±3	Pass
Oven	120	120	0	±3	Pass
	140	140	0	±3	Pass
	100	100	0	±3	Pass
Filter	120	120	0	±3	Pass
	140	140	0	±3	Pass
	100	100	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	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

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดของเครื่องมือวัด

Calibrated by : Saksit Phaisanphit

Mr. Saksit Phaisanphit

RYG Field Service Scientist (4)

Approved by :

Nattapon Jangwareewong

Mr. Nattapon Jangwareewong

RYG Field Service Specialist (1)

FORM NO. : F 68-027 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

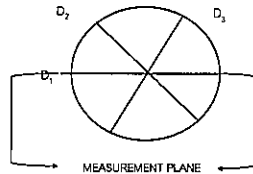
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo $\Delta D$	$(D_1 + D_2 + D_3) / 3$ $D_{avg}$
	$D_1$	$D_2$	$D_3$		
1	0.318	0.318	0.318	0.000	0.318
2	0.472	0.474	0.475	0.003	0.474
3	0.632	0.635	0.634	0.003	0.634
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.091	1.110	1.092	0.019	1.098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

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

Approved by : Nattapong Jengwareewong

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

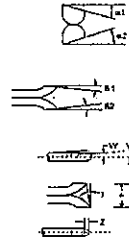
FORM NO. : F 06-124 REVISION NO. : 0 ISSUE DATE : 25/12/23



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
B1	-2.0	$-5^\circ < B1 < +5^\circ$	OK
B2	1.3	$-5^\circ < B2 < +5^\circ$	OK
y	0.3	-	-
B	0.2	-	-
$Z = A \tan y$	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 Phaisanphitsut  
( Mr. Saksit Phaisanphitsut )  
RYG Field Services Scientist (4)

Approved By : Nattapong Jengwareewong  
( Mr. Nattapong Jengwareewong )  
RYG Field Services Specialist (1)

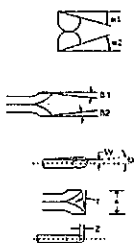
FORM NO. : F 06-124 REVISION NO. : 0 ISSUE DATE : 25/12/23



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
B1	-1.2	$-5^\circ < B1 < +5^\circ$	OK
B2	-1.6	$-5^\circ < B2 < +5^\circ$	OK
y	-1.1	-	-
B	0.2	-	-
$Z = A \tan y$	-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 Phaisanphitsut  
( Mr. Saksit Phaisanphitsut )  
RYG Field Services Scientist (4)

Approved By : Nattapong Jengwareewong  
( Mr. Nattapong Jengwareewong )  
RYG Field Services Specialist (1)



Calibration Certificate



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

Instrument description : Fuel Gas Analyzer  
Instrument model : Testo 350 New  
Control unit serial no. : 03580098/1121  
Instrument serial no. : 6285047/1121  
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 40, 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, 701.9 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 Nigamwongwan 47 Yaek 48, Toongsonghong, Laksa, Bangkok 10210

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 not valid 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

REVIEW BY : Handover P  
APPROVED BY : Handover P  
NEXT CAL. DATE : 25/1/26

Kwanchoi K  
Mr. Kwanchoi Khamdoung  
Calibration Technician

D. Wuttit  
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	Nimk	18-Nov-26
Oxygen (O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimk	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimk	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	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	3240/21	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	Nimk	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	23-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	9.92	-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 : Fuel 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, Toongsongphong, 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 not valid 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 : 24-Apr-24

*Kwanchai Khamdang*  
Mr. Kwanchai Khamdang  
Calibration Technician

*Mrs. Nongluck Wongsettee*  
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	Nimk	18-Nov-26
Oxygen (O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimk	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimk	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	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> ) 81.32 ppm	3546/23	Linde	14-Jan-26
Nitrogen Dioxide (NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nimk	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 : 1008.6 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





MS-1151-15 3703  
CALIBRATION 0426

SARTORIUS

# Certificate of Calibration

REVIEW BY: Thawit  
APPROVED BY: [Signature]  
NEXT CAL. DATE: 02/02/2025

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)  
618/10 Moo 5 T.Maenam Khu. A.Pluek Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)  
618/10 Moo 5 T.Maenam Khu. A.Pluek Daeng, Rayong 21140, Thailand.

Calibrated By: Mr.Chonchal Intirhana  
Calibration Date: Thursday, February 22, 2024

Calibration Procedure No.: This calibration was conducted by Using in-house calibration procedure number (VI-003) Based on UKAS LAB 14 : 2019

Metrological data :  
Capacity: 220 g Readability: 0.0001 g

Ambients Conditions:  
Temperature: 23.7 °C ± 5.0 °C  
Humidity: 62.0 % RH ± 10.0 % RH  
Pressure:  ±

Reasons for calibration  
☐ New Installation ☐ Service / Repair ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

## Measurement Method UKAS Publication Ref :Lab 14

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

### Traceability:

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

[Signature]  
Mr.chonchal Intirhana(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 results under constant test conditions when the same load within a measurement range is placed repeatedly on its weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the reading of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R113).		
Nominal Value : (Low Load)	20.0000	200.0001	Nominal value :	100	9
20 g	20.0000	200.0000	Tolerance	0.0004	9
Tolerance	0.0001 g	0.0001 g	Difference		
	20.0000	200.0001	1		
	20.0000	200.0001	2	0.0000	
Nominal Value : (High Load)	20.0000	200.0001	3	-0.0001	
200 g	19.9999	200.0001	4	0.0000	
Tolerance	0.0001 g	0.0001 g	5	0.0001	
	20.0000	200.0000	6		
	20.0000	200.0001			
Standard Deviation	0.00005	0.00005			

## Linearity

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

Tolerance 0.0002 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (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. 2443955-1

## ANALYZER CALIBRATION DATA

Client: Gulf T83 Co., Ltd. Location: Udab HRSG 11  
Date: 28 May 24 Test Operator: Sakait P.

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.01	0.00	0.04
Low-Level Gas	8.00	7.99	8.00	0.04
Span Gas	16.00	15.99	16.00	0.04

NO<sub>2</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	0.05	0.01	0.02
Low-Level Gas	82.39	82.44	82.40	0.02
Span Gas	164.40	164.45	164.41	0.02

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.03	-0.01	0.01
Low-Level Gas	76.75	76.72	76.74	0.01
Span Gas	159.80	159.87	159.89	0.01

CO ANALYZER  
Model: TELEDYNE API 300EM Serial No.: 451  
Span (ppm): 500

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.05	-0.01	0.01
Low-Level Gas	78.48	78.43	78.47	0.01
Span Gas	407.40	407.35	407.38	0.01

Calibrated by

Sakait P.

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



Lot No. 2443955-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: Gulf T83 Co., Ltd. Location: Udab HRSG 11  
Date: 28 May 24 Test Operator: Sakait 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	-0.01	-0.01	0.00	0.00	0.04	0.04
Upscale Gas	15.99	15.99	0.00	16.00	0.04	0.04

NO<sub>2</sub> ANALYZER  
Cylinder Conc. (ppm): 164.40 Span (ppm): 200

	NO <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	0.05	0.05	0.00	0.01	0.02	0.02
Upscale Gas	164.45	164.45	0.00	164.41	0.02	0.02

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

	SO <sub>2</sub> Analyzer Calibration Response	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	0.01	0.01
Upscale Gas	159.87	159.87	0.00	159.89	0.01	0.01

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

Sakait P.

(Mr.Sakait Phaisanphit)

Environmental Field Scientist (4)



## EMISSION TEST RESULT

Client	Gulf TSS Co., Ltd.	Run #	1
Date	20 May 24	Location	Slábe HRSG 11
Start Time	13:20	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:40
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
13:20	14.08	3.56	15.99	0.30	0.05	
13:21	14.05	3.90	15.27	0.40	0.04	
13:22	14.09	3.58	15.19	0.40	0.10	
13:23	14.07	3.55	15.33	0.40	0.06	
13:24	14.08	3.58	15.05	0.40	0.10	
13:25	14.11	3.50	15.10	0.40	0.07	
13:26	14.11	3.50	15.11	0.40	0.05	
13:27	14.10	3.57	15.00	0.40	0.03	
13:28	14.08	3.59	15.54	0.39	0.09	
13:29	14.07	3.59	15.39	0.38	0.04	
13:30	14.07	3.59	15.54	0.47	0.05	
13:31	14.08	3.59	15.59	0.47	0.11	
13:32	14.10	3.58	15.07	0.47	0.10	
13:33	14.09	3.57	15.59	0.40	0.12	
13:34	14.07	3.58	15.51	0.45	0.07	
13:35	14.06	3.50	15.75	0.40	0.05	
13:36	14.08	3.58	15.78	0.45	0.05	
13:37	14.07	3.59	15.89	0.45	0.12	
13:38	14.07	3.57	15.03	0.44	0.10	
13:39	14.06	3.58	15.27	0.45	0.15	
13:40	14.08	3.58	15.39	0.44	0.12	
Average	14.08	3.55	15.53	0.43	0.08	

*Sakait P.*  
(Mr.Sakait Phaisanphut)

Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf TSS Co., Ltd.	Run #	2
Date	20 May 24	Location	Slábe HRSG 11
Start Time	13:41	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	14:01
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
13:41	14.10	3.88	15.41	0.44	0.12	
13:42	14.09	3.86	15.33	0.42	0.14	
13:43	14.09	3.89	15.24	0.43	0.12	
13:44	14.08	3.85	15.14	0.41	0.15	
13:45	14.08	3.89	15.13	0.41	0.12	
13:46	14.07	3.90	15.02	0.40	0.14	
13:47	14.05	3.90	15.93	0.41	0.15	
13:48	14.05	3.90	15.90	0.39	0.09	
13:49	14.05	3.90	15.85	0.40	0.15	
13:50	14.07	3.90	15.85	0.39	0.15	
13:51	14.07	3.90	15.87	0.39	0.15	
13:52	14.07	3.90	15.87	0.38	0.15	
13:53	14.07	3.90	15.82	0.38	0.15	
13:54	14.06	3.89	15.85	0.38	0.18	
13:55	14.05	3.88	15.07	0.37	0.27	
13:56	14.09	3.88	15.19	0.37	0.23	
13:57	14.09	3.89	15.13	0.36	0.25	
13:58	14.07	3.89	15.88	0.35	0.25	
13:59	14.07	3.89	15.90	0.35	0.21	
14:00	14.08	3.89	15.20	0.45	0.21	
14:01	14.10	3.85	15.23	0.44	0.23	
Average	14.07	3.85	15.83	0.40	0.18	

*Sakait P.*  
(Mr.Sakait Phaisanphut)

Environmental Field Scientist (4)

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## EMISSION TEST RESULT

Client	Gulf TSS Co., Ltd.	Run #	3
Date	20 May 24	Location	Slábe HRSG 11
Start Time	14:02	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	14:22
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
14:02	14.09	3.85	15.09	0.45	0.23	
14:03	14.07	3.89	15.83	0.45	0.27	
14:04	14.05	3.89	15.81	0.44	0.20	
14:05	14.05	3.90	15.85	0.43	0.19	
14:06	14.07	3.89	15.85	0.44	0.24	
14:07	14.08	3.89	15.83	0.43	0.19	
14:08	14.07	3.89	15.81	0.41	0.15	
14:09	14.09	3.88	15.88	0.40	0.21	
14:10	14.08	3.88	15.84	0.41	0.23	
14:11	14.08	3.89	15.87	0.42	0.19	
14:12	14.08	3.89	15.85	0.41	0.12	
14:13	14.07	3.89	15.83	0.39	0.14	
14:14	14.08	3.88	15.80	0.39	0.17	
14:15	14.09	3.85	15.83	0.40	0.19	
14:16	14.09	3.87	15.84	0.39	0.19	
14:17	14.10	3.88	15.85	0.38	0.24	
14:18	14.09	3.86	15.88	0.38	0.27	
14:19	14.08	3.90	15.13	0.38	0.22	
14:20	14.06	3.91	15.42	0.35	0.18	
14:21	14.09	3.89	15.39	0.37	0.20	
14:22	14.09	3.89	15.19	0.37	0.20	
Average	14.07	3.85	15.85	0.41	0.21	

*Sakait P.*  
(Mr.Sakait Phaisanphut)

Environmental Field Scientist (4)

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## ANALYZER CALIBRATION DATA

Lot No. 2443956-1

Client	Gulf TSS Co., Ltd.	Location	Slábe HRSG 12
Date	20 May 24	Test Operator	Sathaporn T.
O <sub>2</sub> ANALYZER			
Model	HORIBA PG-350	Serial No.	TDBARGKP
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	5.19	5.20	5.22	0.05
Span Gas	15.07	15.09	15.10	0.04

NO <sub>x</sub> ANALYZER			
Model	HORIBA PG-350	Serial No.	TDBARGKP
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	0.01
Low-Level Gas	54.95	54.85	54.85	0.09
Span Gas	82.51	82.50	82.48	0.02

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.09
Low-Level Gas	55.55	55.53	55.52	0.01
Span Gas	79.75	79.75	79.75	0.00

