ภาคผนวก ง

ใบรับรองเอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0536	19-May-25	18-Nov-25	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0485	24-May-25	23-Nov-25	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS1114	24-May-25	23-Nov-25	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS1117	24-May-25	23-Nov-25	6
Stack	Total Suspended Particulate	Fuel Gas Analyzer	BKK_FS1095	3-Dec-24	3-Dec-25	12
Stack	Total Suspended Particulate	Fuel Gas Analyzer	BKK_FS1160	7-Nov-24	7-Nov-25	12
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	5-Nov-24	5-Nov-25	12
Stack (CEMs)	Flow Rate & Temperature	Console Control Unit	BKK_FS0536	19-May-25	18-Nov-25	6
Stack (CEMs)	Flow Rate & Temperature	Console Control Unit	BKK_FS0485	24-May-25	23-Nov-25	6
Stack (CEMs)	Flow Rate & Temperature	Pitot Tube	BKK_FS1114	24-May-25	23-Nov-25	6
Stack (CEMs)	Flow Rate & Temperature	Pitot Tube	BKK_FS1117	24-May-25	23-Nov-25	6
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Sta	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Sta	-	-	-	-
Stack (CEMs)	Oxygen	Analyzer , System calibration, Sta	-	-	-	-
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS1072	2-Jul-25	2-Jan-26	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS0803	2-Jul-25	2-Jan-26	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS1457	3-Jul-25	3-Jan-26	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS0785	2-Jul-25	2-Jan-26	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	BKK_FS1071	1-Jul-25	1-Jan-26	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	BKK_FS0802	1-Jul-25	1-Jan-26	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	BKK_FS1456	1-Jul-25	1-Jan-26	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	BKK_FS0784	1-Jul-25	1-Jan-26	6
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0384	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0385	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0383	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1487	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0403	30-May-25	30-May-26	12
Ambient	Total Suspended Particulate	High Volume	BKK_FS0370	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1375	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0372	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1485	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0403	30-May-25	30-May-26	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1440	18-Sep-24	18-Mar-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1438	17-Sep-24	17-Mar-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1439	17-Sep-24	17-Mar-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1441	18-Sep-24	18-Mar-26	18
Ambient	Temperature	Temperature Sensor	BKK_FS1440	18-Sep-24	18-Mar-26	18
Ambient	Temperature	Temperature Sensor	BKK_FS1438	17-Sep-24	17-Mar-26	18
Ambient	Temperature	Temperature Sensor	BKK_FS1439	17-Sep-24	17-Mar-26	18
Ambient	Temperature	Temperature Sensor	BKK_FS1441	18-Sep-24	18-Mar-26	18
Noise	Leq 24 hrs / Leq 5 min	Sound Calibrator	BKK_FS0631	16-Dec-24	16-Dec-25	12
Noise	Leq 24 hrs / Leq 5 min	Sound Level Meter	BKK_FS0879	13-Dec-24	13-Dec-25	12
Noise	Leq 24 hrs / Leq 5 min	Sound Level Meter	BKK_FS0877	3-Dec-24	3-Dec-25	12
Noise	Leq 24 hrs / Leq 5 min	Sound Level Meter	BKK_FS0117	13-Dec-24	13-Dec-25	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0618	4-Dec-24	4-Dec-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0997	21-Jan-25	21-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0999	14-Nov-24	14-Nov-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1215	3-Dec-24	3-Dec-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1216	3-Dec-24	3-Dec-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1214	14-Nov-24	14-Nov-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0998	14-Nov-24	14-Nov-25	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0632	16-Jan-25	16-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0876	21-Jan-25	21-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0874	21-Jan-25	21-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0101	17-Jun-25	17-Jun-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0023	21-Jul-25	20-Jul-26	12

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0876	9-Jan-25	9-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0099	6-Sep-25	3-Sep-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0680	6-Jun-25	6-Jun-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0679	21-Nov-24	21-Nov-25	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0677	7-Jul-25	7-Jul-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0672	10-Feb-25	10-Feb-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0682	22-Nov-24	22-Nov-25	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0671	19-Nov-25	18-Nov-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0672	10-Feb-25	10-Feb-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0680	6-Jun-25	6-Jun-26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0679	10 Feb 25	10 Feb 26	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0670	24-Jul-25	23-Jul-26	12
Illuminance	Illuminance	Lux Meter	BKK_FS1344	14-Jan-25	14-Jan-26	12
Illuminance	Illuminance	Lux Meter	BKK_FS1345	14-Jan-25	14-Jan-26	12
Water Lab	Temperature	pH meter	BKK_UG0076	24-Jun-25	24-Jun-26	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0342	9-Oct-25	9-Oct-26	12
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0003	17-Jul-25	17-Jul-26	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0439	9-Oct-25	9-Oct-26	12
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0003	17-Jul-25	17-Jul-26	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0425	6-Oct-25	6-Oct-26	12
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BKK_EN0003	17-Jul-25	17-Jul-26	12
Water Lab	Total Dissolved Solids 180°C	Oven	BKK_EN0425	6-Oct-25	6-Oct-26	12
Water Lab	BOD	DO Meter	BKK_EN0205	25-Jul-25	25-Jan-27	18
Water Lab	BOD	Incubator	BKK_EN0304	6-Mar-25	4-Mar-26	12
Water Lab	BOD	Burette	BKK_EN0422	3-Sep-25	3-Sep-26	12
Water Lab	Residual Free Chlorine	Chlorine Meter	BKK_UG0062	19-Feb-25	19-Feb-26	12
Water Lab	Dissolved Oxygen	Burette	BKK_EN0422	3-Sep-25	3-Sep-26	12
Water Lab	Dissolved Oxygen	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Dissolved Oxygen (on site)	DO Meter	BKK_UG0079	28-Jun-25	28-Jun-26	12
Water Lab	Calcium	ICP-OES	BKK_EL0037	23-Sep-24	23-Mar-26	18
Water Lab	Calcium	Hot Block	BKK_EL0054	6-Mar-25	4-Sep-26	18
Water Lab	Calcium	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	23-Sep-24	23-Mar-26	18
Water Lab	Magnesium	Hot Block	BKK_EL0054	6-Mar-25	4-Sep-26	18
Water Lab	Magnesium	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	23-Sep-24	23-Mar-26	18
Water Lab	Sodium	Hot Block	BKK_EL0054	6-Mar-25	4-Sep-26	18
Water Lab	Sodium	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	SAR	ICP-OES	BKK_EL0037	23-Sep-24	23-Mar-26	18
Water Lab	SAR	Hot Block	BKK_EL0054	6-Mar-25	4-Sep-26	18
Water Lab	SAR	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Total. Trihalomethane	Gas Chromatography (MSD)	BKK_EN0059	25-Jun-25	25-Dec-26	18
Water Lab	Conductivity	Conductivity meter	BKK_EN0373	30-Jun-25	30-Jun-26	12
Water Lab	Conductivity (On site)	Conductivity meter	BKK_UG0072	13-Jun-25	13-Jun-26	12

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 19 May 25
Next Cal. Date : 18 Nov 25

Console Control Meter Data
Calibration No. : C-190525-BKK-FS0536
Dry Gas Meter ID : BKK-FS0536
Serial No. : 1508054
Model No. : XC-572-V

Barometric Pressure (mmHg) : 756
Relative Humidity (%) : 80.0
Temperature (°C) : 29.0

Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK-FS0629
Serial No. : 1607009
Correction Factor (Y) : 1.0000
Next Calibration Date : 10 Jun 25

ΔH (mm H_2O)	θ Minutes	Reference Dry Gas Meter Calibration Vm (Liters) Final	Initial	Total	Tr (°C)	Console Control Unit Dry Gas Meter Vm (Liters) Final	Initial	Total	Ti (°C)	To (°C)	Avg Tm (°C)	Dry Gas Meter Correction Factor (Y)	Office Calibration Factor ΔH@
15	11.77	150.00	0.00	150.00	32.0	256.0	110.0	146.0	33.0	33.0	33.0	1.0284	427.6458
25	9.12	150.00	0.00	150.00	32.0	406.0	260.0	146.0	33.0	33.0	33.0	1.0283	427.7799
50	6.53	150.00	0.00	150.00	32.0	557.0	410.0	147.0	34.0	34.0	34.0	1.0221	437.1148
100	4.58	150.00	0.00	150.00	32.0	714.0	565.0	149.0	34.0	34.0	34.0	1.0003	432.9119
150	3.75	150.00	0.00	150.00	33.0	874.0	725.0	149.0	35.0	35.0	35.0	0.9987	433.9927
Avg											35.0	1.0172	431.1939

Y : Ratio of reading of reference to dry gas meter, tolerance for individual values ± 0.02 from average.
ΔH@ : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury, mmH2O, tolerance for individual values ± 5.08 from average.

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

Calibrated by : (Mr.Navaphut Sriviriya)
Field Scientist(2)

Approved by : (Mr.Samart Roo-ngan)
Field Specialist(1)

FORM NO.: F 06-024 REVISION NO.: 00 ISSUE DATE: 1 Jan 24

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	19 May 25	Ambient Temperature (°C)	29.0
Calibration sheet No. :	C-190525-BKK_FS0536	Relative Humidity (%) :	80.0
Digital Temperature ID :	BKK_FS0537	Reference Temperature ID	BKK_FS1144
Serial No. :	1508054	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	28 Nov 25

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	1	1	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	151	1	±3	Pass
	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	501	1	±3	Pass
Probe	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	2	±3	Pass
	120	122	1	±3	Pass
	140	142	2	±3	Pass
Filter	100	101	1	±3	Pass
	120	122	2	±3	Pass
	140	142	2	±3	Pass
Exit	0	1	1	±3	Pass
	10	11	1	±3	Pass
	20	21	1	±3	Pass
Meter	0	1	1	±3	Pass
	25	26	1	±3	Pass
	50	51	1	±3	Pass
AUX	0	1	1	±3	Pass
	25	26	1	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมได้

Calibrated by : (Mr.Navaphut Sriviriya)
Field Scientist (2)

Approved by : Mr.Samart Roo-ngan
Specialist (1)

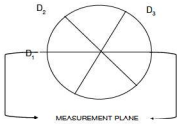
FORM NO.: F 06-027 REVISION NO.: 2 ISSUE DATE: 16/2/23

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	19 May 25	Nozzle Set ID. :	BKK_FS0542
Calibration Sheet No. :	C-190525-BKK_FS0542	Vernier Caliper ID.:	BKK_FS1123

Nozzle ID #	Nozzle Diameter (cm.) D_1	D_2	D_3	Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.530	0.530	0.530	0.000	0.530
4	0.635	0.635	0.635	0.000	0.635
5	0.790	0.790	0.790	0.000	0.790
6	0.950	0.950	0.950	0.000	0.950
7	1.110	1.110	1.110	0.000	1.110
8	1.270	1.270	1.270	0.000	1.270
9	1.600	1.600	1.600	0.000	1.600

Where :
D_1, D_2, D_3 = There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.
D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by : (Mr.Navaphut Sriviriya)
Field Scientist (2)