CO ANALYZER			
Model	HORIBA PG-350	Serial No.	TDBARGKP
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	54.84	54.83	54.81	0.02
Span Gas	79.74	79.73	79.71	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. 2443956-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: Gulf T83 Co., Ltd. Location: Jilae HRSG 12  
Date: 29 May 24 Test Operator: Sathaporn T.O<sub>2</sub> ANALYZER  
Cylinder Conc. (%): 18.07 Span (%): 25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00
Upscale Gas	18.09	18.12	0.12	0.14	0.20	0.20	0.05	0.05

NO<sub>2</sub> ANALYZER  
Cylinder Conc. (ppm): 82.51 Span (ppm): 100

	NO <sub>2</sub> Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.02	0.01	0.02	0.01	0.01	0.00	0.00
Upscale Gas	82.50	82.45	0.02	0.02	0.05	0.05	0.03	0.03

SO<sub>2</sub> ANALYZER  
Cylinder Conc. (ppm): 79.75 Span (ppm): 100

	SO <sub>2</sub> Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.02	0.01	0.02	0.01	0.01	0.00	0.00
Upscale Gas	79.75	79.72	0.03	0.03	0.03	0.03	0.00	0.00

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

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

Calibrated by

Sathaporn T.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-065 REVISION NO.: 4 ISSUE DATE: 18/01/24

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## EMISSION TEST RESULT

Client: Gulf T83 Co., Ltd. Location: Jilae HRSG 12  
Date: 29 May 24 Test Operator: Sathaporn T.  
Start Time: 10:20 Finish Time: 10:40  
SO<sub>2</sub> Analyzer Model: TELEDYNE API 100EH  
NO<sub>x</sub>/O<sub>2</sub> Analyzer Model: HORIBA PG-350  
CO/CO<sub>2</sub> Analyzer Model: HORIBA PG-350  
Run #: 1  
Serial No.: TDSARGKP  
Serial No.: TDSARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
10:20	13.77	3.87	12.13	0.54	0.48	
10:21	13.78	3.88	12.75	0.54	0.48	
10:22	13.76	3.87	11.70	0.55	0.48	
10:23	13.74	3.87	12.28	0.54	0.48	
10:24	13.73	3.88	11.60	0.55	0.48	
10:25	13.71	3.88	12.21	0.56	0.51	
10:26	13.71	3.88	12.21	0.54	0.48	
10:27	13.72	3.87	12.63	0.53	0.51	
10:28	13.72	3.87	11.98	0.54	0.51	
10:29	13.71	3.87	12.18	0.54	0.48	
10:30	13.72	3.87	12.99	0.54	0.48	
10:31	13.71	3.87	13.55	0.55	0.48	
10:32	13.72	3.87	12.48	0.55	0.48	
10:33	13.72	3.86	12.67	0.55	0.48	
10:34	13.72	3.86	13.17	0.56	0.51	
10:35	13.71	3.87	11.69	0.56	0.48	
10:36	13.69	3.88	12.20	0.56	0.48	
10:37	13.69	3.88	13.05	0.56	0.51	
10:38	13.69	3.87	12.80	0.56	0.51	
10:39	13.69	3.88	12.87	0.56	0.51	
10:40	13.69	3.88	13.03	0.55	0.48	
Average	13.71	3.87	12.53	0.55	0.48	

Sathaporn T.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-065 REVISION NO.: 1 ISSUE DATE: 18/01/24

ALS Laboratory Group

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## EMISSION TEST RESULT

Client: Gulf T83 Co., Ltd. Location: Jilae HRSG 12  
Date: 29 May 24 Test Operator: Sathaporn T.  
Start Time: 10:41 Finish Time: 11:01  
SO<sub>2</sub> Analyzer Model: TELEDYNE API 100EH  
NO<sub>x</sub>/O<sub>2</sub> Analyzer Model: HORIBA PG-350  
CO/CO<sub>2</sub> Analyzer Model: HORIBA PG-350  
Run #: 2  
Serial No.: TDSARGKP  
Serial No.: TDSARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
10:41	13.69	3.85	12.61	0.55	0.48	
10:42	13.69	3.87	13.45	0.55	0.51	
10:43	13.70	3.87	12.83	0.56	0.51	
10:44	13.69	3.87	12.81	0.55	0.51	
10:45	13.65	3.87	12.27	0.56	0.51	
10:46	13.65	3.87	12.47	0.56	0.51	
10:47	13.68	3.88	12.60	0.56	0.51	
10:48	13.70	3.88	12.27	0.57	0.51	
10:49	13.69	3.88	11.97	0.57	0.51	
10:50	13.70	3.88	13.44	0.57	0.51	
10:51	13.70	3.88	12.50	0.57	0.51	
10:52	13.68	3.88	13.57	0.57	0.51	
10:53	13.68	3.88	12.69	0.57	0.48	
10:54	13.69	3.87	13.35	0.58	0.48	
10:55	13.71	3.88	13.71	0.58	0.48	
10:56	13.65	3.88	12.18	0.58	0.48	
10:57	13.65	3.88	13.48	0.58	0.48	
10:58	13.64	3.89	13.45	0.58	0.51	
10:59	13.61	3.87	12.65	0.51	0.51	
11:00	13.65	3.88	13.84	0.55	0.51	
11:01	13.65	3.88	12.69	0.55	0.47	
Average	13.68	3.87	12.90	0.58	0.48	

Sathaporn T.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-065 REVISION NO.: 1 ISSUE DATE: 18/01/24

ALS Laboratory Group

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## EMISSION TEST RESULT

Client: Gulf T83 Co., Ltd. Location: Jilae HRSG 12  
Date: 29 May 24 Test Operator: Sathaporn T.  
Start Time: 11:02 Finish Time: 11:22  
SO<sub>2</sub> Analyzer Model: TELEDYNE API 100EH  
NO<sub>x</sub>/O<sub>2</sub> Analyzer Model: HORIBA PG-350  
CO/CO<sub>2</sub> Analyzer Model: HORIBA PG-350  
Run #: 3  
Serial No.: TDSARGKP  
Serial No.: TDSARGKP

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
11:02	13.68	3.87	13.17	0.55	0.51	
11:03	13.69	3.88	12.93	0.54	0.47	
11:04	13.70	3.88	13.45	0.54	0.47	
11:05	13.67	3.87	12.28	0.54	0.51	
11:06	13.67	3.87	13.16	0.54	0.51	
11:07	13.69	3.88	13.21	0.55	0.47	
11:08	13.65	3.87	12.53	0.55	0.51	
11:09	13.65	3.88	12.43	0.55	0.47	
11:10	13.67	3.87	12.04	0.55	0.44	
11:11	13.67	3.87	11.84	0.55	0.47	
11:12	13.69	3.87	13.42	0.53	0.47	
11:13	13.69	3.87	13.30	0.53	0.51	
11:14	13.68	3.88	12.29	0.53	0.47	
11:15	13.68	3.87	13.20	0.52	0.47	
11:16	13.69	3.88	12.78	0.52	0.47	
11:17	13.67	3.87	12.44	0.53	0.44	
11:18	13.65	3.88	12.89	0.54	0.51	
11:19	13.62	3.90	12.32	0.54	0.51	
11:20	13.65	3.88	13.38	0.55	0.51	
11:21	13.67	3.87	12.52	0.55	0.42	
11:22	13.65	3.86	12.85	0.56	0.47	
Average	13.67	3.87	12.76	0.54	0.48	

Sathaporn T.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-065 REVISION NO.: 1 ISSUE DATE: 18/01/24

ALS Laboratory Group

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## 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, 2030

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.

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, 02/11/2021
CARBON MONOXIDE	80.00 PPM	79.48 PPM	G1	+/- 0.6% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	82.38 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2021
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 15, 2024
NTRM	200610-15	C0733106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	C0708044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889139	C0323707	4.087 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet IS50 FTIR AUP2010245 CO	FTIR	Feb 03, 2022
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 10, 2022
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Jan 27, 2022
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Jan 20, 2022

Triad Data Available Upon Request

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



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: 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, 2029

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.

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	54.89 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14060753	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	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet IS50 FTIR AUP2010245 CO	FTIR	Feb 04, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:  
Gross Weight: 28.6 Kg  
Net Weight: 4.8 Kg



*Michael A. Fisher*  
Approved for Release

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## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E3HA0066  
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, 2029

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.

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	55.17 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	KAL004536	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	200610-50	CC733426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2025
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003838	97.59 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet IS50 FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicolet IS50 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: 160-402138465-1  
Cylinder Volume: 247.2 Cubic Feet  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 660  
Certification Date: Jul 15, 2021

Expiration Date: Jul 15, 2029

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.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	60.00 PPM	62.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	60.00 PPM	79.74 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	60.00 PPM	62.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	60.00 PPM	79.76 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	KAL004536	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	200610-50	CC733426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2025
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003838	97.59 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet IS50 FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicolet IS50 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 160-402138465-1

# CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E02N192E3HA0000 Reference Number: 82-401016725-1  
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-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
OXYGEN	8.000 %	8.003 %	G1	+/- 0.4% NIST Traceable	10/23/2017
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRMplus	09060208	CG263337	8.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 08, 2018
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Mettler MP4 610-C2-7VMJ041	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-12/031. 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

Approved for Release

Page 1 of 82-401016725-1

# CERTIFICATE OF ANALYSIS Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD  
Part Number: E02N184E3HA0001 Reference Number: 160-402830555-1  
Cylinder Number: GN0025835 Cylinder Volume: 250.0 CF  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG  
PGVP Number: A12023 Valve Outlet: 590  
Gas Code: O2,BALN Certification Date: Sep 05, 2023  
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-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. 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	Assay Date
OXYGEN	16.00 %	16.07 %	G1	+/- 0.4% NIST Traceable	09/05/2023
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010205	K061515	23.2 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-051 - 02	PARAMAGNETIC		Aug 16, 2023		

Triad Data Available Upon Request

NOTES: Gross Weight: 50.0 Kg  
Net Weight: 8.4 Kg



Approved for Release

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# CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E02N192E3HA0000 Reference Number: 160-401848144-1  
Cylinder Number: GN0025088 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-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
OXYGEN	8.000 %	8.186 %	G1	+/- 0.3% NIST Traceable	11/11/20
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010602	1D38055	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-051 - 02	PARAMAGNETIC		Oct 26, 2020		

Triad Data Available Upon Request

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



Approved for Release

Page 1 of 160-401848144-1

THE LINDE GROUP

**Linde**

# CERTIFICATE OF ANALYSIS

<b>Customer Details:</b> ALS Laboratory Group (Thailand)		<b>Production Order Number:</b> 90137389 <b>Material Number:</b> 557100-J-44 <b>Certification Date:</b> 24-Sep-2016 <b>Expiry Date:</b> 24-Sep-2024	
<b>Cylinder Description:</b> STEEL 47 L The measurement of this cylinder is traceable to SI through the reference standard which is traceable to Swiss National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/031 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%.		<b>Analyst:</b> THIRAT LOYRAT	
<b>Certificate Number:</b> 2857/16 <b>Cylinder Number:</b> 363075		<b>Approve:</b> SUKANYA KAMITHARAT	
<b>Nominal Cylinder Content:</b> 6.560 lit <b>Nominal Pressure:</b> 145.0 Bar		<b>To Re-Order Please Quote:</b> 557100-J-44	
<b>Valve Outlet:</b> CGA 590 BRASS			
<b>Comments:</b> It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig. Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component. Keep and use in well-ventilated and secure area.			

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Udon Ruit (Ludwig) d'In (Ludwig)

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## CERTIFICATE OF ANALYSIS

## Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	16.0 %	16.0 %	±0.15% relative	(2) I-PB-354	24-Sep-2016

## Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expired Date
Oxygen in Nitrogen	243625SG	25.08 ± 0.13 %	19-Aug-2017

## Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multigrain Calibration
Servomex 4106 O2 Analyzer	Paramagnetic	24-Sep-2016

Method of Analysis  
1. Gas Chromatograph  
2. Paramagnetic Oxygen Analyzer  
3. Electrochemical Oxygen Analyzer  
4. Electrochemical Moisture Analyzer  
5. Final Hydrocarbon Analyzer  
6. Other specified

Cylinder Number: 363675  
Production Order Number: 90137389

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

Page 2 of 2

บริษัท ลินด์ (ประเทศไทย) จำกัด (มหาชน)

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Linde (Thailand) Public Company Limited

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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 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 1
1/2 inch Brüel&Kjaer 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 1
1/2 inch Brüel&Kjaer 4180	1003.1	3.1	± 1.5	±1.0%

## 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 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 manual.

Calibrated by: Mr. Weerachai Deechaiyae

Approved by: Mr. Pichai Klaiyong

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

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.

FABL/MTC.002 Rev.4

Head Office  
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Office/Laboratory  
Soi 1C, 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  
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Office  
196 Phanomyethin Road, Chulachak, Bangkok 10900, Thailand  
Tel: (66) 0 2579 1121-30 ext. 5219, 5225, 5217 Fax: (66) 0 2579 8392  
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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 122037.

2. Measuring Amplifier Brüel&amp;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 PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N4106495.