Approved by : (Mr.Samart Roo-ngan)
Field Specialist (1)

FORM NO.: F 06-024 REVISION NO.: 00 ISSUE DATE: 1 Jan 24

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 24 May 25
Next Cal. Date : 23 Nov 25

Console Control Meter Data
Calibration No. : C-240525-BKK_FS0485
Dry Gas Meter ID : BKK-FS0485
Serial No. : 1310055
Model No. : XC-572-V

Barometric Pressure (mmHg) : 754.5
Relative Humidity (%) : 81.0
Temperature (°C) : 30.0

Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK-FS0629
Serial No. : 1607009
Correction Factor (Y) : 1.0000
Next Calibration Date : 10 Jun 25

ΔH (mm H_2O)	θ Minutes	Reference Dry Gas Meter Calibration Vm (Liters) Final	Initial	Total	Tr (°C)	Console Control Unit Dry Gas Meter Vm (Liters) Final	Initial	Total	Ti (°C)	To (°C)	Avg Tm (°C)	Dry Gas Meter Correction Factor (Y)	Office Calibration Factor ΔHg
15	12.40	150.01	0.00	150.01	31.0	1715164	1715830	153.40	32.0	32.0	32.0	0.9797	47.3759
25	9.55	149.84	0.00	149.84	31.0	1716682.2	1716539.0	153.20	33.0	33.0	33.0	0.9821	46.7878
50	6.76	149.94	0.00	149.94	32.0	1718615.8	1717709.0	152.80	33.0	33.0	33.0	0.9797	47.1327
80	5.25	149.89	0.00	149.89	33.0	1720054.4	1718673.0	152.40	33.0	33.0	33.0	0.9759	46.5143
120	4.23	150.04	0.00	150.04	33.0	1722311.2	1720719.0	152.20	33.0	33.0	33.0	0.9744	44.5231
											avg	0.9744	46.3395

Y : Ratio of reading of reference to dry gas meter, tolerance for individual values ± 0.02 from average.
ΔHg : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury, mmH2O, tolerance for individual values ± 5.08 from average.

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

Calibrated by : (Mr.Kritsana Saiwan)
Field Scientist(2)

Approved by : Mr.Samart Roo-ngan
Field Specialist(1)

FORM NO.: F 06-024 REVISION NO.: 00 ISSUE DATE: 1 Jan 24

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	24 May 25	Ambient Temperature (°C)	30.0
Calibration sheet No. :	C-240525-BKK_FS0485	Relative Humidity (%) :	81.0
Digital Temperature ID :	BKK_FS0485	Reference Temperature ID	BKK_FS1144
Serial No. :	1310055	Serial No. :	1607009
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	5 Jan 26

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	2	2	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	149	-1	±3	Pass
	200	198	-2	±3	Pass
	250	247	-3	±3	Pass
	300	297	-3	±3	Pass
	500	497	-3	±3	Pass
Probe	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Filter	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
Exit	0	1	1	±3	Pass
	10	11	1	±3	Pass
	20	21	1	±3	Pass
Meter	0	1	1	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
AUX	0	1	1	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมได้

Calibrated by : KRITSANA
(Mr.Kritsana Saiwan)
Field Scientist (2)

Approved by : Mr.Samart Roo-ngan
Field Specialist (1)

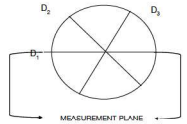
FORM NO.: F 06-027 REVISION NO.: 2 ISSUE DATE: 16/2/23

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	24 May 25	Nozzle Set ID. :	BKK_FS0491
Calibration Sheet No. :	C-240525-BKK_FS0491	Vernier Caliper ID.:	RYG_FS0539

Nozzle ID #	Nozzle Diameter (cm.) D_1	D_2	D_3	Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.530	0.530	0.530	0.000	0.530
4	0.635	0.635	0.635	0.000	0.635
5	0.790	0.790	0.790	0.000	0.790
6	0.950	0.950	0.950	0.000	0.950
7	1.110	1.110	1.110	0.000	1.110
8	1.270	1.270	1.270	0.000	1.270
9	1.600	1.600	1.600	0.000	1.600

Where :
D_1, D_2, D_3 = There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.
D_{avg} = $(D_1 + D_2 + D_3) / 3$



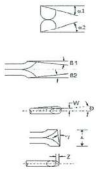
Calibrated by : KRITSANA
(Mr. Kritsana Saiwan)
Field Scientist (2)

Approved by : (Mr.Samart Roo-ngan)
Field Specialist (1)

FORM NO.: F 06-024 REVISION NO.: 00 ISSUE DATE: 1 Jan 24

Type S Pitot Tube Calibration

Date Calibration	24-May-25	**Due Date**	23-Nov-25
Pitot ID	BKK_FS1114	**Inclinometer ID**	BKK_FS1131
Pitot SN	-	**Vernier ID**	BKK_FS1405



Parameter	Value	Allowable Range	Check
α1	6.2	-10° < α1 < +10°	OK
α2	4.2	-10° < α2 < +10°	OK
β1	4.7	-5° < β1 < +5°	OK
β2	0.9	-5° < β2 < +5°	OK
γ	1.7	-	-
θ	1.6	-	-
Z = A tan γ	0.026	Z ≤ 0.125"	OK
W = A tan θ	0.024	W ≤ 0.031"	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.160	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.87	2.1Dt ≤ A ≤ 3Dt	OK

Certify that pitot tube/porbe meets or exceeds all specifications, crieria 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.

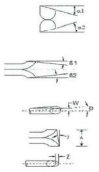
Calibrated by : Prasert S.
(Mr.Prasert.Surakhan)
Enviro Field Services Scientist (3)

Approved By : Sa R.
(Mr.Samart Roo-ngan)
Enviro Field Services Specialist (1)

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

Type S Pitot Tube Calibration

Date Calibration	24-May-25	**Due Date**	22-Nov-25
Pitot ID	BKK_FS1117	**Inclinometer ID**	BKK_FS1131
Pitot SN	W2002529	**Vernier ID**	BKK_FS1405



Parameter	Value	Allowable Range	Check
α1	-0.3	-10° < α1 < +10°	OK
α2	1	-10° < α2 < +10°	OK
β1	-0.6	-5° < β1 < +5°	OK
β2	-1.7	-5° < β2 < +5°	OK
γ	-0.4	-	-
θ	0.8	-	-
Z = A tan γ	-0.006	Z ≤ 0.125"	OK
W = A tan θ	0.013	W ≤ 0.031"	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.92	2.1Dt ≤ A ≤ 3Dt	OK

Certify that pitot tube/porbe meets or exceeds all specifications, crieria 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 : Prasert S.
(Mr.Prasert.Surakhan)
Enviro Field Services Scientist (3)

Approved By : Sa R.
(Mr.Samart Roo-ngan)
Enviro Field Services Specialist (1)

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

ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No: G 670852
Date of issue : 03-Dec-24

Instrument description	:	Flue Gas Analyzer
Instrument model	:	Testo 350 New
Instrument serial no.	:	62087398/1119
Control unit serial no.	:	03404178/1119
ID no. or control no.	:	BKK_FS1095
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-244796
Receiving date.	:	29-Nov-24
Parameter of calibration	:	Gas Calibration(Oxygen 2.50,9.984,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitrogen Dioxide 30.68, 81.8, 201.9 ppm, Nitric Oxide 30.0. 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Condition of UUC.	:	Used
Ambient condition	:	All of the Measurment ware caried out the stabilized labotary Temperature : 23 ±5 °C Humidity : 55 ± 15 %RH
Calibration place	:	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, 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

REVIEW BY Nonlukan P.
APPROVED BY
NEXT CAL DATE 03/12/25

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

Date of calibration : 03-Dec-24

Mr. Kwanchai Khamdoung
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager

FM-CL-09-C Rev.8 Page 1 of 2 Issued Date 26/02/16

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Fax. 0-2779-8899 info@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No.: G 670852

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O2) 9.984 % Vol	CG-0113-24	Nimt	01-Aug-29
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.18 ppm	CG-0002-24	Nimt	11-Jan-29
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1007 ppm	1870/24	Linde	17-Jun-26
Nitric Oxide (NO) 30.0 ppm	CG-0065-24	Nimt	06-May-26
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 (SO2) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions
Temperature : 22.6 °C Humidity : 65.3 %RH Pressure : 1011.8 mbar
Calibration conditions
Gas Temperature : 23 °C Flow rate : 1,300 ml/min Gas pressure : 1015.7 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.58	0.08	0.15
O2 (%Vol)	9.984	10.11	0.126	0.20
O2 (%Vol)	21.02	21.15	0.13	0.30
CO (ppm)	80.18	81	0.82	3.0
CO (ppm)	302	304	2	6.0
CO (ppm)	1007	1010	3	12
NO2 (ppm)	30.68	33.2	2.52	8.0
NO2 (ppm)	81.8	83.9	2.1	8.0
NO2 (ppm)	201.9	204.8	2.9	12
NO (ppm)	30.0	31	1.0	8.0
NO (ppm)	151.5	154	2.5	8.0
NO (ppm)	322.5	324	1.5	12
SO2 (ppm)	50.36	51	0.64	6.0
SO2 (ppm)	100.8	102	1.2	6.0
SO2 (ppm)	600.8	603	2.2	13

Remark : 1 cmol/mol = 1 %vol. 1 µmol/mol = 1 ppm.

End of Report

FM-CL-09-C Rev.8 Page 2 of 2 Issued Date 26/02/16

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Fax. 0-2779-8899 info@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No: G 670782
Date of issue : 07-Nov-24

Instrument description	:	Flue Gas Analyzer
Instrument model	:	Testo 340
Instrument serial no.	:	63119044
Control unit serial no.	:	-
ID no. or control no.	:	BKK_FS1160
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-244322
Receiving date.	:	05-Nov-24
Parameter of calibration	:	Gas Calibration(Oxygen 2.50,9.984,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitric Oxide 30.0, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Condition of UUC.	:	Used
Ambient condition	:	All of the Measurment ware caried out the stabilized labotary Temperature : 23 ±5 °C Humidity : 55 ± 15 %RH
Calibration place	:	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, 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

REVIEW BY Nonlukan P.
APPROVED BY
NEXT CAL DATE 07/11/25

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

Date of calibration : 07-Nov-24

Mr. Kwanchai Khamdoung
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager

FM-CL-09-C Rev.8 Page 1 of 3 Issued Date 26/02/16

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
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Tax ID : 0105536035591 www.entech.co.th

ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No.: G 670782

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O2) 9.984 % Vol	CG-0113-24	Nimt	01-Aug-29
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.18 ppm	CG-0002-24	Nimt	11-Jan-29
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1007 ppm	1870/24	Linde	17-Jun-26
Nitric Oxide (NO) 30.0 ppm	CG-0065-24	Nimt	06-May-26
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 (SO2) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions
Temperature : 21.7 °C Humidity : 59.9 %RH Pressure : 1010.2 mbar
Calibration conditions
Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1012.6 mbar

Calibration Results (Befor adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.45	-0.05	0.15
O2 (%Vol)	9.984	9.91	-0.074	0.20
O2 (%Vol)	21.02	21.13	0.11	0.30
CO (ppm)	80.18	78	-2.18	3.0
CO (ppm)	302	298	-4	6.0
CO (ppm)	1007	990	-17	12
NO (ppm)	30.0	28	-2.0	8.0
NO (ppm)	151.5	148	-3.5	8.0
NO (ppm)	322.5	309	-13.5	12
SO2 (ppm)	50.36	51	0.64	6.0
SO2 (ppm)	100.8	103	2.2	6.0
SO2 (ppm)	600.8	601	0.2	13

FM-CL-09-C Rev.8 Page 2 of 3 Issued Date 26/02/16

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ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No.: G 670782

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.45	-0.05	0.15
O2 (%Vol)	9.984	9.91	-0.074	0.20
O2 (%Vol)	21.02	21.13	0.11	0.30
CO (ppm)	80.18	81	0.82	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1007	1006	-1	12
NO (ppm)	30.0	31	1.0	8.0
NO (ppm)	151.5	154	2.5	8.0
NO (ppm)	322.5	325	2.5	12
SO2 (ppm)	50.36	51	0.54	6.0
SO2 (ppm)	100.8	103	2.2	6.0
SO2 (ppm)	600.8	601	0.2	13

Remark : 1 cmol/mol = 1 %vol. 1 µmol/mol = 1 ppm.