7. Condenser Microphone B&amp;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.

FABL/MTC.002 Rev.5

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SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY

451-45/1 Sithiporn Road, Bangbunru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com

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Cert. No.: ACL24035

Pages: 1 of 8

## Calibration Certificate

Equipment: SOUND LEVEL METER  
Manufacturer: RION  
Model: NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00623394 / 198641 / 26422  
ID No.: RYG\_FS0619

Condition As Found: GOOD

Customer: ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWANG 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 Pisutapaisan

Approved by:

T. Petchurui  
(Thanakul Petchurui)

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

**SITHIPORN ASSOCIATES CO., LTD.**  
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Cert. No. : ACL24035  
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	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. Petch*

**SITHIPORN ASSOCIATES CO., LTD.**  
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Cert. No. : ACL24035  
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 )
14.6

**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	22.9

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

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

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

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Cert. No. : ACL24035  
Job No. : VC67AC0052  
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. : VC67AC0052  
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	0.0	±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

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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	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

*T. Petchur*

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Cert. No. : ACL24035  
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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

**10. Peak C sound level**

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

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

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Cert. No. : ACL24035  
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	89.5	-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*

**SITHIPORN ASSOCIATES CO., LTD.**  
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Cert. No. : ACL24033  
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 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.



**SITHIPORN ASSOCIATES CO., LTD.**  
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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 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. Petch.*

**SITHIPORN ASSOCIATES CO., LTD.**  
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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.*

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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.*

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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
Log	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**

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

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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, 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	136.2	-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*

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

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

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Cert. No. : ACL24093  
Job No. : VC67AC0058  
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	89.8	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**

451-451/1 Sirinthorn Rd, Bangbunmu, Bangkok 10700 THAILAND.  
Tel: 0-2435-8800 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 / Preamplifier NH-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,  
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 : 15 JUNE 2023  
Calibration Date : 20-22 JUNE 2023  
Date of Issue : 23 JUNE 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

REVIEW BY	<i>Nathakorn P</i>
APPROVED BY	<i>T. Petchur</i>
NEXT CAL DATE	20/6/24

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-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).

QF-TS12-04-04-020664

T. Petch.

## 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

QF-TS12-04-04-020664

T. Petch.

## 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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T. Petch.

## Continuation of Calibration Certificate

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

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch.

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 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
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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

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

11. Overload Indication

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

12. High level stability

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

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

End of Calibration Certificate

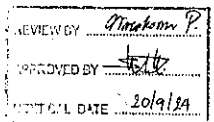
451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : 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 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

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

Received Date : 07 SEPTEMBER 2023  
Calibration Date : 20 SEPTEMBER 2023  
Date of Issue : 20 SEPTEMBER 2023

Calibrated by : Nathakorn Pisulpaisan

Approved by : T. Petchur  
( Thanakul Petchuraj )

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QF-TS12-04-04-020664

T. Petchur

QF-TS12-04-04-020664

## 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

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY451-451/7 Sirinthorn Road, Bangbunru, Bangkok, 10700 Thailand  
Tel : +66 2433 8331 Email : calibration@sithiporn.comSITHIPORN  
associatesCert. No. : ACL24090  
Pages : 1 of 3

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RUON  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00233183 / 144835 / 23230  
ID No. : RYG\_FS0024

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Peichurai )

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T. Petchur

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Tel : +66 2433 8331 Email : calibration@sithiporn.comSITHIPORN  
associatesCert. No. : ACL24090  
Job No. : VC67AC0058  
Pages : 2 of 3

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-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).

T. Petchur

**SITHIPORN ASSOCIATES CO., LTD.**  
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Cert. No. : ACL24090  
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

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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	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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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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)
18.3

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

Frequency Weighting	Measured value (dB)
A - weight	14.2
C - weight	20.0
Flat	25.6

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	0.3	0.3	0.3	±5.0

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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	74.1	0.1	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.2	0.2	± 1.1
28.0	28.3	0.3	± 1.1
27.0	27.3	0.3	± 1.1
26.0	26.4	0.4	± 1.1
25.0	25.4	0.4	± 1.1

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Cert. No. : ACL24099  
Job No. : VC67AC0058  
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## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, T <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>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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

*G. Petchur*Cert. No. : ACL24092  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00734220 / 145286 / 34371  
ID No.: RYG\_FS0026

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 Pisutpaisan

Approved by :

*G. Petchur*  
( Thankul 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.

Cert. No. : ACL24090  
Job No. : VC67AC0058  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

*G. Petchur*Cert. No. : ACL24092  
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-0069-23	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-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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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

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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	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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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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)
16.3

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

Frequency Weighting	Measured value (dB)
A - weight	13.4
C - weight	19.5
Flat	25.4

**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	0.3	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	2.3	2.3	2.3	±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	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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Pages : 7 of 8

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

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.6	-0.8	±3.0

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

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Cert. No. : ACL24095  
Pages : 1 of 9

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21  
Serial No.: 00376364 / 71486 / 23142  
ID No.: RYG\_FS0012

Condition As Found : GOOD

Customer : 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 Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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Cert. No. : ACL24092  
Job No. : VC67AC0058  
Pages : 8 of 8

**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

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Cert. No. : ACL24096  
Job No. : VC67AC0058  
Pages : 2 of 9

Calibration Procedure : CP-AC-02

**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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Job No. : VC67AC0058  
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**Summary of Measurement Result :**

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.1	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

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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	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.1	0.1	0.0	±2.0
4000	0.1	0.1	0.0	±3.0
8000	0.1	0.1	0.1	±5.0

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

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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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Job No. : VC67AC0058  
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**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.96)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
26.2

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

Frequency Weighting	Measured value (dB)
A - weight	22.9
C - weight	24.2
Flat	27.6

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	0.5	0.6	0.6	±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)
135.0	135.0	0.0	± 1.1
134.0	134.0	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

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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)
130	94.0	94.0	0.0	±1.1
120	94.0	94.0	0.0	±1.1
110	94.0	94.0	0.0	±1.1
100	94.0	94.0	0.0	±1.1
90	94.0	94.0	0.0	±1.1

**Level linearity on each level range**

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	41.6	41.9	0.3	±1.1
120	32.0	31.9	-0.1	±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

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**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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**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	130.0	130.0	0.0	±3.0
One	133.4	132.8	-0.6	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	130.0	130.0	0.0	±2.0
Positive half cycle	132.4	132.1	-0.3	±2.0
Negative half cycle	132.4	132.1	-0.3	±2.0

**11. Overload indication**

Measured value (dB)		Deviated Value	Acceptance Limits
Positive one-half cycle	Negative one-half cycle	(dB)	(dB)
89.3	89.3	0.0	±1.5

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Cert. No. : ACL24074  
Pages : 1 of 8

**Calibration Certificate**

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

**Condition As Found :** GOOD

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

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

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

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** *g. 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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Cert. No. : ACL24074  
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-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).

*7. Retain.*

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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)
17.0

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	22.7

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-1.4	-1.4	-1.3	±5.0

*7. Retain.*

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**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. Retain.*

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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	-0.1	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.1	0.0	±3.0
8000	0.1	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

*7. Retain.*

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## 7. Level linearity on the reference level range

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

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## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (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	133.1	0.1	± 2.0
Positive half cycle	135.4	135.2	-0.2	± 2.0
Negative half cycle	135.4	135.2	-0.2	± 2.0

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## 11. Overload Indication

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

## 12. High level stability

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

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

End of Calibration Certificate

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Cert. No. : ACL24076  
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## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00734221 / 157777 / 22653  
ID No. : RYG\_FS0027

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai  
( Thanakul Petchurai )

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T. Petchurai

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

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



Cert. No. : ACL24076  
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-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).

*7. Peter*

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Cert. No. : ACL24076  
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)
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	12.6
C - weight	18.9
Flat	24.7

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

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

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

*7. Peter*

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Cert. No. : ACL24076  
Job No. : VC67AC0054  
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**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	-0.1	-0.1	-0.1	±2.0
125	-0.1	0.0	-0.1	±1.5
250	-0.1	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

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

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	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. Peter*

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Cert. No. : ACL24076  
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	137.1	0.1	±1.1
136.0	136.1	0.1	±1.1
135.0	135.1	0.1	±1.1
134.0	134.1	0.1	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.1	0.1	±1.1
124.0	124.0	0.0	±1.1
119.0	119.1	0.1	±1.1
114.0	114.1	0.1	±1.1
109.0	109.0	0.0	±1.1
104.0	104.1	0.1	±1.1
99.0	99.1	0.1	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	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. Petchur*

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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	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

*T. Petchur*

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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		
89.6	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

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

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Cert. No. : ACL23263  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01122567 / 143473 / 22605  
ID No.: RYG\_FS0016

Condition As Found : GOOD

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

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

Received Date : 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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## Continuation of Calibration Certificate

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	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).

## Continuation of Calibration Certificate

Cert. No. : ACL23263  
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.

QF-TS12-04-04-020664

P. Petch...

## Continuation of Calibration Certificate

Cert. No. : ACL23263  
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)
15.4

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.3
Flat	24.2

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.0	-1.9	-1.9	±5.0

QF-TS12-04-04-020664

P. Petch...

## Continuation of Calibration Certificate

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

QF-TS12-04-04-020664

P. Petch...



## Continuation of Calibration Certificate

Cert. No. : ACL23263  
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	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

T. Petchurani

## Continuation of Calibration Certificate

Cert. No. : ACL23263  
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	128.1	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	136.1	-0.3	±3.0

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

QF-TS12-04-04-020664

T. Petchurani

## Continuation of Calibration Certificate

Cert. No. : ACL23263  
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	137.0	137.0	0.0	±0.3

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

End of Calibration Certificate

451-451/1 Sindhorn Road, Bangbunru, Bangkok, 10700 Thailand  
Tel. +66 2493 8331 Email: calibration@sithiporn.comCert. No. : ACL24081  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25  
Serial No. : 0120936 / 21737 / 22325  
ID No. : RYG\_FS0627

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 : Nathakorn Pisetpaisan

Approved by :

T. Petchurani  
( Thanakul Petchurani )

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**CALIBRATION LABORATORY**

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Cert. No. : ACL24081  
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-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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Cert. No. : ACL24081  
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)	94.0	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
13.4

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

Frequency Weighting	Measured value ( dB )
A - weight	8.7
C - weight	13.7
Flat	19.3

**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	0.2	0.3	0.3	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.4	0.5	0.5	+ 1.5, - 2.5

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**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	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

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**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	±1.0
125	0.1	0.1	0.0	±1.0
250	0.1	0.0	0.0	±1.0
500	0.1	0.1	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.1	+ 2.5, -16.0

**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	± 0.1

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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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.1	0.1	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	26.0	0.0	±0.8
25.0	24.9	-0.1	±0.8

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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±0.8

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.0; -3.0
	2	8	117.0	116.9	-0.1	1.0; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	107.9	-0.1	1.0; -3.0
	200	800	127.6	127.5	-0.1	±0.5
SEL	0.25	1	99.0	98.8	-0.2	1.0; -3.0
	2	8	108.0	107.9	-0.1	1.0; -1.5
	200	800	128.0	128.0	0.0	±0.5

**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	±2.0
One	136.4	136.1	-0.3	±2.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±1.0
Positive half cycle	135.4	135.1	-0.3	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

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**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

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Cert. No. : ACL24009  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623387 / 198634 / 26415  
ID No. : RYQ\_FS0612

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 DECEMBER 2023  
Calibration Date : 05-08 JANUARY 2024  
Date of Issue : 09 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurui*  
( Thanakul Petchurui )

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

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Cert. No. : ACL24009  
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-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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Job No. : VC67AC0044  
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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 )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.8
Flat	23.6

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.6	0.7	0.7	±5.0

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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

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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	0.1	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

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Job No. : VC67AC0044  
Pages : 6 of 8

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

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

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

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <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	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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**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. : ACL23321  
Pages : 1 of 8

**Calibration Certificate**

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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

*T. Petchur*

## Continuation of Calibration Certificate

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

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-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).

QF-TS12-04-04-020664

7. Return

## Continuation of Calibration Certificate

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

## Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

7. Return

## Continuation of Calibration Certificate

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

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.8

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

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

## 3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

7. Return

## Continuation of Calibration Certificate

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

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

7. Return

## Continuation of Calibration Certificate

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

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	135.6	-0.8	±3.0

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

QP-TS12-04-04-020664

7. Petchu...

SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok, 10700 Thailand  
Tel. +66 2433 8331 Email : calibration@sithiporn.comSITHIPORN  
associatesCert. No. : ACL24082  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-S2A / Microphone UC-59 / Preamplifier NH-25  
Serial No. : 01120937 / 21845 / 22326  
ID No. : RYG\_FS0628

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 : Nathakorn Pisutpaisan

Approved by :

7. Petchu...  
( 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. : ACL23321  
Job No. : VC67AC0011  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor  $k = 2$ 

or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QP-TS12-04-04-020664

7. Petchu...

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associatesCert. No. : ACL24082  
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 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.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).