End of Report

FM-CL-09-C Rev.8 Page 3 of 3 Issued Date 26/02/16

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Fax. 0-2779-8899 info@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

SARTORIUS

Accredited by
NSC-TISI-TIS 17025
Calibration 0426

NSC-TISI-TIS 17025
CALIBRATION 0426

Calibration certificate

Calibration Certificate No. 24BCI0440

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	SECURA224-1S	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial | QM Ident. no.	38304165 | BKK_EN0309	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand)Co., Ltd. 104 Phatthanakarn 40,Phattanakarn Rd.,Khwaeng Phatthanakarn ,Khet Suan Luang,Bangkok 10250	
Order no.	246928	
Number of pages	4	
Date of calibration	05 Nov 2024	

REVIEW BY Sunda K.
APPROVED BY Shiuk P.
NEXT CAL DATE 05/11/25

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date	Approval of the Calibration Certificate	Person in charge
05 Nov 2024	Mr. Chonchai Inthana	Chonchai Inthana

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang
10310 Bangkok

Verical®
Version 6.5

Calibration object

Single range instrument

Model	SECURA224-1S
Serial Number	38304165
QM Ident. no | Inventory no.	BKK_EN0309 | ---
Maximum capacity (Max. load)	220.0000 g
Measured range	220.0000 g
Scale interval	0.0001 g

Place of calibration

Address	According to page 1
Department | Cost center	Laboratory Department. | ---
Building | Floor	--- | 1st Floor.
Room	Laboratory Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	05 Nov 2024
Temperature at place of calibration | Temp. diff. $T_{weights} - T_{place}$	19.6 °C | 0.4 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 68.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal):	10 g	100 g
1	10.0000 g	100.0000 g
2	10.0000 g	99.9999 g
3	10.0001 g	100.0000 g
4	10.0000 g	99.9999 g
5	10.0000 g	100.0000 g
6	9.9999 g	99.9999 g
7	10.0000 g	100.0000 g
8	9.9999 g	100.0000 g
9	10.0000 g	99.9999 g
10	10.0001 g	100.0000 g
	s = 0.00007 g	s = 0.00005 g

Eccentricity

Test load (nominal):	100 g
Center	100.0000 g
Front left	100.0001 g
Back left	100.0000 g
Back right	100.0000 g
Front right	100.0000 g
Maximum deviation from centric loading indication $\lvert \Delta I_{ecc} \rvert$ max = 0.0001 g	

Error of indication

Testload L	Indication I	Error E	Expansion factor k	Uncertainty $U(E)$	Uncertainty relative $U_{rel}(E)$
0.0100 g	0.0100 g	0.0000 g	2.00	0.00016 g	1.6 %
0.0500 g	0.0500 g	0.0000 g	2.00	0.00013 g	0.26 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.027 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
2.0000 g	2.0000 g	0.0000 g	2.00	0.00013 g	0.0067 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00014 g	0.0027 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00014 g	0.0014 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00071 %
200.0000 g	199.9999 g	-0.0001 g	2.00	0.00028 g	0.00014 %
210.0000 g	210.0000 g	0.0000 g	2.00	0.00031 g	0.00015 %
Maximum error of indication		$\lvert E \rvert_{max}$ = 0.0001 g			

$U_{rel}(E)$ is the quotient of $U(E)$ and test load L. The uncertainty of measurement $U(E)$ is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate

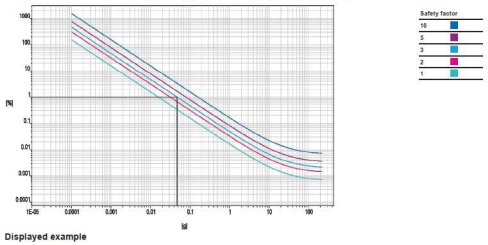
Uncertainty of measurement in use

Device adjusted before measurement	Yes
Temperature deviation considered	1 K (isoCAL active)
Temperature coefficient considered	2 · 10⁻⁶/K
Uncertainty of the weighing result $U_{gi}(W)$	$U_{gi}(W) = 0.00016\ g + 6.42 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication R	Uncertainty $U_{gi}(W)$	Uncertainty relative $U_{gi}(W)_{rel}$
1 %	2.2000 g	0.00017 g	0.0079 %
25 %	55.0000 g	0.00051 g	0.00093 %
50 %	110.0000 g	0.00087 g	0.00079 %
75 %	165.0000 g	0.0012 g	0.00074 %
100 %	220.0000 g	0.0016 g	0.00071 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.0470 g

Lot No. 2595685-1

ANALYZER CALIBRATION DATA

Client : Gulf BL Co., Ltd. Location : ปล่อง HRSG 11
Date : 22 Oct 25 Test Operator : Boonyarith I.

O_2 ANALYZER
Model : TELEDYNE API T200H Serial No. : 482
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	7.98	7.95	7.97	0.08
Span Gas	16.12	16.07	16.09	0.08

NO_x ANALYZER
Model : TELEDYNE API T200H Serial No. : 482
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.02	0.02
Low-Level Gas	56.16	56.09	56.11	0.02
Span Gas	80.73	80.61	80.66	0.05

SO2 ANALYZER
Model : TELEDYNE API T100H Serial No. : 324
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	55.55	55.48	55.56	0.08
Span Gas	79.43	79.32	79.58	0.26

CO ANALYZER
Model : TELEDYNE API T300M Serial No. : 377
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.20	0.20
Low-Level Gas	54.22	54.07	54.13	0.06
Span Gas	79.82	79.74	79.66	0.08

Calibrated by

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

Lot No. 2595685-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BL Co., Ltd. Location : ปล่อง HRSG 11
Date : 22 Oct 25 Test Operator : Boonyarith I.

O_2 ANALYZER
Cylinder Conc. (%) : 16.12 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values System Calibration Response	Initial Values System Cal Bias (% of Span)	Final Values System Calibration Response	Final Values System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.02	0.08	0.03	0.12	0.04
Upscale Gas	16.07	16.08	0.04	16.10	0.12	0.08

NO_x ANALYZER
Cylinder Conc. (ppm) : 80.73 Span (ppm) : 100

	NO_x Analyzer Calibration Response	Initial Values System Calibration Response	Initial Values System Cal Bias (% of Span)	Final Values System Calibration Response	Final Values System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.04	0.04	0.02	0.02	0.02
Upscale Gas	80.61	81.76	1.15	81.80	1.19	0.04

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.43 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values System Calibration Response	Initial Values System Cal Bias (% of Span)	Final Values System Calibration Response	Final Values System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.05	0.05	0.03	0.03	0.02
Upscale Gas	79.32	80.34	1.02	80.37	1.05	0.03

CO ANALYZER
Cylinder Conc. (ppm) : 79.82 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values System Calibration Response	Initial Values System Cal Bias (% of Span)	Final Values System Calibration Response	Final Values System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.01	0.01	0.03	0.03	0.02
Upscale Gas	79.74	79.59	0.15	79.73	0.01	0.14

Calibrated by

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

Client	Gulf BL Co., Ltd.	Run #	1
Date	22 Oct 25	Location	ปล่อง HRSG 11
Start Time	13:20	Test Operator	Boonyarith I.
SO_2 Analyzer Model	TELEDYNE API T100H	Finish Time	13:40
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	324
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	482
		Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
13:20	13.92	4.02	23.00	0.06	0.28	
13:21	13.98	3.99	24.78	0.06	0.30	
13:22	13.98	3.99	24.61	0.05	0.28	
13:23	13.98	4.00	24.38	0.05	0.35	
13:24	13.99	3.99	24.56	0.05	0.38	
13:25	14.00	4.01	24.20	0.05	0.37	
13:26	14.02	3.97	23.25	0.04	0.36	
13:27	14.04	3.98	22.80	0.04	0.41	
13:28	14.02	4.01	22.89	0.04	0.44	
13:29	14.03	4.00	22.89	0.03	0.40	
13:30	14.02	3.98	22.78	0.03	0.38	
13:31	14.02	3.99	22.66	0.03	0.39	
13:32	14.02	3.99	22.63	0.03	0.41	
13:33	14.03	3.94	22.62	0.07	0.40	
13:34	14.03	3.98	22.72	0.09	0.45	
13:35	14.03	3.95	22.94	0.09	0.42	
13:36	14.05	3.96	23.08	0.09	0.39	
13:37	14.03	3.97	23.08	0.08	0.42	
13:38	14.04	3.98	23.04	0.08	0.42	
13:39	14.01	3.97	22.98	0.09	0.45	
13:40	14.02	3.94	22.87	0.07	0.50	
Average	**14.02**	**3.98**	**23.27**	**0.06**	**0.39**	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

Client	Gulf BL Co., Ltd.	Run #	2
Date	22 Oct 25	Location	ปล่อง HRSG 11
Start Time	13:41	Test Operator	Boonyarith I.
SO_2 Analyzer Model	TELEDYNE API T100H	Finish Time	14:01
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	324
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	482
		Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
13:41	14.02	3.99	22.94	0.08	0.43	
13:42	14.01	3.98	23.12	0.08	0.38	
13:43	14.02	3.99	23.28	0.08	0.45	
13:44	14.02	3.99	23.57	0.08	0.48	
13:45	14.03	3.97	23.68	0.07	0.50	
13:46	14.03	3.97	23.54	0.07	0.54	
13:47	14.01	3.99	23.38	0.07	0.46	
13:48	14.02	3.97	23.29	0.06	0.50	
13:49	14.00	4.00	23.19	0.05	0.51	
13:50	14.00	4.00	23.11	0.05	0.56	
13:51	14.00	3.97	23.06	0.05	0.55	
13:52	14.02	4.02	23.00	0.05	0.54	
13:53	14.02	3.99	22.99	0.05	0.53	
13:54	14.01	3.98	23.11	0.05	0.57	
13:55	14.01	3.95	23.19	0.05	0.56	
13:56	14.02	4.02	23.02	0.05	0.53	
13:57	14.01	3.94	22.88	0.04	0.55	
13:58	14.00	4.03	22.91	0.04	0.50	
13:59	14.01	3.98	23.01	0.04	0.53	
14:00	14.01	3.98	23.06	0.04	0.64	
14:01	14.01	3.97	23.03	0.04	0.60	
Average	**14.02**	**3.98**	**23.16**	**0.06**	**0.52**	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

Client	Gulf BL Co., Ltd.	Run #	3
Date	22 Oct 25	Location	ปล่อง HRSG 11
Start Time	14:02	Test Operator	Boonyarith I.
SO_2 Analyzer Model	TELEDYNE API T100H	Finish Time	14:22
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	324
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	482
		Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
14:02	14.00	4.01	22.89	0.03	0.53	
14:03	14.00	3.98	22.86	0.06	0.57	
14:04	13.99	4.03	22.91	0.08	0.59	
14:05	14.00	3.96	22.92	0.08	0.56	
14:06	13.98	3.97	22.91	0.08	0.60	
14:07	13.98	4.00	22.78	0.07	0.56	
14:08	14.00	4.01	22.77	0.07	0.59	
14:09	13.99	4.00	22.94	0.07	0.60	
14:10	14.00	3.98	22.98	0.06	0.64	
14:11	13.99	3.98	22.91	0.08	0.64	
14:12	13.99	3.96	22.86	0.07	0.59	
14:13	13.99	4.00	22.89	0.07	0.57	
14:14	14.00	4.05	22.84	0.06	0.62	
14:15	14.00	4.01	22.80	0.07	0.66	
14:16	14.00	3.99	22.86	0.07	0.64	
14:17	14.02	4.04	23.03	0.08	0.65	
14:18	14.01	3.99	23.16	0.08	0.64	
14:19	14.02	3.98	23.30	0.07	0.64	
14:20	14.02	3.97	23.32	0.07	0.63	
14:21	14.00	3.96	23.12	0.08	0.60	
14:22	13.99	3.94	22.71	0.07	0.61	
Average	**14.00**	**3.99**	**22.94**	**0.07**	**0.60**	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

Lot No. 2595686-1

ANALYZER CALIBRATION DATA

Client	:	Gulf BL Co., Ltd.	Location	:	ปล่อง HRSG 12
Date	:	22 Oct 25	Test Operator	:	Boonyarith I.

O_2 ANALYZER

Model	:	TELEDYNE API T200H	Serial No.	:	991
Span (%)	:	25			

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	7.98	7.90	7.88	0.08
Span Gas	16.12	16.10	16.11	0.04

NO_X ANALYZER

Model	:	TELEDYNE API T200H	Serial No.	:	991
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	56.16	56.07	55.11	0.96
Span Gas	80.73	80.64	80.72	0.08

SO2 ANALYZER

Model	:	TELEDYNE API T100H	Serial No.	:	553
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.48	55.51	0.03
Span Gas	79.43	79.39	79.47	0.08

CO ANALYZER

Model	:	TELEDYNE API T300M	Serial No.	:	924
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.00	0.02
Low-Level Gas	54.22	54.16	54.23	0.07
Span Gas	79.82	80.14	80.23	0.09

Calibrated by

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

Lot No. 2595686-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	:	Gulf BL Co., Ltd.	Location	:	ปล่อง HRSG 12
Date	:	22 Oct 25	Test Operator	:	Boonyarith I.

O_2 ANALYZER

Cylinder Conc. (%) : 16.12 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	16.10	16.06	0.16	16.10	0.00	0.16

NO_X ANALYZER

Cylinder Conc. (ppm) : 80.73 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	80.64	80.67	0.03	80.74	0.10	0.07

SO_2 ANALYZER

Cylinder Conc. (ppm) : 79.43 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	79.39	79.28	0.11	79.29	0.10	0.01

CO ANALYZER

Cylinder Conc. (ppm) : 79.82 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.00	0.02	0.00	0.02	0.00
Upscale Gas	80.14	79.70	0.44	79.65	0.49	0.05

Calibrated by

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

		Run #	1
Client	Gulf BL Co., Ltd.	Location	ปล่อง HRSG 12
Date	22 Oct 25	Test Operator	Boonyarith I.
Start Time	13:20	Finish Time	13:40
SO_2 Analyzer Model	TELEDYNE API T100H	Serial No.	553
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	991
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	924

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
13:20	14.04	3.72	19.92	0.96	0.61	
13:21	14.12	3.71	21.11	0.94	0.61	
13:22	14.13	3.68	21.10	0.93	0.62	
13:23	14.12	3.68	20.72	0.94	0.57	
13:24	14.11	3.68	20.75	0.93	0.58	
13:25	14.13	3.69	20.76	0.90	0.60	
13:26	14.15	3.68	20.39	0.89	0.52	
13:27	14.15	3.67	19.89	0.89	0.52	
13:28	14.13	3.67	19.83	0.86	0.57	
13:29	14.11	3.67	19.94	0.86	0.57	
13:30	14.14	3.68	19.88	0.85	0.56	
13:31	14.15	3.68	19.73	0.86	0.52	
13:32	14.14	3.67	19.71	0.83	0.51	
13:33	14.15	3.67	19.77	0.85	0.49	
13:34	14.15	3.67	19.76	0.86	0.52	
13:35	14.14	3.67	19.80	0.84	0.51	
13:36	14.11	3.68	19.89	0.83	0.50	
13:37	14.14	3.68	19.90	0.85	0.51	
13:38	14.14	3.67	19.82	0.83	0.52	
13:39	14.14	3.68	19.83	0.80	0.56	
13:40	14.15	3.68	19.84	0.81	0.54	
Average	14.13	3.68	20.11	0.87	0.55	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

		Run #	2
Client	Gulf BL Co., Ltd.	Location	ปล่อง HRSG 12
Date	22 Oct 25	Test Operator	Boonyarith I.
Start Time	13:41	Finish Time	14:01
SO_2 Analyzer Model	TELEDYNE API T100H	Serial No.	553
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	991
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	924

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
13:41	14.15	3.67	19.84	0.79	0.53	
13:42	14.14	3.68	19.87	0.80	0.54	
13:43	14.14	3.68	19.96	0.79	0.54	
13:44	14.16	3.67	20.00	0.79	0.48	
13:45	14.14	3.66	20.06	0.75	0.54	
13:46	14.13	3.67	20.10	0.76	0.54	
13:47	14.14	3.68	20.05	0.76	0.52	
13:48	14.11	3.69	20.01	0.76	0.50	
13:49	14.13	3.68	19.99	0.76	0.58	
13:50	14.10	3.68	19.98	0.74	0.52	
13:51	14.12	3.68	19.88	0.71	0.52	
13:52	14.11	3.68	19.84	0.72	0.50	
13:53	14.13	3.68	19.84	0.70	0.52	
13:54	14.11	3.68	19.93	0.69	0.53	
13:55	14.09	3.68	20.02	0.69	0.54	
13:56	14.10	3.69	19.99	0.68	0.54	
13:57	14.12	3.68	19.88	0.67	0.53	
13:58	14.11	3.68	19.83	0.64	0.51	
13:59	14.13	3.68	19.94	0.66	0.54	
14:00	14.10	3.67	19.95	0.64	0.53	
14:01	14.11	3.67	19.97	0.65	0.50	
Average	14.12	3.68	19.95	0.72	0.53	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

EMISSION TEST RESULT

		Run #	3
Client	Gulf BL Co., Ltd.	Location	ปล่อง HRSG 12
Date	22 Oct 25	Test Operator	Boonyarith I.
Start Time	14:02	Finish Time	14:22
SO_2 Analyzer Model	TELEDYNE API T100H	Serial No.	553
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	991
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	924

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
14:02	14.11	3.67	19.98	0.87	0.54	
14:03	14.10	3.68	19.91	0.89	0.55	
14:04	14.12	3.68	19.93	0.85	0.54	
14:05	14.11	3.68	19.96	0.86	0.59	
14:06	14.09	3.68	19.96	0.85	0.58	
14:07	14.12	3.68	19.90	0.85	0.56	
14:08	14.08	3.68	19.81	0.83	0.55	
14:09	14.11	3.68	19.78	0.85	0.52	
14:10	14.11	3.67	19.87	0.81	0.54	
14:11	14.09	3.67	19.91	0.82	0.53	
14:12	14.12	3.68	19.94	0.81	0.58	
14:13	14.10	3.68	19.90	0.81	0.55	
14:14	14.09	3.68	19.87	0.82	0.53	
14:15	14.11	3.68	19.86	0.81	0.55	
14:16	14.12	3.68	19.84	0.79	0.55	
14:17	14.11	3.67	19.82	0.78	0.54	
14:18	14.11	3.68	19.88	0.79	0.58	
14:19	14.11	3.67	19.95	0.82	0.53	
14:20	14.09	3.67	19.94	0.81	0.55	
14:21	14.09	3.68	19.96	0.78	0.59	
14:22	14.09	3.69	19.84	0.78	0.54	
Average	14.10	3.68	19.90	0.82	0.55	

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

Lot No. 2595693-1

ANALYZER CALIBRATION DATA

Client	:	Gulf BL Co., Ltd.	Location	:	ปล่อง HRSG 11
Date	:	22 Oct 25	Test Operator	:	Boonyarith I.

O_2 ANALYZER

Model	:	TELEDYNE API T200H	Serial No.	:	482
Span (%)	:	25			

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	7.98	7.95	7.97	0.08
Span Gas	16.12	16.07	16.09	0.08

NO_X ANALYZER

Model	:	TELEDYNE API T200H	Serial No.	:	482
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.02	0.02
Low-Level Gas	56.16	56.09	56.11	0.02
Span Gas	80.73	80.61	80.66	0.05

SO2 ANALYZER

Model	:	TELEDYNE API T100H	Serial No.	:	324
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	55.55	55.48	55.56	0.08
Span Gas	79.43	79.32	79.58	0.26

CO ANALYZER

Model	:	TELEDYNE API T300M	Serial No.	:	377
Span (ppm)	:	100			

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.20	0.20
Low-Level Gas	54.22	54.07	54.13	0.06
Span Gas	79.82	79.74	79.66	0.08

Calibrated by

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

Lot No. 2595693-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	:	Gulf BL Co., Ltd.	Location	:	ปล่อง HRSG 11
Date	:	22 Oct 25	Test Operator	:	Boonyarith I.