7. Petchu...

**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	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

*T. Pithu.*

**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	±1.0
125	0.0	0.1	0.1	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.1	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.1	+ 2.5, -16.0

**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	± 0.1

*T. Pithu.*

**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	94.0	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	14.3
Flat	19.9

**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	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.4	0.5	0.5	+ 1.5, - 2.5

*T. Pithu.*

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	±0.8
136.0	136.0	0.0	±0.8
135.0	135.1	0.1	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	28.9	-0.1	±0.8
28.0	28.0	0.0	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

*T. Pithu.*



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Cert. No. : ACL24082  
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	±0.3

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	1.0; -3.0
	2	8	117.0	117.0	0.0	1.0; -1.5
	200	800	134.0	134.1	0.1	±0.5
Slow	2	8	108.0	108.0	0.0	1.0; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0; -3.0
	2	8	108.0	108.0	0.0	1.0; -1.5
	200	800	128.0	128.1	0.1	±0.5

10. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
One	136.4	136.4	0.0	±2.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±1.0
Positive half cycle	135.4	135.1	-0.3	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

7. Petchur

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Cert. No. : ACL24075  
Pages : 1 of 8

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 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 : Nathakorn Pisutpaisan

Approved by :

7. Petchur  
( Thunakul Petchur )

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CALIBRATION LABORATORY

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

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Cert. No. : ACL24082  
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	89.6	0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

7. Petchur

SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY

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

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associates



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	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).

7. 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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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
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	135.3	-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

*T. Petchur*

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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 / Preamplifier 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,  
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 JANUARY 2024  
**Calibration Date :** 25-26 JANUARY 2024  
**Date of Issue :** 29 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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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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Job No. : VC67AC0058  
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**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. : ACL24894  
Job No. : VC67AC0058  
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**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. : VC67AC0058  
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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	0.0	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*

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Job No. : VC67AC0058  
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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)
14.8

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*

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Job No. : VC67AC0058  
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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	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

*T. Petch*

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## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

## 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. Retin



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Web site : www.jiranae.com

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

Temperature measurement laboratory  
Calibration services department.



MSC-TIS-TIS 17025  
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Continuation of Certificate of Calibration Number CDT-030-67

Page 2 of 2 Pages

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-030-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor  
MANUFACTURER : Delta OHM  
MODEL/TYPE : HD32.2  
SERIAL NUMBER : 20032242  
ID NUMBER : RY6\_F50522  
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 : 25 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.

REVIEW BY : *Wanwan P*  
APPROVED BY : *J. Retin*  
NEXT CAL. DATE : 24/1/25

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

Traceability:  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).  
Certificate number: TT-0038-23, Certificate number: ER-0101-23

Reference Used During Calibration:  
1. Standard Temperature Probe Model: STS-100 AS00, Serial No.: 667682-05, Due date: 28 Mar 2024  
2. Digital Temperature Indicator Model: DTI-3000-A MK II, Serial No.: 671497-00591 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

### Functions:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 21001206.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.055	20.0	-0.1	0.099
80	25.051	25.0	-0.1	0.099
80	30.040	30.1	0.1	0.099
80	35.032	35.1	0.1	0.099
80	40.022	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001250.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.055	20.0	-0.1	0.099
110	25.051	25.1	0.0	0.099
110	30.040	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.023	40.1	0.1	0.099

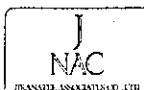
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001796.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.055	20.1	0.0	0.099
75	25.051	25.0	-0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.032	34.9	-0.1	0.099
75	40.023	39.8	-0.2	0.099

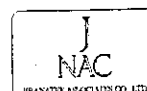
UUC: Unit Under Calibration

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

Calibrated by:  
☐ Mr. Sorwis Thachalad  
☐ Miss Jitraporn Lertsomphol  
☐ Miss Ruangrump Phoommit



Approved signatory: *[Signature]*  
Calibration Department Manager



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-023-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta DHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 22016387  
**ID NUMBER** : RYG\_F50277  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwang Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 11 Jan 2024  
**MEASUREMENT DATE** : 15 Jan 2024  
**ISSUE DATE** : 17 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 In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).  
Certificate number: TT-0038-23, Certificate number: ER-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS200, 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.

**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: 22025572.  
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.060	19.9	-0.2	0.099
80	25.051	24.9	-0.2	0.099
80	30.042	29.9	-0.1	0.099
80	35.035	34.9	-0.1	0.099
80	40.025	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001243.  
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.0	-0.1	0.099
110	25.051	25.0	-0.1	0.099
110	30.042	30.0	0.0	0.099
110	35.035	35.0	0.0	0.099
110	40.025	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 22025042.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.060	20.0	-0.1	0.099
75	25.051	24.9	-0.3	0.099
75	30.042	29.8	-0.3	0.099
75	35.035	34.7	-0.3	0.099
75	40.025	39.7	-0.3	0.099

UUC\*: Unit Under Calibration

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

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager



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

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-015-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta DHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006715  
**ID NUMBER** : RYG\_F50220  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwang Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 11 Jan 2024  
**MEASUREMENT DATE** : 11 Jan 2024  
**ISSUE DATE** : 17 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 In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).  
Certificate number: TT-0038-23, Certificate number: ER-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS200, 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.

**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: 17022563.  
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.060	20.0	0.0	0.099
80	25.042	25.0	0.0	0.099
80	30.040	30.0	0.0	0.099
80	35.034	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: 20019632.  
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.0	0.0	0.099
110	25.042	25.0	0.0	0.099
110	30.040	30.1	0.1	0.099
110	35.034	35.1	0.1	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: 15015507.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.060	20.2	0.2	0.099
75	25.042	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.034	35.0	0.0	0.099
75	40.026	39.9	-0.1	0.099

UUC\*: Unit Under Calibration

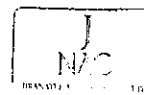
\*\*\*End of Certificate of Calibration\*\*\*

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager



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

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-017-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006718  
**ID NUMBER** : RYG\_F50223  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 13 Jan 2024  
**MEASUREMENT DATE** : 13 Jan 2024  
**ISSUE DATE** : 17 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.

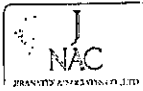
**Calibration procedure:**  
The temperature calibration was done by In-House calibration method as per WI-CI-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

**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: ER-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS00, 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

Approved signatory:   
Mr. Parinya Booncharoen  
Calibration Department Manager



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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009588.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	20.1	0.0	0.099
80	25.045	25.1	0.1	0.099
80	30.040	30.1	0.1	0.099
80	35.039	35.1	0.1	0.099
80	40.030	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20015638.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.1	0.1	0.14
110	25.045	25.2	0.2	0.099
110	30.040	30.3	0.3	0.099
110	35.039	35.3	0.3	0.099
110	40.030	40.3	0.3	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015456.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.053	20.2	0.1	0.099
75	25.045	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.039	34.9	-0.1	0.099
75	40.030	39.8	-0.2	0.099

UUC\*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.14, based on standard uncertainty multiplied by a coverage factor k=2.14 providing a level of confidence of approximately 95%.

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



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-057-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15006726  
**ID NUMBER** : RYG\_F50226  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 12 Feb 2024  
**MEASUREMENT DATE** : 16 Feb 2024  
**ISSUE DATE** : 20 Feb 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.

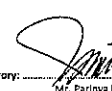
**TABULATION OF RESULTS:**  
The table on next page give the measured values.

**Calibration procedure:**  
The temperature calibration was done by In-House calibration method as per 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: ER-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 AS00, 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

Approved signatory:   
Mr. Parinya Booncharoen  
Calibration Department Manager



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**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 - 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15015841.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.054	20.0	-0.1	0.095
80	25.055	25.0	-0.1	0.099
80	30.041	30.0	0.0	0.099
80	35.032	35.0	0.0	0.099
80	40.018	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20008282.  
Dimension: Diameter 3.3 mm. Length 205 mm.

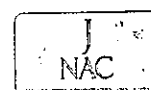
Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.0	-0.1	0.099
110	25.055	25.1	0.0	0.099
110	30.041	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.018	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015454.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.054	20.2	0.1	0.099
75	25.054	25.0	-0.1	0.099
75	30.041	29.9	-0.1	0.099
75	35.032	34.8	-0.2	0.099
75	40.018	39.7	-0.3	0.099

UUC\*: Unit Under Calibration

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



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-054-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta GHM  
**MODEL/TYPE** : HDS2.2  
**SERIAL NUMBER** : 15006713  
**ID NUMBER** : RYG\_F50218  
**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 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 per ISO 17025 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the International system of units (SI) through National Institute of Metrology Thailand (NIMT).  
Certificate number: TT-0038-23, Certificate number: ER-0103-23

**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 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: 22035270.  
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.064	20.1	0.0	0.099
80	25.053	25.1	0.0	0.099
80	30.043	30.1	0.1	0.099
80	35.033	35.1	0.1	0.099
80	40.018	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 22035462.  
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.064	20.1	0.0	0.099
110	25.053	25.1	0.1	0.16
110	30.043	30.2	0.2	0.099
110	35.033	35.2	0.2	0.099
110	40.018	40.2	0.2	0.099

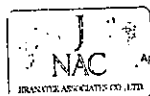
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015499.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.3	0.2	0.099
75	25.053	25.2	0.1	0.099
75	30.043	30.0	0.0	0.099
75	35.033	35.0	0.0	0.099
75	40.018	39.8	-0.2	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%.

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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



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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL: 0-2717-1000-24 FAX: 0-2719-9484



## Certificate of Calibration

Certificate No. : 23PH828  
Page : 1 of 2

Cert. No.: 23PH828  
Page: 2 of 2

**Equipment** : Lux Meter  
**Manufacturer** : PEAK METER  
**Model** : PM5612L  
**Serial No.** : H12A-D16324  
**ID No.** : RYG\_F50536  
**Condition As-Received:** Used Item  
**Received Date** : 27 November 2023  
**Calibration Date** : 28 November 2023  
**Reference** : 2311-0889WSC  
**Ambient Temperature** : ( 23 ± 2 ) °C  
**Relative Humidity** : ( 50 ± 15 ) %

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

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

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

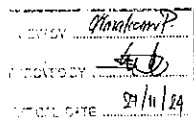
**Procedure used:** Calibration were conducted using calibration procedure No. CP-PH01 based on inverse square law technique.

### Condition of this result of calibration

1. Reference standards Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguko R,8 m	120RC003	DL-0004-22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1473	TP-1026-23	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. This 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: Nivat Nitas  
Issue Date : 30 November 2023

Approved Signatory :

[ ] Phalinoo Prabpalai  
[ ] Chatchawan Khunpluek  
[x] Nuntawal Khanchal

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

**Function** : Illuminance Measurement **Range** : Autorange

Standard Value	Before Adjust UUC* Reading	After Adjust UUC* Reading	Error	Uncertainty
( lx )	( lx )	( lx )	( lx )	( ± lx )
0	0.00	0.00	0.00	-
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	65

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

Before adjustment light source factor setting mode : L1 = 0.990

After adjustment light source factor setting mode : L1 = 1.284

UUC\* = Unit Under Calibration.

-000-





## Certificate of Calibration

Certificate No.: 24PH145  
Page: 1 of 2

Equipment: Lux Meter  
Manufacturer: Tenmars  
Model: TM-201L  
Serial No.: 190702490  
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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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

REVIEW BY: *[Signature]*  
APPROVED BY: *[Signature]*  
NEXT CAL. DATE: 13/3/25

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand

Procedure used: Calibration was 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 5.6 m	120RC003	DL-0084-22	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 request at the point specified by customer.

3. Test Equipment: Programmable Voltage/Current Source (Model: OL83A, SN: 16221394).

4. Test Equipment: Illuminance Meter (Model: S1002, SN: 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-ONSQ Accredited No. Calibration 0144

Calibrated by: Nivat Nitae  
Issue Date: 18 March 2024

Approved Signatory:

[ ] Phalinee Prabpaijai  
[ ] Wanlop Larkkom  
[x] Muntawat Khanchai

B 0337449



Cert. No.: 24PH145  
Page: 2 of 2

### Result of calibration:-

Function: Illuminance Measurement	Standard Value	UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(± lx)
	0	0.0	0.0	-
	20	20.1	0.1	0.28
	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	Standard Value	UUC* Reading	Error	Uncertainty
	(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	Standard Value	UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(± lx)
	2000	1990	-10	26
	3000	3000	0	39
	4000	4000	0	52
	5000	5000	0	65

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

UUC\* = Unit Under Calibration.

-000-

a 1206570



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.Maanam 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)

REVIEW BY: *[Signature]*  
APPROVED BY: *[Signature]*  
NEXT CAL. DATE: 24/07/24

Calibrated by: Warakorn Lemgagrakul

Approved by:

*[Signature]*  
Approved Signatory

( ) Malee Bulkruea  
(x) Sathip Meangmal  
( ) Warakorn Lemgagrakul  
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.



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	64030049	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-1835

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	Coverage factor
	pH	mV	mV	(± mV)	k
pH Meter	4.00	177.48	177	0.58	2.00
S/N.: C129171496	7.00	0.00	0	0.58	2.00
	10.00	-177.48	-177	0.58	2.00

#### Function: pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode	4.008	4.01	185	0.0078	2.00
S/N.: 3184175	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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*[Signature]*

A 0056655

a 1172154



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. Pivakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 25 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V  
Calibrated by : Preecha Hiahb  
Approved by :   
( ) Parnthippa Tameyakul  
( ) Mafee Butkruea  
(✓) Suwit Injal  
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053R17



Equipment : pH Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2307-0713DSC-4  
Procedure Used :-

Cert. No.: 23LM126  
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPT ) 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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate No.: 23E3924  
Page.: 1 of 2

## 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 : 14 December 2023  
Reference : 2312-0151DSC  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
Ambient Temperature : ( 23 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
616/10 Moo 5, T. Maenam Khu. A. Pivakdaeng,  
Rayong 21140, Thailand

Procedure used : Calibration were conducted using calibration procedure No. CP-E17 according to EURAMET eq-15.

### Condition of this result of calibration

#### 1. Reference standards instruments :

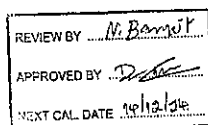
Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435802	EE-0041-23	26 Apr 2024

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 : Napachonok Prasomsosiri  
Issue Date : 15 December 2023

Approved Signatory :  
( ) Phalinee Prapalpal  
(✓) Nuntawat Khannachai  
( ) Pongsagorn Boonyaporn

n 0331106



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

Function: DC voltage measurement Range: 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (± μV)
-200.0000	-199.9	0.1	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	100.0	0.0	63
150.0000	150.0	0.0	65
200.0000	199.9	-0.1	68

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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Cert. No.: 23E3924  
Page.: 2 of 2

a 1193422



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23CH1574  
Page: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No. : B834291445  
ID No. : RYG\_EN0162  
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  
616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :   
Approved Signatory

( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul  
(x) 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 & Equipment Calibration and Testing Services.

A 0061696



Cert.No.: 23CH1574  
Page: 2 of 3

### Condition of this calibration result

#### 1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23B908	25 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 6.886	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940108	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 (±mV)	Coverage factor k
			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	4.013	184.1	0.0045	2.00
	6.886	6.988	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0088	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%.

-00-

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10510  
Tel: +66 2843 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS

## Certificate of Calibration

REVIEW BY:   
APPROVED BY:   
NEXT CAL. DATE: 21/02/2025

Model Number : MSE224S-100-DU  
Description : Analytical Balance  
Serial Number : 0026207038  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius  
Certificate No. : 24B10059  
Issued Date : Friday, February 23, 2024  
Reference No. : 229198  
Page No. : 1 of 2

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

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

Calibrated By : Mr. 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: 2016

Metrological data : Capacity : 220 g Readability : 0.0001 g  
Ambients Conditions : Temperature : 24.2 °C ± 5.0 °C  
Humidity : 57.0 % RH ± 10.0 % RH  
Pressure : ±

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

### Measurement Method UKAS Publication Ref : Lab 14

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

### Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	TCS	M2305197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.

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the prior written approval of the Verification Operation Division  
Sartorius (Thailand) Co., Ltd.

Mr. Chonchal Inthana (Technical Manager)



a 1193851

SOP FM 33 03 February 2022

# Certificate of Calibration

Model Number : MSE224S-100-DU  
Description : Analytical Balance  
Serial Number : 0026207038  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius

Certificate No. : 24BCI0059  
Issued Date : Friday, February 23, 2024  
Reference No. : 229196  
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 readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/2 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 EN 876).		
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	
0.0001 g	19.9999	200.0000	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



## 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)  
616/10 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 : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :  
( ) Pomthippa Tameyakul  
( ) Unnopphol Harachai  
(x) Suwit Imjai

Issue Date : 22 March 2024

The Uncertainties 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.: 24TM632  
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)

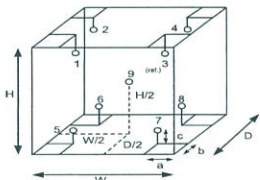
Result of Calibration : ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	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



Probe Installation Details : Dimension of Chamber :  
a = 5.0 cm D = 0.40 m  
b = 5.0 cm W = 0.56 m  
c = 5.0 cm H = 0.48 m  
Capacity = 0.11 m³



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.: 24TM632  
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 %.

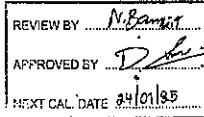
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Cert.No.: 23TW168  
Page.: 1 of 2

## 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  
618/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Laboratory Condition : Temperature (  $25 \pm 5$  ) °C  
Humidity (  $50 \pm 20$  ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
Tested by : Waleak Sirihean  
Approved by :   
Approved Signatory  
( ) Malee Butkruea  
(x) Sathip Meangmal  
( ) Warakorn 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	112G143764	140RC004	22MM50	20 Sep 2023

### 2. Standard Material :-

Material	Manufacturer	Lot No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study  
the system efficiency. The environmental impact control and present to organization it may concerned  
intend to use for advertising and referral purpose is prohibited. This report may not be reproduced  
other in full, without written approval of the laboratory

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B 0320211

a 1172155



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  
618/10 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 : (  $26 \pm 10$  ) °C  
Relative Humidity : (  $50 \pm 30$  ) %  
AC Line Voltage : (  $220 \pm 22$  ) V  
Calibrated by : Preacha Hahib  
Approved by :   
Approved Signatory  
( ) Pornthippa Temeyakul  
( ) Malee Butkruea  
(x) Suwit Imjai  
Issue Date : 31 July 2023



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

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

### Condition of this result of calibration

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2189080	221265	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.: 1226475367

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

UUC\* : Unit Under Calibration

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

-o0o-

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 0053616

a 1159515



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2  
Procedure Used :-

Cert. No.: 23TM962  
Page : 2 of 3

## Certificate of Calibration

Cert. No.: 23TM962  
Page : 1 of 3

Equipment : Low Temp. Incubator  
Manufacturer : Memmert  
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 ± 10) °C  
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpalboon

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Butkrua  
(x) Suwit Imjai

Issue Date : 7 June 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.

REVIEW BY   
APPROVED BY   
NEXT CAL. DATE 09/11/24

Calibration were conducted using calibration procedure GP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

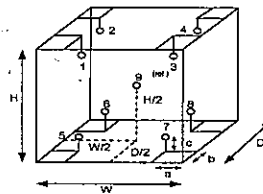
3. This certification is traceable to the International System of Unit.

Result of Calibration : ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °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 m³

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

A 0054967

a 1165130



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM962  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.115	0.30

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

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

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

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

UUC\* : Unit Under Calibration

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

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

-000-

a 1165129



## Certificate of Calibration

Cert. No.: 24TM634  
Page : 1 of 3

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 110  
Serial No. : B423.0853  
ID No. : RYG\_EN0213

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

Received Order : 21 March 2024  
Calibration Date : 21 - 22 March 2024  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpalboon

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Unnopphol Harachai  
(x) Suwit Imjai

Issue Date : 23 March 2024

REVIEW BY   
APPROVED BY   
NEXT CAL. DATE 21/03/25

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: Hot Air Oven  
Condition As-Received: Used Item  
Reference: 2403-0563OC-3

Cert. No.: 24TM634  
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.

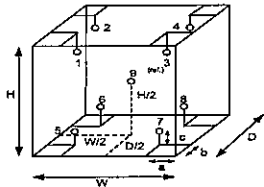
3. This certification is traceable to the International System of Unit.

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 = 0.66 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
REL.Humid. ( % )	59	59
AC Supply ( Volt )	224	223

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-3  
**Result of Calibration :-** ( " ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

Cert. No.: 24TM634  
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	0.065	0.52	0.90	2
180.0	180.0	180.0	0.20	1.2	2.0	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.999	180.127	180.138	180.895	179.313	180.211	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 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL.0-2717-3000-29 FAX.0-2719-9484



Equipment: Water Bath  
Condition As-Received: Used Item  
Reference: 2403-0563OC-4  
**Procedure Used :-**

Cert. No.: 24TM635  
Page: 2 of 3

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.

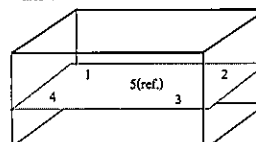
Remark: TPA : Technology Promotion Association (Thailand - Japan)

**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

**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)  
818/10 Moo 5, T. Maenam Khu,  
A. Piuakdaeng,  
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 Harachai  
(✓) Suwit Imjai

Issue Date: 23 March 2024

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 : 2403-0563OC-4  
 Result of Calibration : ( \* ) Without Adjustment  
 Function of UUC\* : Temperature Source

Cert. No.: 24TM635  
 Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )					Uncertainty ( ± °C )
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.428	84.424	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 temperatures at any one probe.  
**UUC\*** : Unit Under Calibration  
**Note** : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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## 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@sog.com

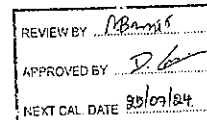


Certificate No. T230116

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber ( Cooling Room )  
 Manufacturer : MODULAR  
 Model : IREVCORCOO  
 Serial No. : C00351459  
 Customer Code : RYG\_EN0184  
 ID No. : T1939A5  
 Customer : ALS Laboratory Group (Thailand) Co.,Ltd. ( Rayong Branch )  
 616/10 Moo 5 T.Maenam Khu,  
 A.Pluakdaeng, Rayong 21140  
 Customer Location : Laboratory  
 Date of Receipt : 23 January 2023  
 Calibrated By : Atiphong Rongrat ( Technician )  
 Approved By : Boonchai Suriyawong (Site Calibration Manager)  
 07 FEB 2023  
 Date of Issue :



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.

TM-L14118/31-05-64



## Metrological Center

SCI ECO Services Company Limited

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



Certificate No. T230116

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )  
 Date of Calibration : 25 January 2023  
 Environment : Temperature : 23.4-24.9 °C  
 Line Voltage : 221.4-230.2 V  
 Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ).  
 All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244 ).

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant : 1 Hour - Minute At 3 °C  
 Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

Approved By: Boonchai Suriyawong



## Metrological Center

SCI ECO Services Company Limited

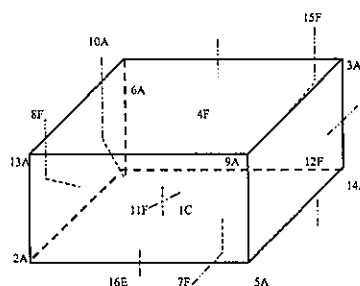
33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.



Certificate No. T230116

Page 3 of 4

## Calibration Report



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

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

Approved By: Boonchai Suriyawong





Certificate No. T230116

Page 4 of 4

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24	3.34
	TN153	TN154	TN155	TN156								
	3.28	3.22	3.28	3.21								

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (°C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max				
3.0	2.8, 4.1	3.5	1.20	1.20	1.90	2.07

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By:



## 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)  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.

Environment Condition: Temperature 23.9 °C ± 0.2  
Humidity 65.3 %RH ± 1.4

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.Nattapat Rungruang  
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 Stama 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. Nattapat Rungruang)  
Person in charge

(Mr. Nithun Srihawan)  
Authorized signatory

This certificate is issued under the authority of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.  
DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260  
Phone: +66 2639 1000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022



Certificate No.: C06230441 Page 2 of 3

### Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.81	418.3	0.31	0.13	
536.66	536.6	0.06	0.13	
637.98	636.3	-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
	0.2930	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2667	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
	0.2516	0.250	0.0018	0.0045
	0.4585	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	0.468	-0.0008	0.0045
	0.9468	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	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



Certificate No.: C06230441 Page 3 of 3

### Calibration Results: Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	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
	0.2864	0.290	-0.0036	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)	
260.62 +/- 0.11 nm	260.6	1.3	1.886	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	BBW
Standard Wavelength (nm )	268.66	268.69	1.38	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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## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขใบงาน: WO-0005382

## Certificate of Calibration

Represent to Certificate of Calibration No. C29240017

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000		หมายเลขเครื่อง: 1627845	
ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)	
18 Sep 2023		18 Sep 2023	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ
รายการตรวจเช็ค		หมายเหตุ	
General			
1. ความสมบูรณ์เครื่อง			
2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)			
3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)			
4. ปุ่มกด (Keypad)			
5. หน้าจอ (Display, Screen Contrast)			
Spectrophotometer			
6. แบตเตอรี่สำรอง (Battery Backup) $\geq 2.5$ VDC			
7. ตัวควบคุมเลือกความยาวคลื่น (Wavelength Control)			
8. ความยาวคลื่น (Wavelength Check)			
9. แหล่งกำเนิดแสง (UV $< 3,000$ hour)			
10. แหล่งกำเนิดแสง (Visible $< 5,000$ hour)			
11. ช่องรีไซเคิลตัวอย่าง (Carousel Module)			
pH Meter and Conductivity Meter			
12. อิเล็กโทรด (Electrode and Connection Cable)			
13. ระดับสารละลายใน Electrode (Level KCl)			
14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)			
15. ขาตั้งอิเล็กโทรด (Stand)			
Turbidimeter			
16. ค่าความทึบที่ว่าง (No Sample)			
17. ระดับการส่องสว่างของแสง ( $\geq 2.5$ ไม่น้อย 3.0)			
Automatic Dilutor			
18. สภาวะ Piston Burettes			
19. Function Rinsing and Dosing			
20. ระบบท่อสายยางและอุปกรณ์ประกอบ			

เพิ่มสิ่งวัดแสงเข้า: \*656.1nm=656.1nm

\*488.0nm=485.5nm

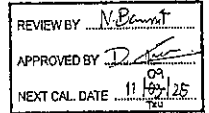
Mr.Nattapat Rungrueang  
Service Engineer

Equipment: Block Digestion Unit  
Model: KT-20s  
Serial No. (or ID.): 57201009/577020073  
Manufacturer: Gerhardt  
Condition: In Condition

Certificate No.: C29240011  
Issued Date: 22 March 2024  
Job No.: WO-00020429  
Page: 1 of 4  
Digestion Block: 20 holes.