O_2 ANALYZER

Cylinder Conc. (%) : 16.12 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.02	0.08	0.03	0.12	0.04
Upscale Gas	16.07	16.08	0.04	16.10	0.12	0.08

NO_X ANALYZER

Cylinder Conc. (ppm) : 80.73 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.04	0.04	0.02	0.02	0.02
Upscale Gas	80.61	81.76	1.15	81.80	1.19	0.04

SO_2 ANALYZER

Cylinder Conc. (ppm) : 79.43 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.05	0.05	0.03	0.03	0.02
Upscale Gas	79.32	80.34	1.02	80.37	1.05	0.03

CO ANALYZER

Cylinder Conc. (ppm) : 79.82 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.01	0.01	0.03	0.03	0.02
Upscale Gas	79.74	79.59	0.15	79.73	0.01	0.14

Calibrated by

Boonyarith I.

(Mr. Boonyarith Iamted)

Environmental Field Scientist (2)

CEMs Data

Client Name	Gulf BL Co., Ltd.	Date	22 Oct 25
Plant Name	GBL	Location	ปล่อง HRSG 11

Run No: 1 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	13:20	0.39	20.44	1.67	14.77	43.21
22 Oct 25	13:21	0.31	19.60	1.67	14.83	43.21
22 Oct 25	13:22	0.26	20.11	1.66	14.83	43.31
22 Oct 25	13:23	0.01	20.63	1.66	14.83	42.71
22 Oct 25	13:24	0.03	21.11	1.66	14.83	42.11
22 Oct 25	13:25	0.04	18.96	1.65	14.83	42.18
22 Oct 25	13:26	0.05	19.11	1.65	14.83	42.43
22 Oct 25	13:27	0.14	18.83	1.65	14.83	42.20
22 Oct 25	13:28	0.34	18.43	1.64	14.83	41.96
22 Oct 25	13:29	0.35	18.03	1.64	14.83	41.99
22 Oct 25	13:30	0.21	18.19	1.64	14.84	42.07
22 Oct 25	13:31	0.00	18.85	1.63	14.84	41.96
22 Oct 25	13:32	0.00	19.50	1.63	14.84	42.34
22 Oct 25	13:33	0.00	20.16	1.63	14.84	42.56
22 Oct 25	13:34	0.00	20.82	1.62	14.84	42.54
22 Oct 25	13:35	0.00	20.52	1.62	14.84	42.53
22 Oct 25	13:36	0.00	20.18	1.62	14.84	42.61
22 Oct 25	13:37	0.00	19.84	1.61	14.84	42.36
22 Oct 25	13:38	0.00	19.17	1.61	14.84	42.27
22 Oct 25	13:39	0.25	18.31	1.60	14.84	42.45
22 Oct 25	13:40	0.22	18.52	1.60	14.84	42.59
Max		0.39	21.11	1.67	14.84	43.31
Avg		0.12	19.49	1.64	14.83	42.46

Run No: 2 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	13:41	0.34	18.77	1.60	14.84	42.71
22 Oct 25	13:42	0.35	19.03	1.59	14.84	43.05
22 Oct 25	13:43	0.10	19.38	1.59	14.84	42.95
22 Oct 25	13:44	0.03	19.95	1.59	14.84	42.86
22 Oct 25	13:45	0.02	19.64	1.58	14.84	42.64
22 Oct 25	13:46	0.01	19.33	1.58	14.84	42.71
22 Oct 25	13:47	0.05	19.02	1.58	14.83	42.63
22 Oct 25	13:48	0.12	18.71	1.57	14.83	42.51
22 Oct 25	13:49	0.33	18.40	1.57	14.83	42.35
22 Oct 25	13:50	0.39	18.44	1.57	14.83	42.41
22 Oct 25	13:51	0.22	18.63	1.56	14.83	42.44
22 Oct 25	13:52	0.13	18.82	1.56	14.83	42.70
22 Oct 25	13:53	0.00	19.01	1.56	14.83	42.56
22 Oct 25	13:54	0.08	18.91	1.55	14.83	42.22
22 Oct 25	13:55	0.16	18.28	1.55	14.83	42.43
22 Oct 25	13:56	0.21	18.07	1.55	14.84	42.41
22 Oct 25	13:57	0.32	18.11	1.54	14.84	42.14
22 Oct 25	13:58	0.39	18.15	1.54	14.85	42.48
22 Oct 25	13:59	0.35	18.19	1.53	14.85	42.22
22 Oct 25	14:00	0.10	18.24	1.53	14.85	42.16
22 Oct 25	14:01	0.12	18.29	1.53	14.85	42.18
Max		0.39	19.95	1.60	14.85	43.05
Avg		0.18	18.73	1.56	14.84	42.51

Run No: 3 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:02	0.19	18.38	1.52	14.85	42.25
22 Oct 25	14:03	0.26	18.47	1.52	14.85	42.31
22 Oct 25	14:04	0.06	18.57	1.52	14.84	42.31
22 Oct 25	14:05	0.03	18.67	1.51	14.84	42.26
22 Oct 25	14:06	0.04	18.77	1.51	14.84	42.38
22 Oct 25	14:07	0.03	18.87	1.51	14.83	42.44
22 Oct 25	14:08	0.03	18.93	1.50	14.83	42.42
22 Oct 25	14:09	0.04	18.98	1.50	14.82	42.34
22 Oct 25	14:10	0.04	19.04	1.50	14.82	42.40
22 Oct 25	14:11	0.05	19.10	1.49	14.82	42.39
22 Oct 25	14:12	0.05	19.15	1.49	14.81	42.51
22 Oct 25	14:13	0.06	19.21	1.49	14.81	42.26
22 Oct 25	14:14	0.11	18.53	1.48	14.81	42.46
22 Oct 25	14:15	0.45	18.24	1.48	14.80	42.57
22 Oct 25	14:16	0.42	18.33	1.48	14.80	42.68
22 Oct 25	14:17	0.45	18.48	1.47	14.79	42.74
22 Oct 25	14:18	0.50	18.72	1.47	14.79	42.86
22 Oct 25	14:19	0.35	18.96	1.46	14.79	42.45
22 Oct 25	14:20	0.13	19.07	1.46	14.78	42.21
22 Oct 25	14:21	0.15	18.62	1.46	14.78	41.74
22 Oct 25	14:22	0.02	18.33	1.45	14.78	42.42
Max		0.50	19.21	1.52	14.85	42.86
Avg		0.16	18.73	1.49	14.81	42.40

Run No: 4 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:23	0.02	19.28	1.45	14.77	42.83
22 Oct 25	14:24	0.04	19.54	1.45	14.77	42.48
22 Oct 25	14:25	0.11	19.46	1.44	14.77	42.28
22 Oct 25	14:26	0.35	18.61	1.44	14.78	42.31
22 Oct 25	14:27	0.40	18.66	1.44	14.78	42.19
22 Oct 25	14:28	0.31	18.76	1.43	14.78	42.34
22 Oct 25	14:29	0.00	19.21	1.43	14.78	42.23
22 Oct 25	14:30	0.00	19.89	1.43	14.78	42.36
22 Oct 25	14:31	0.00	20.57	1.42	14.78	42.45
22 Oct 25	14:32	0.00	21.03	1.42	14.78	42.26
22 Oct 25	14:33	0.00	20.93	1.42	14.78	42.42
22 Oct 25	14:34	0.00	20.84	1.41	14.78	42.45
22 Oct 25	14:35	0.00	20.47	1.41	14.78	42.55
22 Oct 25	14:36	0.41	17.50	1.41	14.78	42.57
22 Oct 25	14:37	0.44	16.82	1.40	14.78	42.33
22 Oct 25	14:38	0.39	16.46	1.40	14.78	42.50
22 Oct 25	14:39	0.43	16.43	1.39	14.78	42.57
22 Oct 25	14:40	0.41	16.88	1.39	14.79	42.41
22 Oct 25	14:41	0.44	17.32	1.39	14.79	42.66
22 Oct 25	14:42	0.22	17.77	1.38	14.79	42.28
22 Oct 25	14:43	0.10	17.83	1.38	14.79	42.47
Max		0.44	21.03	1.45	14.79	42.83
Avg		0.19	18.77	1.42	14.78	42.43

Run No: 5 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:44	0.34	17.73	1.38	14.79	42.65
22 Oct 25	14:45	0.14	17.64	1.37	14.79	42.56
22 Oct 25	14:46	0.31	17.55	1.37	14.79	42.60
22 Oct 25	14:47	0.44	17.45	1.37	14.79	42.37
22 Oct 25	14:48	0.39	17.36	1.36	14.79	42.47
22 Oct 25	14:49	0.45	17.72	1.36	14.79	42.84
22 Oct 25	14:50	0.35	18.37	1.36	14.79	42.57
22 Oct 25	14:51	0.36	18.69	1.35	14.79	42.56
22 Oct 25	14:52	0.32	19.00	1.35	14.79	42.55
22 Oct 25	14:53	0.43	19.14	1.35	14.79	42.47
22 Oct 25	14:54	0.43	19.00	1.34	14.80	42.65
22 Oct 25	14:55	0.43	18.86	1.34	14.80	42.68
22 Oct 25	14:56	0.41	18.72	1.34	14.80	42.61
22 Oct 25	14:57	0.42	18.46	1.33	14.80	42.46
22 Oct 25	14:58	0.39	18.74	1.33	14.80	42.47
22 Oct 25	14:59	0.21	19.49	1.33	14.80	42.37
22 Oct 25	15:00	0.02	20.23	1.32	14.80	42.41
22 Oct 25	15:01	0.01	20.46	1.32	14.80	42.51
22 Oct 25	15:02	0.01	20.68	1.31	14.80	42.33
22 Oct 25	15:03	0.02	20.33	1.31	14.80	42.15
22 Oct 25	15:04	0.02	19.92	1.31	14.80	42.27
Max		0.45	20.68	1.38	14.80	42.84
Avg		0.28	18.84	1.34	14.80	42.50

Run No: 6 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:05	0.03	19.50	1.30	14.80	42.23
22 Oct 25	15:06	0.35	19.09	1.30	14.80	42.07
22 Oct 25	15:07	0.38	18.69	1.30	14.80	42.34
22 Oct 25	15:08	0.45	18.55	1.29	14.81	42.46
22 Oct 25	15:09	0.40	18.58	1.29	14.81	42.39
22 Oct 25	15:10	0.43	18.65	1.29	14.81	42.17
22 Oct 25	15:11	0.41	18.91	1.28	14.81	42.34
22 Oct 25	15:12	0.29	19.17	1.28	14.81	42.35
22 Oct 25	15:13	0.17	19.43	1.28	14.81	42.36
22 Oct 25	15:14	0.20	19.66	1.27	14.81	42.30
22 Oct 25	15:15	0.31	19.25	1.27	14.81	42.49
22 Oct 25	15:16	0.32	18.82	1.27	14.81	42.23
22 Oct 25	15:17	0.37	18.56	1.26	14.81	42.34
22 Oct 25	15:18	0.40	18.65	1.26	14.81	42.48
22 Oct 25	15:19	0.32	18.88	1.26	14.81	42.55
22 Oct 25	15:20	0.42	19.29	1.25	14.81	42.76
22 Oct 25	15:21	0.26	19.70	1.25	14.81	42.98
22 Oct 25	15:22	0.09	20.09	1.24	14.81	42.62
22 Oct 25	15:23	0.09	19.94	1.24	14.81	42.88
22 Oct 25	15:24	0.16	19.79	1.24	14.81	42.82
22 Oct 25	15:25	0.28	19.64	1.23	14.82	42.89
Max		0.45	20.09	1.30	14.82	42.98
Avg		0.29	19.18	1.27	14.81	42.48