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

Environment Condition: Temperature:  $25 \text{ }^{\circ}\text{C} \pm 0.7 \text{ }^{\circ}\text{C}$   
Humidity:  $54 \text{ \%RH} \pm 4.1 \text{ \%RH}$   
Voltage:  $225 \text{ VAC} \pm 1.7 \text{ VAC}$



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

(Mr. Thanathorn Phunook)

Person in charge

(Mr. Udon Srichana)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ( $k=2$ ) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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CAL-FM-C29-07: 20 Jul 2022

Certificate No.: C29240011

Page: 2 of 4

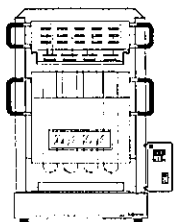
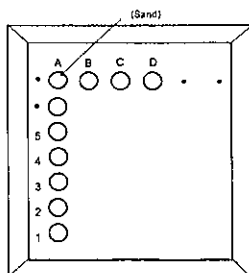


Fig. 1.: Front view



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.

Certificate No.: C29240011

Page: 3 of 4

## Calibration Results:

## Pre Calibration

Locations	Desired ( $^{\circ}\text{C}$ )	Setting ( $^{\circ}\text{C}$ )	Indicating ( $^{\circ}\text{C}$ )	Measured Temperature ( $^{\circ}\text{C}$ )	Correction of UUC: ( $^{\circ}\text{C}$ )	Uncertainty ( $\pm \text{ }^{\circ}\text{C}$ )
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				397.9	17.9	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				397.6	17.6	1.5
D2				396.6	16.6	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

Certificate No.: C25240011

Page: 4 of 4

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	365	365	362.5	17.5	1.5
A2				362.4	17.4	1.5
A3				362.1	17.1	1.5
A4				379.7	14.7	1.5
A5				378.3	13.3	1.5
B1				380.1	15.1	1.5
B2				380.1	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				380.1	15.1	1.5
C2				380.1	15.1	1.5
C3				378.9	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)		รายการตรวจสอบ	ตรวจสอบ (ส่ง)		หมายเหตุ
11 Mar 2024			11 Mar 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อเสนอแนะ:

Mr. Thanathorn Phunook  
Service Engineer

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BKK\_EL0037

Agilent  
CrossLab  
From Insight to Discovery

## Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES  
Preventive Maintenance

REVIEW BY	<i>Thitima B.</i>
APPROVED BY	<i>Sirak K.M.</i>
NEXT CAL. DATE	11/02/2025

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.

Agilent 5100, 5110 Preventive Maintenance Checklist

Agilent  
CrossLab  
From Insight to Discovery

## 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 List section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of 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	G7010A / M716010005
Instrument System Site and Location	RLS Laboratory Group (Thailand) Co., LTD.

List System Component	Product Numbers	List the Serial Numbers of each Component
1	G7010A	M716010005
2	G7010A	A01544-0764
3	G7010A - 30201	5003 - 00159
4		
5		
6		
7		
8		
9		

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

## 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. *See 1.1.1*
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

## Preventive Maintenance Procedures

### Record Pre-PM Instrument performance

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

### Clean and inspect ICP-OES system

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

### Agilent Water Recirculator

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

### SPS 3 Auto Sampler

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

### SPS 4 Auto sampler

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

### AVS 4, 6, 7 Advanced Valve System

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

### ICP-OES adjustment

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

### Record Post-PM Instrument performance

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

### Restore Instrument

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

### Service Review

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

## Test Results

## Instrument Performance Test Results Table

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

Pre PM Sensitivity Check		Post PM Sensitivity Check		
Radial	Axial*	Radial	Axial*	
Zn 213.857 nm SRBR	1571.2	3444.3	1510.0	3421.8
Mn 257.610 nm SRBR	1556.1	11557.6	9346.5	11999.3
Al 396.152 nm SBR	2.1	15.0	5.1	10.3
K 766.491 nm SBR	5.3	64.0	5.6	92.2

\* 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
Mains Voltage	219.311 VAC	215.135 VAC
Mains Current	0.041 A	0.115 A
Instrument Temperature	11.9 °C	23.2 °C
RF Air Flow (sensor speed)	11.0 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	1.07 L/min
Water Inlet Temperature	22.5 °C	23.6 °C
Polychromator Temperature	35.0 °C	35.0 °C
OCD Temperature	-60.1 °C	-60.0 °C
Thermal Stabilizer	31.3 °C	34.6 °C
Argon Supply Pressure	616.44 kPa	551.70 kPa
Purge Gas Supply Pressure*1	610.41 kPa	574.30 kPa
Opton Gas Supply Pressure*1	— kPa	— kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	216.06 kPa
Plasma Gas Flow	No measurement	11.49 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1146.6 W
RF Supply Current	No measurement	9.64 A
RF Supply Voltage	No measurement	114.11 V

\*1 If option installed

## Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-G8014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-G8015	All	1
Agilent Cool Clear Coolant Fluid	S799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-G0136	All	1
Ar Inlet Filter	G8000-68002	All	1
High Capacity Ar Filter	G8010-G0189	Optional	—
Rotor seal for 6-7 port valve for AVS4/7	G8454-60002	G8454A/G8495	—
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	—
Rinse solution to rinse station 2.5mm id x 1m	G8410-E0123	SPS 4	1
Berb connector 2.5mm-1.5mm ID	G8410-E0124	SPS 4	1
PVC waste tubing 8mm od x 5mm id, 2m	G8410-E0122	SPS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	—
Z axis drive belt	5410047400	SPS 3	—
Peristaltic pump tubing, PVC SebaFlex, 3 bridged	3710049000	SPS 4	—

## Consumed Parts Reference

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

☒ Section Not Applicable.

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

## Signature Page

## Service Engineer Comments (optional)

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

## Service Verification

Service Request Number:

6006607534

Service Engineer Name:

Niklaus Ludwigsson

Service Engineer Signature:

Niklaus L.

Total number of pages in this document:

14

Date Service Completed:

Feb 24, 2024

Customer Name:

Customer Signature:



## Metrological Center

SCI ECO Services Company Limited

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

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

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



## Metrological Center

SCI ECO Services Company Limited

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


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

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

Certificate No. T231676

Page 1 of 6

### Certificate of Calibration

Equipment : HEATING BLOCK  
Manufacturer : Environmental Express  
Model : SC 196  
Serial No. : 6974CECW3285  
Customer Code : BKK\_EL0054  
ID No. : T5306A3  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
Khet Suan Luang, Bangkok 10250  
Customer Location : Acid Digestion Lab  
Date of Receipt : 13 September 2023  
Calibrated By : Sanep Musikawan (Site Calibration Manager)  
Approved By :  / Sujjar Nakkared (Site Calibration Manager)  
Date of Issue : 26 SEP 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L13 108/30-05-57

Certificate No. T231676

Page 2 of 6

### Calibration Report

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

#### Condition of this results of calibration :

- This equipment was calibrated by insert 20 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20.  
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS-90.
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024
- This certificate is traceable to :  
National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0244.)
- Condition of calibrated item : good  
Equipment Description :  
Time Constant : 2 Hour 20 Minute At 95 °C  
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :  
( ) without adjustment ( X ) after adjustment

Approved By: 



## Metrological Center

SCI ECO Services Company Limited

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

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

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



## Metrological Center

SCI ECO Services Company Limited

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

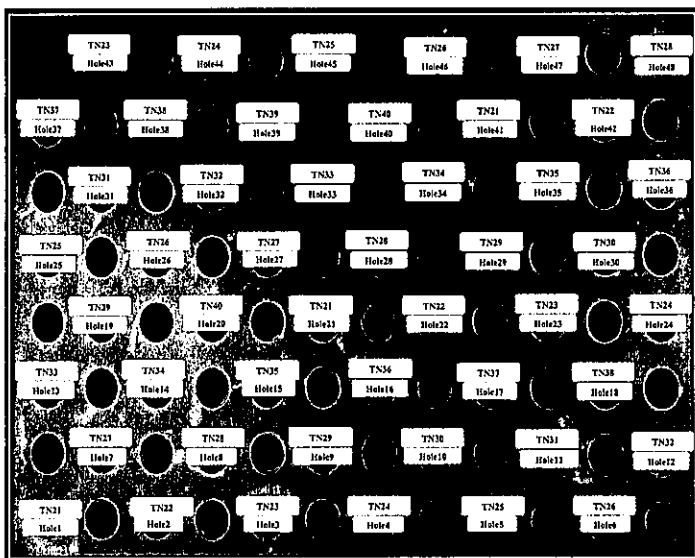
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

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

Certificate No. T231676

Page 3 of 6

### Calibration Report



FRONT CONTROL

Approved By: 

FM-L13 108/30-05-57

Certificate No T231676

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### Calibration Report

#### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51
95	Min	94.57	93.95	94.75	94.92	94.00
	Average	94.79	94.18	94.98	95.17	94.26
R2 Hole7-Hole12	TN27	TN28	TN29	TN30	TN31	TN32
	Max	95.36	95.43	95.19	95.16	95.35
	Min	94.54	94.95	94.72	94.71	94.90
	Average	95.15	95.19	94.96	94.94	95.13
R3 Hole13-Hole18	TN33	TN34	TN35	TN36	TN37	TN38
	Max	95.37	95.50	95.22	95.21	95.33
	Min	94.99	95.09	94.78	94.82	94.88
	Average	95.18	95.30	95.00	95.02	95.11
R4 Hole19-Hole24	TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.59	94.42	94.52	94.24	94.63
	Min	95.21	94.06	94.13	93.88	94.28
	Average	95.40	94.24	94.33	94.06	94.45
R5 Hole25-Hole30	TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.93	93.30	95.14
	Min	94.83	95.03	92.56	94.95	94.79
	Average	95.01	95.20	92.75	95.12	94.96
R6 Hole31-Hole36	TN31	TN32	TN33	TN34	TN35	TN36
	Max	94.63	94.90	94.77	94.31	94.24
	Min	94.24	94.55	94.44	93.98	93.92
	Average	94.43	94.72	94.60	94.14	94.08
R7 Hole37-Hole42	TN37	TN38	TN39	TN40	TN21	TN22
	Max	94.30	94.44	94.04	93.81	94.89
	Min	93.95	94.05	93.67	93.48	94.39
	Average	94.13	94.24	93.86	93.65	94.64
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	Max	95.99	95.63	95.28	95.29	95.45
	Min	95.57	95.15	94.82	94.84	94.99
	Average	95.78	95.39	95.05	95.07	95.22

Approved By: 

FM-L13 108/30-05-57



Certificate No T231676

Page 5 of 6

### Calibration Report

#### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44
	Min	104.94	103.95	105.15	105.04	104.11
	Average	105.09	104.13	105.29	105.15	104.28
R2 Hole7-Hole12	TN27	TN28	TN29	TN30	TN31	TN32
	Max	105.30	105.12	105.18	105.22	105.12
	Min	105.11	104.92	104.96	105.00	104.92
	Average	105.20	105.02	105.07	105.11	105.02
R3 Hole13-Hole18	TN33	TN34	TN35	TN36	TN37	TN38
	Max	105.37	105.63	105.62	104.80	104.69
	Min	105.17	105.37	104.75	104.59	104.50
	Average	105.27	105.50	104.88	104.69	104.60
R4 Hole19-Hole24	TN39	TN40	TN21	TN22	TN23	TN24
	Max	105.31	104.43	106.41	104.71	105.63
	Min	105.08	104.22	106.15	104.41	105.37
	Average	105.19	104.33	106.28	104.56	105.50
R5 Hole25-Hole30	TN25	TN26	TN27	TN28	TN29	TN30
	Max	104.95	106.26	103.34	105.78	105.59
	Min	104.67	105.96	103.08	105.56	105.36
	Average	104.81	106.11	103.21	105.67	105.48
R6 Hole31-Hole36	TN31	TN32	TN33	TN34	TN35	TN36
	Max	104.75	104.86	104.80	105.20	104.50
	Min	104.54	104.63	104.59	105.00	104.32
	Average	104.65	104.75	104.69	105.10	104.41
R7 Hole37-Hole42	TN37	TN38	TN39	TN40	TN21	TN22
	Max	104.30	104.90	104.85	104.65	104.88
	Min	104.09	104.72	104.66	104.49	104.63
	Average	104.19	104.81	104.75	104.57	104.76
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	Max	105.71	105.85	105.39	105.61	105.42
	Min	105.45	105.61	105.14	105.27	105.18
	Average	105.58	105.73	105.27	105.44	105.30

Approved By.

FM-L13 108/30-05-57

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### Calibration Report

#### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min, Max	Average		
100.0	100.3, 100.5	100.4	0.26	0.81
107.0	107.0, 107.1	107.1	0.19	0.78

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

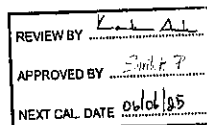


Certificate No. T232160

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### 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 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
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



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 119/18-08-66



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 :

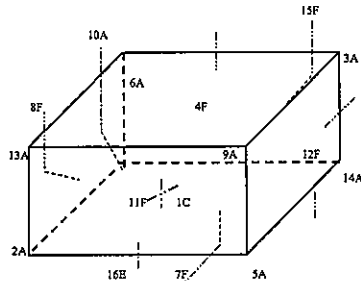
( X ) without adjustment ( ) after adjustment

Approved By.

FM-L15 118/18-08-66



## 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:

FM-L15 118/18-08-66

## 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
	TN173	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)
	Min, Max	Average				
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:

FM-L15 118/18-08-66

BKK\_EN0284

REVIEW BY: Autcharawan S.  
APPROVED BY: Tanyatayam M.  
NEXT CAL. DATE: 12 Jan 2025



## 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

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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 Patthanakam 40, Patthanakam Rd., Kwang Suan Luang, Khut 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 Sor  
NEXT CAL. DATE: 25 May 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: MM

Setpoint Status: Pass

Setpoint: 25.0 psi  
Actual: 24.9 psi

Accuracy: 0.1 psi

Agilent Recommended: &lt;= 1.2

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

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## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

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

## Overall GC Oven Temperature Stability Test Status

Pass

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

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## Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	70000			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			

## Overall Tune EI Test Status

Pass

## Scouting Run

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

## Overall Scouting Run Status

Completed

## Instrument Detection Limit

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

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

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Setpoint Status:	Pass		
Injection Volume on Column:	1.0		µL
Area	10.58		%
Agilent Recommended:	<= 12.00		
Status:	Pass		
Retention Time	0.05		%
Agilent Recommended:	<= 1.00		
Status:	Pass		
Instrument Detection Limit:	3.69552		fg
Agilent Recommended:	<= 4.03800		
Status:	Pass		

## Overall Instrument Detection Limit Test Status

Pass

## Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	7693A			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0			µL
Area Mass 1	3.22			%
Abundance's	<= 15.00			
RSD:	4.08			%
Agilent Recommended:	<= 5.00			
Status:	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	CN15170137
Firmware Revision	A.11.03
Vial Heater	Not Installed

## Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN16153080
Firmware Revision	B.02.05
Oven Type	Standard

## Inlet 1

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

## Inlet 2

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

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

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## 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	US1625U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

## MS EI Source 1

Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

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

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

## Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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System ID: GM-10

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User Name: nattapat.hengcharoen  
Host Name: ASB6R0K285

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

## ALS\_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:32:30 PM	Audit	Session Created	Session	None
May 22, 2023 1:32:30 PM	Start	Configuration	Session	None
May 22, 2023 1:32:30 PM	Audit	End Session	Session	User is Field Engineer and does not require an unlock code
May 22, 2023 1:37:45 PM	Audit	ExpLoaded	Session	EOP details for primary technique (GC) - File path: [Protocol/Passwd/Data/Config/low02 GC/GC-02.02.ecp], EOP File Name: [GC-02.02.ecp], EOP Name: [Agilent/Recommended/Protocol Revision] [GC-02.02] EOP details for hyphenated technique (GC/MS) - File path: [Protocol/Passwd/Data/Config/low02 GC/MS/GC-02.02.1.ecp], EOP File Name: [GC-02.02.1.ecp], EOP Name: [Agilent/Recommended]
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	CDS Logon Verification - GC : None - Qualitative test	
May 22, 2023 2:02:27 PM	Start	Execution	CDS Logon Verification - GC : None - Qualitative test	
May 22, 2023 2:02:33 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MH, TC - 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: naitapal.jangchanoen  
Hostname: ASBKKW0285  
ALS\_GM-10 Transaction log:

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

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:02:37 PM	Start	Execution	QC Logon Verification - GC : - Qualitative test	None
May 22, 2023 2:03:33 PM	End	Execution	QC Logon Verification - GC : - Qualitative test	Run Count: 1
May 22, 2023 2:34:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 : - Qualitative Test - No setpoints associated	None
May 22, 2023 2:35:02 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890 : - Qualitative Test - No setpoints associated	Run Count: 1
May 22, 2023 2:35:17 PM	Start	Execution	Inlet Pressure Accuracy - Front MFC - Pressure Controlled Inlet : - S: 25.0 psi - L: <= 1.2 psi	None
May 22, 2023 2:35:22 PM	End	Execution	Inlet Pressure Accuracy - Front MFC - Pressure Controlled Inlet : - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
May 22, 2023 2:35:24 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 250.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:35:48 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 250.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 22, 2023 2:35:54 PM	End	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 250.0°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: naitapal.jangchanoen  
Hostname: ASBKKW0285  
ALS\_GM-10 Transaction log:

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

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:38:55 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:58:06 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
May 22, 2023 3:08:09 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - Part of GCMS System Preparation	None
May 22, 2023 3:10:34 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
May 22, 2023 3:12:51 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - L (RSD): <= 5.00%	None
May 22, 2023 3:17:49 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:17:50 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:18:08 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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

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User Name: naitapal.jangchanoen  
Hostname: ASBKKW0285  
ALS\_GM-10 Transaction log:

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

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 3:18:07 PM	End	Execution	GC Oven Temperature Accuracy - 7890 : Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
May 22, 2023 3:39:07 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - Part of GCMS System Preparation	None
May 22, 2023 3:39:10 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
May 22, 2023 4:02:59 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
May 22, 2023 4:03:06 PM	Start	Execution	GC Oven Temperature Stability - 7890 : Temperature : Oven - S: 190.0°C - L: <= 0.5°C	None
May 22, 2023 4:03:52 PM	Audit	Data	GC Oven Temperature Stability - 7890 : Temperature : Oven - S: 190.0°C - L: <= 0.5°C	Manual Data Entry
May 22, 2023 4:03:54 PM	End	Execution	GC Oven Temperature Stability - 7890 : Temperature : Oven - S: 190.0°C - L: <= 0.5°C	Run Count: 1
May 23, 2023 5:30:15 PM	Audit	AccClosed	Session	None
May 24, 2023 4:03:19 PM	Audit	AccRestarted	Session	None
May 24, 2023 4:14:45 PM	Audit	AccClosed	Session	None
May 25, 2023 10:13:57 AM	Audit	AccRestarted	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: naitapal.jangchanoen  
Hostname: ASBKKW0285  
ALS\_GM-10 Transaction log:

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

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:27:13 AM	Start	Qualification	Session	DQ
May 25, 2023 10:27:16 AM	Start	Execution	Tune EI - 70000 TQ : - Source: - None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:42 AM	Start	Execution	Tune EI - 70000 TQ : - Source: - None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:58 AM	End	Execution	Tune EI - 70000 TQ : - Source: - Run Count: 1 EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 25, 2023 10:27:57 AM	Start	Execution	Tune EI - 70000 TQ : - Source: - None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
May 25, 2023 10:29:07 AM	End	Execution	Tune EI - 70000 TQ : - Source: - Run Count: 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
May 25, 2023 10:29:08 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - Part of GCMS System Preparation	None
May 25, 2023 10:29:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
May 25, 2023 10:28:29 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ : - Source: - EI - Extractor - Part of GCMS System Preparation	None

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

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User Name: nattapaLhengcharoen.  
Hostname: A3BKKW0264

System Id: OM-10  
Print Date: May 25, 2023 11:05:00 AM

**ALB\_QM.12 Transaction log :**

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:28:58 AM	Audit	Data	Scouting Run - Injection Tolerant, Front MMU, TID - Source - EI + Extraction Part of GCMS System Preparation	Data Base Path : D:\MassHunter\GCMS\Hdata\Agilent\CO_2023\NO_012
May 25, 2023 10:29:24 AM	End	Execution	Scouting Run - Injection Tolerant, Front MMU, TID - Source - EI + Extraction Part of GCMS System Preparation	Run Count : 1
May 25, 2023 10:29:25 AM	Start	Execution	Instrument Detection Limit - Injection Tolerant, Front MMU, TID - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	None
May 25, 2023 10:30:09 AM	Audit	Data	Instrument Detection Limit - Injection Tolerant, Front MMU, TID - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data Base Path : D:\MassHunter\GCMS\Hdata\Agilent\CO_2023\NO_012
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tolerant, Front MMU, TID - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data Base Path : D:\MassHunter\GCMS\Hdata\Agilent\CO_2023\NO_002
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tolerant, Front MMU, TID - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data Base Path : D:\MassHunter\GCMS\Hdata\Agilent\CO_2023\NO_003
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tolerant, Front MMU, TID - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data Base Path : D:\MassHunter\GCMS\Hdata\Agilent\CO_2023\NO_004

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

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User Name: natlapathengcharoen  
Host Name: 450.VICP.VCE

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

ALB-GM-10 Transaction Log:

Time	Transaction Status	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:04 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2055
May 25, 2023 10:30:20 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2061
May 25, 2023 10:30:30 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2067
May 25, 2023 10:30:50 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2073
May 25, 2023 10:31:00 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2079
May 25, 2023 10:31:10 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2085
May 25, 2023 10:31:20 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2091
May 25, 2023 10:31:31 AM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Data File Path: D:\MassData\GCMS\1User\AgilentGC_2023\MS_2100
May 25, 2023 10:30:18 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MIM, TG - Source - EI - Extractor - RSD L (Area) <= 12.00% - RSD L (Ret. Time) <= 1.00%	Run Count: 1

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Date: May 25, 2023 11:05:07 AM  
System ID: G14-10

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User Name: natipai.hengcharoen  
Hostname: a5hK0WY265

System Id: QM-10  
Print Date: May 24, 2023 11:55:03 AM

**ALS\_GM-10 Transmission log :**

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:22 AM	Start	Execution	Mass Rate Prediction - Injection	None Tower, Front MMU, TQ - Source: E1 - Extractor - L (RSID) - @ 5.00%
May 25, 2023 10:30:45 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_01_01 - @ 5.00%
May 25, 2023 10:30:49 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_02_01 - @ 5.00%
May 25, 2023 10:30:48 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_03_01 - @ 5.00%
May 25, 2023 10:30:49 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_04_01 - @ 5.00%
May 25, 2023 10:30:49 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_05_01 - @ 5.00%
May 25, 2023 10:30:48 AM	Auth	Data	Mass Rate Prediction - Injection	Data File Path : Tower, Front MMU, TQ - D:\Mass\Hunt\AQ\CSVs\1\data Source: E1 - Extractor - L (RSID) - VaghenAQO_2023\WAP_06_01 - @ 5.00%
May 25, 2023 10:30:57 AM	End	Execution	Mass Rate Prediction - Injection	Run Count : 1 Tower, Front MMU, TQ - Source: E1 - Extractor - L (RSID) - @ 5.00%
May 25, 2023 10:31:02 AM	End	Qualification	Session	OQ

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

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User Name: notapel.hengcharoen  
 Message: 3885510385

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

ALB 04-10 Transaction log 3

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 28, 2023 10:31:02 AM	Start	Reporting	Session	None
May 28, 2023 11:04:34 AM	Audit	Reporting	Session	Report Generated : C:\Reports

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Date: May 26, 2023 11:06:07 AM  
System ID: GM-10

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Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Siam Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-367/23  
Equipment UV/Vis Spectrophotometer  
Model UV-1800  
Manufacturer Shimadzu  
Serial No. A11454908533CD  
ID No. BKK\_EN0018  
Date of receipt 15 September 2023  
Date of calibration 15 September 2023  
Date of issue 22 September 2023

Number of Page(s) 1 of 3

REVIEW BY Satuk P.  
APPROVED BY LLAL  
NEXT CAL DATE 15/9/2024

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

Address 104 Soi Phatthanakan 40, Phatthanakan Road, Phatthanakan, Suan Luang, Bangkok 10250

Temperature (23.4 - 24.7) °C (On site)  
Humidity (55.5 - 61.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Prep

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  
Stray Light is traceable to certificate No. 95908  
(The above certificate are traceable to SI unit through Starra Scientific Ltd.  
UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janioey

Approved by

Mr. Kanchit Choothep  
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
except in full, without written approval of the Bara Scientific Co., Ltd.



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Siam 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	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.89	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

### 2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7460	-0.0007	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8646	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2908	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6429	0.6415	-0.0014	0.0075

\*CNR = Customer not request

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FM-UV-708-02 Rev 01 (2301/83)

BKK\_EL0043



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Siam 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) 3 of 3

Calibration Results:

### 3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5793	0.0010	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.0209	1.0216	0.0010	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5625	0.0004	0.0042
	0.7455	0.7452	-0.0003	0.0042
	0.9385	0.9389	0.0004	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.8487	0.8486	-0.0001	0.0042
540.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9959	0.9944	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7253	0.7236	-0.0017	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5612	-0.0004	0.0042
	0.6927	0.6908	-0.0018	0.0042
	1.0581	1.0566	-0.0015	0.0042

\*CNR = Customer not request

### 4. Stray Light\*

Standard cut-off wavelength (nm)	Wavelength (nm)	Transmission (%)	Absorbance (A)
200 95±0.1 nm	200.55	0.9770	2.0104

The Stray light transmission reference is less than 1.04% and Stray light absorbance reference is greater than 2.00A  
\*Stray Light not NSC-ONSC Accredited.