CEMs Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 11

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:26	0.40	19.49	1.23	14.82	42.62
22 Oct 25	15:27	0.31	19.34	1.23	14.82	42.54
22 Oct 25	15:28	0.22	19.52	1.22	14.82	42.43
22 Oct 25	15:29	0.01	20.12	1.22	14.82	42.61
22 Oct 25	15:30	0.01	20.71	1.22	14.82	42.53
22 Oct 25	15:31	0.01	21.14	1.21	14.82	42.46
22 Oct 25	15:32	0.01	21.55	1.21	14.82	42.44
22 Oct 25	15:33	0.02	21.12	1.21	14.82	42.51
22 Oct 25	15:34	0.02	20.65	1.20	14.82	42.36
22 Oct 25	15:35	0.02	20.04	1.20	14.82	42.25
22 Oct 25	15:36	0.34	19.11	1.20	14.82	41.87
22 Oct 25	15:37	0.34	18.42	1.19	14.82	42.34
22 Oct 25	15:38	0.34	18.65	1.19	14.82	42.44
22 Oct 25	15:39	0.35	18.89	1.19	14.82	42.61
22 Oct 25	15:40	0.29	19.13	1.18	14.82	42.47
22 Oct 25	15:41	0.13	19.37	1.18	14.82	42.28
22 Oct 25	15:42	0.03	19.60	1.17	14.82	42.30
22 Oct 25	15:43	0.04	19.84	1.17	14.83	42.39
22 Oct 25	15:44	0.05	19.60	1.17	14.83	42.29
22 Oct 25	15:45	0.16	19.29	1.16	14.83	42.06
22 Oct 25	15:46	0.31	18.90	1.16	14.83	42.30
Max		0.40	21.55	1.23	14.83	42.62
Avg		0.16	19.74	1.20	14.82	42.39

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:47	0.38	18.86	1.16	14.83	42.35
22 Oct 25	15:48	0.37	19.01	1.15	14.83	42.40
22 Oct 25	15:49	0.27	19.17	1.15	14.83	42.33
22 Oct 25	15:50	0.14	19.32	1.15	14.83	42.31
22 Oct 25	15:51	0.10	19.47	1.14	14.83	42.65
22 Oct 25	15:52	0.01	19.63	1.14	14.83	42.49
22 Oct 25	15:53	0.04	19.78	1.14	14.83	42.13
22 Oct 25	15:54	0.28	19.29	1.13	14.83	42.21
22 Oct 25	15:55	0.40	18.98	1.13	14.83	42.14
22 Oct 25	15:56	0.37	18.95	1.13	14.83	42.12
22 Oct 25	15:57	0.16	19.04	1.12	14.83	42.04
22 Oct 25	15:58	0.02	19.58	1.12	14.83	42.19
22 Oct 25	15:59	0.03	20.12	1.12	14.83	42.35
22 Oct 25	16:00	0.03	20.66	1.11	14.83	42.40
22 Oct 25	16:01	0.04	20.89	1.11	14.84	42.47
22 Oct 25	16:02	0.05	20.93	1.10	14.84	42.49
22 Oct 25	16:03	0.05	20.88	1.10	14.84	42.61
22 Oct 25	16:04	0.06	20.18	1.10	14.84	42.51
22 Oct 25	16:05	0.28	19.47	1.09	14.84	42.67
22 Oct 25	16:06	0.37	18.76	1.09	14.84	42.75
22 Oct 25	16:07	0.33	18.25	1.09	14.84	42.76
Max		0.40	20.93	1.16	14.84	42.76
Avg		0.18	19.58	1.12	14.83	42.40

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:08	0.39	18.54	1.08	14.84	42.93
22 Oct 25	16:09	0.36	18.83	1.08	14.84	42.84
22 Oct 25	16:10	0.40	19.08	1.08	14.84	42.82
22 Oct 25	16:11	0.10	19.18	1.07	14.84	42.81
22 Oct 25	16:12	0.02	19.29	1.07	14.84	42.79
22 Oct 25	16:13	0.04	19.39	1.07	14.84	42.76
22 Oct 25	16:14	0.30	19.25	1.06	14.84	42.53
22 Oct 25	16:15	0.37	18.67	1.06	14.84	42.56
22 Oct 25	16:16	0.40	18.27	1.06	14.84	42.53
22 Oct 25	16:17	0.41	18.56	1.05	14.84	42.74
22 Oct 25	16:18	0.39	18.85	1.05	14.84	42.73
22 Oct 25	16:19	0.30	19.14	1.05	14.84	42.62
22 Oct 25	16:20	0.04	19.36	1.04	14.84	42.62
22 Oct 25	16:21	0.03	19.30	1.04	14.84	42.78
22 Oct 25	16:22	0.04	19.24	1.04	14.84	42.81
22 Oct 25	16:23	0.23	19.19	1.03	14.84	42.93
22 Oct 25	16:24	0.43	18.95	1.03	14.84	42.87
22 Oct 25	16:25	0.41	18.68	1.02	14.84	42.76
22 Oct 25	16:26	0.31	19.19	1.02	14.83	42.91
22 Oct 25	16:27	0.01	19.86	1.02	14.83	43.14
22 Oct 25	16:28	0.01	20.52	1.01	14.83	43.10
Max		0.43	20.52	1.08	14.84	43.14
Avg		0.24	19.11	1.05	14.84	42.79

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:29	0.02	21.26	1.01	14.83	43.14
22 Oct 25	16:30	0.02	21.25	1.01	14.83	42.97
22 Oct 25	16:31	0.02	21.23	1.00	14.83	42.96
22 Oct 25	16:32	0.03	20.75	1.00	14.83	43.02
22 Oct 25	16:33	0.03	20.00	1.00	14.83	42.87
22 Oct 25	16:34	0.18	19.26	0.99	14.83	42.72
22 Oct 25	16:35	0.32	19.07	0.99	14.83	42.82
22 Oct 25	16:36	0.42	19.02	0.99	14.83	42.95
22 Oct 25	16:37	0.40	18.97	0.98	14.83	42.87
22 Oct 25	16:38	0.45	18.92	0.98	14.83	42.88
22 Oct 25	16:39	0.41	19.06	0.98	14.83	43.08
22 Oct 25	16:40	0.48	19.42	0.97	14.83	43.14
22 Oct 25	16:41	0.02	19.78	0.97	14.83	43.15
22 Oct 25	16:42	0.00	20.03	0.97	14.83	43.00
22 Oct 25	16:43	0.00	19.91	0.96	14.83	42.94
22 Oct 25	16:44	0.01	19.79	0.96	14.83	42.77
22 Oct 25	16:45	0.02	19.66	0.95	14.83	42.87
22 Oct 25	16:46	0.29	19.48	0.95	14.83	42.96
22 Oct 25	16:47	0.38	19.27	0.95	14.83	42.92
22 Oct 25	16:48	0.14	19.63	0.94	14.83	42.92
22 Oct 25	16:49	0.05	19.99	0.94	14.83	42.76
Max		0.48	21.26	1.01	14.83	43.15
Avg		0.18	19.80	0.98	14.83	42.94

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:50	0.07	20.10	0.94	14.83	42.84
22 Oct 25	16:51	0.01	20.20	0.93	14.83	43.00
22 Oct 25	16:52	0.01	20.21	0.93	14.83	42.98
22 Oct 25	16:53	0.01	19.90	0.94	14.83	42.87
22 Oct 25	16:54	0.05	19.58	0.94	14.83	42.82
22 Oct 25	16:55	0.32	19.27	0.94	14.83	42.80
22 Oct 25	16:56	0.34	18.95	0.94	14.83	42.84
22 Oct 25	16:57	0.25	19.19	0.95	14.83	42.97
22 Oct 25	16:58	0.19	19.46	0.95	14.83	42.85
22 Oct 25	16:59	0.11	19.72	0.95	14.83	42.90
22 Oct 25	17:00	0.03	19.98	0.96	14.83	42.84
22 Oct 25	17:01	0.01	19.91	0.96	14.83	42.72
22 Oct 25	17:02	0.03	19.64	0.96	14.83	42.61
22 Oct 25	17:03	0.17	19.38	0.96	14.83	42.59
22 Oct 25	17:04	0.26	19.11	0.97	14.83	42.71
22 Oct 25	17:05	0.36	19.09	0.97	14.83	42.77
22 Oct 25	17:06	0.31	19.21	0.97	14.83	42.58
22 Oct 25	17:07	0.14	19.33	0.97	14.83	42.63
22 Oct 25	17:08	0.10	19.45	0.98	14.83	42.58
22 Oct 25	17:09	0.02	19.57	0.98	14.83	42.65
22 Oct 25	17:10	0.03	19.69	0.98	14.83	42.74
Max		0.36	20.21	0.98	14.83	43.00
Avg		0.13	19.57	0.96	14.83	42.78

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	17:11	0.04	19.66	0.98	14.83	42.55
22 Oct 25	17:12	0.05	19.61	0.99	14.83	42.45
22 Oct 25	17:13	0.09	19.33	0.99	14.83	42.75
22 Oct 25	17:14	0.27	19.04	0.99	14.83	42.75
22 Oct 25	17:15	0.31	18.98	0.99	14.83	42.76
22 Oct 25	17:16	0.29	19.06	1.00	14.83	42.87
22 Oct 25	17:17	0.14	19.14	1.00	14.83	42.83
22 Oct 25	17:18	0.02	19.22	1.00	14.83	42.79
22 Oct 25	17:19	0.03	19.30	1.00	14.83	42.74
22 Oct 25	17:20	0.05	19.38	1.01	14.83	42.75
22 Oct 25	17:21	0.14	19.46	1.01	14.83	42.63
22 Oct 25	17:22	0.27	19.15	1.01	14.83	42.55
22 Oct 25	17:23	0.32	18.82	1.02	14.83	42.42
22 Oct 25	17:24	0.33	18.89	1.02	14.83	42.54
22 Oct 25	17:25	0.18	18.96	1.02	14.82	42.78
22 Oct 25	17:26	0.01	19.12	1.02	14.82	42.53
22 Oct 25	17:27	0.02	19.28	1.03	14.82	42.62
22 Oct 25	17:28	0.02	19.44	1.03	14.82	42.72
22 Oct 25	17:29	0.03	19.44	1.03	14.82	42.72
22 Oct 25	17:30	0.06	19.15	1.03	14.82	42.67
22 Oct 25	17:31	0.22	18.86	1.04	14.82	42.55
Max		0.33	19.66	1.04	14.83	42.87
Avg		0.14	19.21	1.01	14.83	42.67

Reference Method Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 11

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	13:20	0.06	23.00	0.28	13.92	4.02
22 Oct 25	13:21	0.06	24.78	0.30	13.98	3.99
22 Oct 25	13:22	0.05	24.61	0.28	13.98	3.99
22 Oct 25	13:23	0.05	24.36	0.35	13.98	4.00
22 Oct 25	13:24	0.05	24.56	0.38	13.99	3.99
22 Oct 25	13:25	0.05	24.20	0.37	14.00	4.01
22 Oct 25	13:26	0.04	23.25	0.36	14.02	3.97
22 Oct 25	13:27	0.04	22.80	0.41	14.04	3.98
22 Oct 25	13:28	0.04	22.89	0.44	14.02	4.01
22 Oct 25	13:29	0.03	22.89	0.40	14.03	4.00
22 Oct 25	13:30	0.03	22.76	0.38	14.02	3.97
22 Oct 25	13:31	0.03	22.66	0.39	14.02	3.99
22 Oct 25	13:32	0.03	22.63	0.41	14.02	3.99
22 Oct 25	13:33	0.07	22.62	0.40	14.03	3.94
22 Oct 25	13:34	0.09	22.72	0.45	14.03	3.98
22 Oct 25	13:35	0.09	22.94	0.42	14.03	3.95
22 Oct 25	13:36	0.09	23.08	0.39	14.05	3.96
22 Oct 25	13:37	0.08	23.08	0.42	14.03	3.97
22 Oct 25	13:38	0.08	23.04	0.42	14.04	3.98
22 Oct 25	13:39	0.09	22.96	0.45	14.01	3.97
22 Oct 25	13:40	0.07	22.87	0.50	14.02	3.94
Max		0.09	24.78	0.50	14.05	4.02
Avg		0.06	23.27	0.39	14.02	3.98

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	13:41	0.08	22.94	0.43	14.02	3.99
22 Oct 25	13:42	0.08	23.12	0.38	14.01	3.98
22 Oct 25	13:43	0.08	23.28	0.45	14.02	3.99
22 Oct 25	13:44	0.08	23.57	0.48	14.02	3.99
22 Oct 25	13:45	0.07	23.68	0.50	14.03	3.97
22 Oct 25	13:46	0.07	23.54	0.54	14.03	3.97
22 Oct 25	13:47	0.07	23.38	0.46	14.01	3.99
22 Oct 25	13:48	0.06	23.29	0.50	14.02	3.97
22 Oct 25	13:49	0.05	23.19	0.51	14.00	4.00
22 Oct 25	13:50	0.05	23.11	0.56	14.00	4.00
22 Oct 25	13:51	0.05	23.06	0.55	14.00	3.97
22 Oct 25	13:52	0.05	23.00	0.54	14.02	4.02
22 Oct 25	13:53	0.05	22.99	0.53	14.02	3.99
22 Oct 25	13:54	0.05	23.11	0.57	14.01	3.98
22 Oct 25	13:55	0.05	23.19	0.56	14.01	3.95
22 Oct 25	13:56	0.05	23.02	0.53	14.02	4.02
22 Oct 25	13:57	0.04	22.88	0.55	14.01	3.94
22 Oct 25	13:58	0.04	22.91	0.50	14.00	4.03
22 Oct 25	13:59	0.04	23.01	0.53	14.01	3.98
22 Oct 25	14:00	0.04	23.06	0.64	14.01	3.98
22 Oct 25	14:01	0.04	23.03	0.60	14.01	3.97
Max		0.08	23.68	0.64	14.03	4.03
Avg		0.06	23.16	0.52	14.02	3.98

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:02	0.03	22.89	0.53	14.00	4.01
22 Oct 25	14:03	0.06	22.86	0.57	14.00	3.98
22 Oct 25	14:04	0.08	22.91	0.59	13.99	4.03
22 Oct 25	14:05	0.08	22.92	0.56	14.00	3.96
22 Oct 25	14:06	0.08	22.91	0.60	13.98	3.97
22 Oct 25	14:07	0.07	22.78	0.56	13.98	4.00
22 Oct 25	14:08	0.07	22.77	0.59	14.00	4.01
22 Oct 25	14:09	0.07	22.94	0.60	13.99	4.00
22 Oct 25	14:10	0.08	22.98	0.64	14.00	3.98
22 Oct 25	14:11	0.08	22.91	0.64	13.99	3.98
22 Oct 25	14:12	0.07	22.86	0.59	13.99	3.96
22 Oct 25	14:13	0.07	22.89	0.57	13.99	4.00
22 Oct 25	14:14	0.08	22.84	0.62	14.00	4.05
22 Oct 25	14:15	0.07	22.80	0.66	14.00	4.01
22 Oct 25	14:16	0.07	22.86	0.64	14.00	3.99
22 Oct 25	14:17	0.08	23.03	0.65	14.02	4.04
22 Oct 25	14:18	0.08	23.16	0.64	14.01	3.99
22 Oct 25	14:19	0.07	23.30	0.64	14.02	3.98
22 Oct 25	14:20	0.07	23.32	0.63	14.02	3.97
22 Oct 25	14:21	0.08	23.12	0.60	14.00	3.96
22 Oct 25	14:22	0.07	22.71	0.61	14.19	3.94
Max		0.08	23.32	0.66	14.19	4.05
Avg		0.07	22.94	0.60	14.01	3.99

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:23	0.07	20.48	0.70	14.20	3.99
22 Oct 25	14:24	0.07	20.63	0.66	14.21	4.04
22 Oct 25	14:25	0.06	20.96	0.63	14.19	3.99
22 Oct 25	14:26	0.07	21.01	0.63	14.20	4.01
22 Oct 25	14:27	0.07	20.89	0.66	14.21	3.99
22 Oct 25	14:28	0.07	20.84	0.73	14.22	4.00
22 Oct 25	14:29	0.07	20.73	0.69	14.25	3.97
22 Oct 25	14:30	0.07	20.66	0.73	14.22	3.97
22 Oct 25	14:31	0.07	20.68	0.72	14.21	4.00
22 Oct 25	14:32	0.06	20.77	0.69	14.20	3.93
22 Oct 25	14:33	0.08	20.85	0.72	14.19	4.00
22 Oct 25	14:34	0.09	20.90	0.77	14.20	4.00
22 Oct 25	14:35	0.10	20.93	0.82	14.22	4.00
22 Oct 25	14:36	0.09	20.96	0.86	14.21	3.97
22 Oct 25	14:37	0.09	21.09	0.83	14.21	3.94
22 Oct 25	14:38	0.09	21.28	0.74	14.19	3.96
22 Oct 25	14:39	0.09	21.31	0.80	14.20	3.97
22 Oct 25	14:40	0.09	21.32	0.81	14.20	4.00
22 Oct 25	14:41	0.09	21.34	0.81	14.19	3.99
22 Oct 25	14:42	0.09	21.35	0.78	14.20	4.00
22 Oct 25	14:43	0.09	21.26	0.77	14.20	3.99
Max		0.10	21.35	0.86	14.25	4.04
Avg		0.08	20.96	0.74	14.21	3.98

Run No: 5 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:44	0.08	21.17	0.83	14.21	3.96
22 Oct 25	14:45	0.08	21.13	0.78	14.20	4.00
22 Oct 25	14:46	0.09	21.20	0.81	14.20	4.01
22 Oct 25	14:47	0.10	21.23	0.84	14.19	4.00
22 Oct 25	14:48	0.09	21.19	0.85	14.19	3.95
22 Oct 25	14:49	0.07	21.10	0.86	14.19	3.99
22 Oct 25	14:50	0.09	21.04	0.86	14.19	3.98
22 Oct 25	14:51	0.08	21.10	0.81	14.20	4.00
22 Oct 25	14:52	0.08	21.17	0.81	14.18	3.98
22 Oct 25	14:53	0.07	21.16	0.83	14.18	3.99
22 Oct 25	14:54	0.07	21.16	0.83	14.17	4.00
22 Oct 25	14:55	0.07	21.11	0.86	14.18	3.95
22 Oct 25	14:56	0.06	21.14	0.87	14.18	3.98
22 Oct 25	14:57	0.07	21.28	0.82	14.18	3.97
22 Oct 25	14:58	0.07	21.32	0.84	14.17	3.96
22 Oct 25	14:59	0.06	21.27	0.89	14.18	3.97
22 Oct 25	15:00	0.06	21.25	0.90	14.16	3.96
22 Oct 25	15:01	0.06	21.15	0.88	14.17	3.99
22 Oct 25	15:02	0.05	21.05	0.82	14.17	3.98
22 Oct 25	15:03	0.06	21.03	0.88	14.17	3.99
22 Oct 25	15:04	0.07	20.97	0.88	14.16	3.98
Max		0.10	21.32	0.90	14.21	4.01
Avg		0.07	21.16	0.84	14.19	3.98

Run No: 6 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:05	0.06	20.85	0.87	14.17	4.04
22 Oct 25	15:06	0.06	20.84	0.89	14.16	4.00
22 Oct 25	15:07	0.06	20.87	0.96	14.16	3.97
22 Oct 25	15:08	0.06	20.93	0.87	14.16	3.97
22 Oct 25	15:09	0.06	21.05	0.90	14.16	4.00
22 Oct 25	15:10	0.05	21.19	0.96	14.15	4.00
22 Oct 25	15:11	0.05	21.14	0.93	14.15	3.96
22 Oct 25	15:12	0.05	21.00	0.87	14.16	4.01
22 Oct 25	15:13	0.05	21.04	0.88	14.16	3.97
22 Oct 25	15:14	0.03	21.06	0.90	14.14	3.98
22 Oct 25	15:15	0.03	21.03	0.90	14.16	3.98
22 Oct 25	15:16	0.03	21.00	0.56	14.17	3.97
22 Oct 25	15:17	0.04	21.02	0.57	14.15	4.01
22 Oct 25	15:18	0.03	21.09	0.60	14.15	3.98
22 Oct 25	15:19	0.03	21.14	0.62	14.14	3.97
22 Oct 25	15:20	0.02	21.31	0.54	14.16	3.96
22 Oct 25	15:21	0.02	21.41	0.54	14.16	3.98
22 Oct 25	15:22	0.02	21.52	0.60	14.16	3.96
22 Oct 25	15:23	0.02	21.60	0.58	14.16	3.96
22 Oct 25	15:24	0.02	21.63	0.59	14.18	3.97
22 Oct 25	15:25	0.02	21.64	0.57	14.17	4.01
Max		0.06	21.64	0.96	14.18	4.04
Avg		0.04	21.16	0.75	14.16	3.98