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

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

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Agilent Technologies (Thailand) Limited  
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968 RAMA 4 ROAD, SIAM, BANGKOK  
Bangkok 10500 Thailand

Tel: +662 637 6363  
Fax: +662 632 4334  
Email: ccc-sm@agilent.com  
Website: www.agilent.com/tham

### Customer Contact

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan  
TAX ID : 0105540004859  
bounced:incom.chanattagarn@alsglobal.com  
227158760519

### Invoice To:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

### Delivery Site:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

### Location:

Room  
Bldg  
Lab  
Dept

### SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 600066207	Service Confirmation: 6904837529

REVIEW BY Archalee K.  
APPROVED BY Sun-L N  
NEXT CAL DATE 01/10/2024

### Direct Inquiries to:

Contact Name: Customer Contact Center  
Contact Email: ccc-sm@agilent.com  
Contact Telephone: +662 637 6363  
Contact Fax: +662 632 4334

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Bangkok 10500 Thailand  
Tax ID: 0105540004859

Chubank N.A. Bangkok Branch  
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Act. No. 012-4452-907  
THD Krung Thai Bank PCL  
Siam Square Bldg. 116/1-2 Rama 1 Rd, Pathumwan, BKK 10330  
Thailand

ORIGINAL

Service Instrument:



Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7900	ICPMS 7900 System			
G8410A	SPS 4 Autosampler	AU15430722	ICP MS 7900	SYS-IM-7900
G8411A	ISIS 3 for Agilent 7850/7900/8900	JP15510227	ICP MS 7900	SYS-IM-7900
G3292A	PSC 6106T Chiller	2U15A1848	ICP MS 7900	SYS-IM-7900
G8453A	Agilent 7900 ICP-MS	JP15471169	ICP MS 7900	SYS-IM-7900

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EOQ	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	06.04.2023	06.04.2023
1010	S185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement - 100 % covered		



Additional Information:

Service Information:

<b>Problem Description:</b> WUS-QQ-ICP MS 7900-5001143313		
<b>Service Provided:</b> Test QC control of instrument (ICPMS = BKK_EL0043, After done all instrument test all Pass.		
<b>Service Overview Code:</b> Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
<b>Reported Hours:</b> 6.0	<b>Travel Hours:</b> 1.0	
<b>Customer Field Service Representative Name:</b> Pantthap Kurasathain	<b>Customer Field Service Representative Signature:</b> 	<b>Date:</b> 06 Apr 2023
<b>Customer Name:</b> Anchee Khamjen	<b>Customer Signature:</b> 	<b>Date:</b> 06 Apr 2023
<b>Additional Comments:</b>		

BKK\_EL0023

analytikjena

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	22/11/2024

analytikjena

Serial-No.: K170A0143 Customer-No.:  
Date: 24 May 2023 Carried out by: Srithal Fak-on

Maintenance with following Operational Qualification (OQ)  
(requires a separate OQ protocol) ☐

## Maintenance Protocol

Atomic Fluorescence Spectrometer  
mercur DUO /  
mercur DUO plus

Company	บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด
User	
Department	ห้องแล็บปฏิบัติการ
Street	104 ซอย 40 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง
Zip Code, City	กรุงเทพมหานคร 10250
Country	ประเทศไทย
Phone	
Fax	
E-mail	

## Maintenance works basic unit

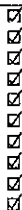
tightness visual check inside the Mercur  
 visual check if gold-traps are broken  
 visual check if spectrometer is contaminated  
 visual check of the fluorescence cell  
 visual check of the absorption cell, incl. window  
 reactor cleaning  
 check pump-hose, if necessary change it  
 check swivel drive (SEV)  
 check drying-hose, output gas-liquid-separator  
 test Bubble-Sensor  
 check gas flows  
 check volume flows, reagents  
 recording stray light values  
 measurement with 30 ng/l



## Maintenance works Autosampler

Serial No.: 701 739

lubricate the dosing-winding (Teflon-grease-spray)  
 clean the dosing cylinder, if necessary exchange it  
 lubricate the winding system of the height drive with some drops of oil  
 check the toothed belt  
 check the position of the mechanical stopper (height: 13mm)  
 check the pump rate of mixing pump (<14s AS62, typ.7s<20s AS52S, typ.10s)  
 check the pump rate of washing cup  
 check the electrical hose connections for good contact  
 check the connectors of the magnetic valves  
 check the dosing hose for buckling, if necessary exchange it



Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor	o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
Valve 1	10 Nl/h or 0.165 NL/min	0.163 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.403 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.140 NL/min
Valve 4	10 Nl/h or 0.165 NL/min	0.108 NL/min
Check liquidflow		
Acid	2.5 ml/min ± 1 ml	2.5 ml/min
Red-agent	2.5 ml/min ± 1 ml	2.5 ml/min
Sample	10 ml/min ± 2 ml	10 ml/min
Adventitious light - values	(V)	from file
	100	0
	200	0
	300	0
	350	0
	400	0
	450	2
	500	5
	550	10
	575	15
	600	20

35 Main St, 3rd Floor, Chiang Mai, Thailand  
 Bangkok: 10120 Thailand  
 Phone: +662 1062910-12  
 Fax: +662 1062915  
 www.analytikjena.com

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: 0.45...%
Conditions.: max conc.: 1.7 µg/L PMT-voltage: ...352.....V		
Blank-solution with enrichment / FBR 30 ng/L	Int. > 0.005 RSD < 3 %	Int.: 0.00370... Int.: 0.01060... RSD: 2.38...%
Fok.-factor (Int./Int.)	> 3.5	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.: 0.00449... RSD: 2.59...%
<b>Comments</b>		

Signature Technician  
 24 May 2023  
 Place, Date (DD/MM/YYYY)

Signature Customer  
 24 May 2023  
 Place, Date (DD/MM/YYYY)

## Service Report

Customer's address: 35 Main St, 3rd Floor, Chiang Mai, Thailand  
 Customer's Ref. No.: ANALYTIKJENA-2023-001  
 For use as confirmation of maintenance work only.  
 E-mail: service@analytikjena.com Phone: +662 1062910 Fax: +662 1062915

Job No.: 23052221 User: KITADIS Service Engineer: ANALYTIKJENA Date: 24/5/2023 Page: 1/1  
 Instrument model: Mercur Serial No.: 701739 Software Version No.: 4.7.10.0  
☐ Repair (RE) ☒ Maintenance (MA) ☐ Installation (IN) ☐ Warranty ☐ Application (AP) ☐ Site Prep (SP) ☐ Visit (VI)  
 Fault / Claim: Performance of the instrument is not as good as before. ☐ Error Code: 0000  
 - Performance of the instrument is not as good as before. (Time / New 2023)

Action taken: Maintenance of the Basic Unit  
Check device parameters.  
Check gas flow.  
Check liquid flow.  
Check Adventitious light - values  
Test run Analytical parameter Fluorescence cell  
Test run Analytical parameter Absorption cell

Action Pending / Recommendation: None

Item No.	Name	Quantity	Unit Price
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Hereby the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the acceptability of the specified spare parts.  
 \*Travel hours and labor costs can only be entered after the return of the service engineer.

Date / Signature of Customer: 24 May 2023  
 Date / Signature of Service Engineer: ANALYTIKJENA  
 Work completed? ☒ Yes ☐ No



## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pre\_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  
 Code: IL\_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	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 NL/h
Autosampler			
Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		

Dilution

Mercur

## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep. measurement	off	QC std.2 no.	1(30,000 ng/L)
QC std.1 no.	1(30,000 ng/L)	QC std.2 limit	± 50.00%
QC std.1 limit	± 50.00%	Reaction	flag + continue
QC std. act.	flag + continue	Reaction	off
Expect. blank abs.	0.0100± 0.0100	QC Recal.factor	Off
QC precision	off		

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD,%
1	Cal-Zero	(-)	79	0.000	H: 0.000248 A: 0.004274	0.000132 0.001698	53.13 39.72
2	Cal-Std1	(-)	80	30.000	H: 0.001720 A: 0.02172	0.000007 0.000023	0.459 0.107

Hg

Mercur

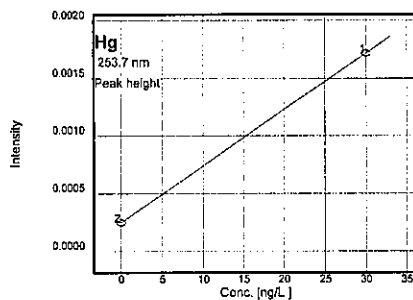
Calibration function 1 5/24/2023 12:44 Calibration (Peak height)

Ints=k1+k2\*conc

k1=0.000249 k2=0.000049

Recal. factor: ---

Slope	0.00005 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

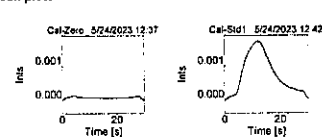


## Measurements and events (sorted by time)

Hg	Without enrichment / FBR 30ng/L_PM 24052023	5/24/2023 12:35
ID	Conc.	Ints BG SD RSD,% Int. type Time
Cal-Zero		0.000143 12:37
		0.000397 12:38
		0.000207 12:40
	0ng/L	0.000249 0.0001324 53.13 12:40
Cal-Std1		0.001720 12:42
		0.001712 12:43
		0.001728 12:44
	30.00ng/L	0.001720 0.00007897 0.459 12:44
Calibration	Calibration function: 01	12:44

Mercur

## Peak plots



Hg

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: IL\_Hg095\_2023  
 Remarks:  
 Food,water

## Method parameters

Method Enrichment / FER 30ng/L PM\_24052023  
 Created on 5/24/2023 Time 13:36  
 Program

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V		
AZ time	5 s	Peak smoothing	12/11
Delay	0 s		
Working mode	Err. 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

## QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	1(30.000 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		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: 0.06686	0.000253 0.002766	2.386 4.136

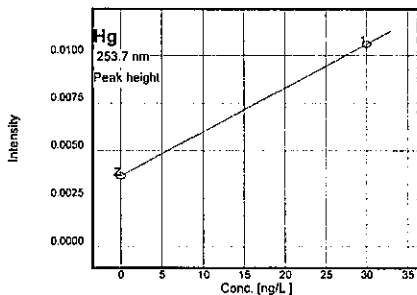
Mercur

Mercur

## Calibration function 1

## 5/24/2023 14:00 Calibration (Peak height)

Ints=k1+k2*conc			
k1=0.003700	k2=0.000230	Recal. factor:	---
Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

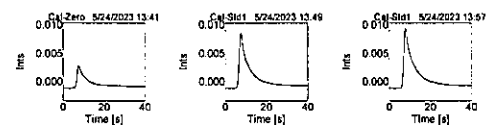
Hg	Enrichment / FER 30ng/L PM_24052023	5/24/2023 13:37
ID	Conc.	Ints BG SD RSD/% Int. type Time
Cal-Zero		0.003782 13:41
		0.003666 13:43
		0.003640 13:44
	0 ng/L	0.003700 0.000081090 2.192 13:44
Cal-Std1		0.009498 13:49
		0.008333 13:50
		0.008861 13:52
	30.00ng/L	0.008931 0.0005630 6.528 13:52
Cal-Std1		0.01031 13:57
		0.01074 13:58
		0.01076 14:00
	30.00ng/L	0.01060 0.0002530 2.386 14:00
Calibration	Calibration function: 01	14:00

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## Peak plots

## Hg



**Mercur**

Report file: C:\WinAASITMP\2023\May\Pro\_034  
 Program version: 4.7.10.0 Printed on: 5/24/2023 14:33  
 Recording started on 5/24/2023 14:19 GMT+7.0  
 Operator: PSU,OTA  
 Laboratory: ALS-BKK  
 Code: II\_Hg095\_2023  
 Remarks:  
 Food,water

**Method parameters**

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	Peak smoothing	2/5
AZ time	5 s		
Delay	5 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

**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	Reaction	flag + continue
Expect. blank abs.	0.0100± 0.0100	Reaction	off
QC precision	off	QC Recal. factor	Off

**Calibration settings**

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blank cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

**Sample statistics**

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blank cycles	1
Grubbs stat.	---		

**Calibration standards**

Hg

No	Name	State	Pos	Conc./ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000932 A: 0.035826	0.000138 0.006208	14.88 17.28
2	Cal-Std1	(-)	##	100.00	H: 0.004494 A: 0.061296	0.000116 0.001275	2.656 2.082

Mercur

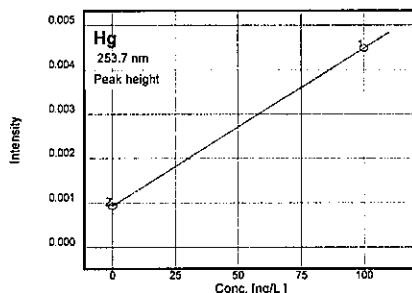
Mercur

**Calibration function 1**

5/24/2023 14:33 Calibration (Peak height)

Abs=k1+k2\*conc  
 k1=0.000932 k2=0.000036 Recal. factor: ---

Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg	Without enrichment / Abs / FBR 100ng/L_PM 24052023	5/24/2023	14:19
ID	Conc.	Abs	BG
Cal-Zero		0.001039	
		0.000775	
		0.000981	
	0ng/L	0.000932	0.00013872 14.88
Cal-Std1		0.004528	
		0.004364	
		0.004589	
	100.ng/L	0.004494	0.00011623 2.586
Calibration	Calibration function: 01		14:33

Mercur

Mercur

**Peak plots**

Hg