Reference Method Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 11

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:26	0.01	21.59	0.61	14.16	3.95
22 Oct 25	15:27	0.01	21.57	0.63	14.16	3.95
22 Oct 25	15:28	0.01	21.46	0.61	14.15	3.99
22 Oct 25	15:29	0.00	21.35	0.55	14.16	3.95
22 Oct 25	15:30	0.01	21.22	0.54	14.15	3.96
22 Oct 25	15:31	-0.01	21.25	0.54	14.15	4.01
22 Oct 25	15:32	-0.01	21.33	0.62	14.15	4.01
22 Oct 25	15:33	0.02	21.31	0.57	14.15	3.98
22 Oct 25	15:34	0.04	21.32	0.62	14.15	3.98
22 Oct 25	15:35	0.04	21.30	0.67	14.15	4.00
22 Oct 25	15:36	0.02	21.22	0.65	14.16	3.95
22 Oct 25	15:37	0.03	21.06	0.60	14.15	3.99
22 Oct 25	15:38	0.03	20.99	0.64	14.15	3.98
22 Oct 25	15:39	0.03	21.05	0.69	14.15	3.99
22 Oct 25	15:40	0.02	21.29	0.66	14.15	3.99
22 Oct 25	15:41	0.02	21.33	0.64	14.15	4.00
22 Oct 25	15:42	0.02	21.26	0.68	14.14	4.00
22 Oct 25	15:43	0.02	21.20	0.67	14.16	3.99
22 Oct 25	15:44	0.02	21.23	0.67	14.14	4.00
22 Oct 25	15:45	0.01	21.25	0.64	14.15	3.97
22 Oct 25	15:46	0.01	21.15	0.64	14.15	4.01
Max		0.04	21.59	0.69	14.16	4.01
Avg		0.02	21.27	0.63	14.15	3.98

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:47	0.02	21.01	0.65	14.14	3.95
22 Oct 25	15:48	0.01	20.98	0.69	14.15	3.97
22 Oct 25	15:49	0.00	21.09	0.67	14.13	3.97
22 Oct 25	15:50	0.00	21.18	0.70	14.13	3.95
22 Oct 25	15:51	0.00	21.24	0.68	14.14	3.99
22 Oct 25	15:52	0.00	21.28	0.65	14.14	3.94
22 Oct 25	15:53	-0.01	21.33	0.64	14.13	3.98
22 Oct 25	15:54	0.00	21.29	0.68	14.13	4.00
22 Oct 25	15:55	0.00	21.11	0.67	14.14	3.97
22 Oct 25	15:56	-0.01	20.96	0.66	14.13	4.00
22 Oct 25	15:57	-0.01	20.93	0.70	14.12	3.98
22 Oct 25	15:58	-0.02	20.85	0.73	14.12	3.98
22 Oct 25	15:59	-0.02	20.87	0.73	14.12	4.01
22 Oct 25	16:00	-0.01	20.88	0.66	14.11	3.99
22 Oct 25	16:01	-0.02	20.95	0.69	14.12	3.97
22 Oct 25	16:02	-0.02	20.99	0.70	14.13	4.00
22 Oct 25	16:03	0.01	21.18	0.71	14.12	3.99
22 Oct 25	16:04	0.03	21.28	0.77	14.13	4.01
22 Oct 25	16:05	0.04	21.35	0.74	14.10	3.99
22 Oct 25	16:06	0.04	21.26	0.74	14.13	3.93
22 Oct 25	16:07	0.03	21.25	0.76	14.13	3.95
Max		0.04	21.35	0.77	14.15	4.01
Avg		0.00	21.11	0.70	14.13	3.97

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:08	0.03	21.38	0.70	14.13	3.96
22 Oct 25	16:09	0.03	21.52	0.75	14.13	4.00
22 Oct 25	16:10	0.03	21.59	0.76	14.12	4.00
22 Oct 25	16:11	0.02	21.63	0.71	14.14	3.97
22 Oct 25	16:12	0.04	21.64	0.70	14.12	3.97
22 Oct 25	16:13	0.03	21.56	0.67	14.13	3.99
22 Oct 25	16:14	0.02	21.53	0.70	14.12	3.98
22 Oct 25	16:15	0.01	21.47	0.76	14.12	4.00
22 Oct 25	16:16	0.02	21.32	0.74	14.12	4.00
22 Oct 25	16:17	0.02	21.23	0.72	14.12	3.99
22 Oct 25	16:18	0.02	21.33	0.70	14.14	3.94
22 Oct 25	16:19	0.01	21.37	0.69	14.14	3.97
22 Oct 25	16:20	0.02	21.31	0.74	14.16	4.02
22 Oct 25	16:21	0.01	21.22	0.69	14.15	3.96
22 Oct 25	16:22	0.01	21.20	0.73	14.15	3.99
22 Oct 25	16:23	0.01	21.35	0.74	14.14	3.97
22 Oct 25	16:24	0.02	21.49	0.80	14.15	3.98
22 Oct 25	16:25	0.00	21.66	0.76	14.16	3.95
22 Oct 25	16:26	0.01	21.61	0.71	14.14	4.00
22 Oct 25	16:27	0.00	21.53	0.72	14.15	3.98
22 Oct 25	16:28	0.00	21.46	0.76	14.14	3.98
Max		0.04	21.66	0.80	14.16	4.02
Avg		0.02	21.45	0.73	14.14	3.98

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:29	0.00	21.57	0.73	14.15	3.97
22 Oct 25	16:30	-0.01	21.67	0.77	14.15	3.97
22 Oct 25	16:31	0.00	21.64	0.79	14.14	3.97
22 Oct 25	16:32	0.00	21.54	0.79	14.14	4.01
22 Oct 25	16:33	0.01	21.47	0.78	14.13	3.99
22 Oct 25	16:34	0.03	21.41	0.77	14.13	4.00
22 Oct 25	16:35	0.05	21.39	0.77	14.13	4.00
22 Oct 25	16:36	0.04	21.32	0.77	14.13	3.98
22 Oct 25	16:37	0.03	21.29	0.76	14.13	3.99
22 Oct 25	16:38	0.05	21.42	0.83	14.15	3.96
22 Oct 25	16:39	0.03	21.50	0.79	14.14	3.97
22 Oct 25	16:40	0.04	21.61	0.80	14.15	4.01
22 Oct 25	16:41	0.04	21.62	0.79	14.13	3.99
22 Oct 25	16:42	0.04	21.59	0.79	14.14	3.98
22 Oct 25	16:43	0.03	21.55	0.81	14.12	4.03
22 Oct 25	16:44	0.03	21.48	0.83	14.13	4.00
22 Oct 25	16:45	0.02	21.42	0.83	14.12	3.99
22 Oct 25	16:46	0.02	21.40	0.83	14.12	3.97
22 Oct 25	16:47	0.01	21.42	0.82	14.13	4.00
22 Oct 25	16:48	0.02	21.63	0.83	14.13	4.00
22 Oct 25	16:49	0.02	21.73	0.82	14.14	4.00
Max		0.05	21.73	0.83	14.15	4.03
Avg		0.02	21.51	0.79	14.14	3.99

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:50	0.01	21.69	0.79	14.13	4.01
22 Oct 25	16:51	0.00	21.54	0.77	14.14	4.00
22 Oct 25	16:52	0.00	21.48	0.75	14.13	4.00
22 Oct 25	16:53	0.00	21.46	0.78	14.12	3.99
22 Oct 25	16:54	-0.01	21.45	0.83	14.13	3.99
22 Oct 25	16:55	-0.01	21.37	0.86	14.13	3.99
22 Oct 25	16:56	-0.01	21.39	0.83	14.13	3.99
22 Oct 25	16:57	-0.01	21.42	0.87	14.13	3.99
22 Oct 25	16:58	-0.01	21.46	0.85	14.13	3.98
22 Oct 25	16:59	-0.02	21.50	0.87	14.11	3.96
22 Oct 25	17:00	-0.02	21.45	0.85	14.12	3.98
22 Oct 25	17:01	-0.03	21.46	0.85	14.13	4.01
22 Oct 25	17:02	-0.03	21.52	0.81	14.12	3.98
22 Oct 25	17:03	0.00	21.52	0.87	14.11	4.00
22 Oct 25	17:04	0.02	21.39	0.88	14.11	3.99
22 Oct 25	17:05	0.02	21.34	0.87	14.12	3.97
22 Oct 25	17:06	0.02	21.41	0.84	14.11	4.01
22 Oct 25	17:07	0.02	21.46	0.79	14.11	4.02
22 Oct 25	17:08	0.01	21.39	0.89	14.10	4.01
22 Oct 25	17:09	0.00	21.27	0.89	14.10	3.99
22 Oct 25	17:10	0.00	21.17	0.90	14.10	4.00
Max		0.02	21.69	0.90	14.14	4.02
Avg		0.00	21.43	0.84	14.12	3.99

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	17:11	0.01	21.23	0.88	14.09	3.99
22 Oct 25	17:12	0.00	21.29	0.87	14.09	3.98
22 Oct 25	17:13	-0.01	21.16	0.89	14.09	4.01
22 Oct 25	17:14	0.00	21.03	0.93	14.10	4.04
22 Oct 25	17:15	0.00	21.06	0.89	14.08	4.01
22 Oct 25	17:16	0.00	21.22	0.89	14.09	4.02
22 Oct 25	17:17	-0.02	21.26	0.94	14.09	3.99
22 Oct 25	17:18	-0.02	21.23	0.93	14.09	3.99
22 Oct 25	17:19	-0.02	21.23	0.97	14.09	3.97
22 Oct 25	17:20	-0.03	21.13	0.92	14.10	4.00
22 Oct 25	17:21	-0.03	21.16	0.95	14.10	3.97
22 Oct 25	17:22	-0.03	21.29	0.96	14.09	4.01
22 Oct 25	17:23	-0.04	21.32	0.96	14.10	3.99
22 Oct 25	17:24	-0.03	21.22	0.97	14.10	3.96
22 Oct 25	17:25	-0.03	21.19	0.91	14.10	4.04
22 Oct 25	17:26	-0.04	21.25	0.90	14.09	3.99
22 Oct 25	17:27	-0.03	21.29	0.97	14.10	4.02
22 Oct 25	17:28	-0.04	21.25	0.96	14.09	4.00
22 Oct 25	17:29	-0.03	21.19	0.94	14.08	3.96
22 Oct 25	17:30	-0.02	21.14	0.99	14.10	3.98
22 Oct 25	17:31	-0.01	21.09	0.93	14.08	4.02
Max		0.01	21.32	0.99	14.10	4.04
Avg		-0.02	21.20	0.93	14.10	3.99

Lot No. 2595696-1

ANALYZER CALIBRATION DATA

Client :	Gulf BL Co., Ltd.	Location :	ปล่อง HRSG 12
Date :	22 Oct 25	Test Operator :	Boonyarith I.

O_2 ANALYZER
Model : TELEDYNE API T200H Serial No. : 991
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	7.98	7.90	7.88	0.08
Span Gas	16.12	16.10	16.11	0.04

NO_X ANALYZER
Model : TELEDYNE API T200H Serial No. : 991
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	56.16	56.07	55.11	0.96
Span Gas	80.73	80.64	80.72	0.08

SO2 ANALYZER
Model : TELEDYNE API T100H Serial No. : 553
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.48	55.51	0.03
Span Gas	79.43	79.39	79.47	0.08

CO ANALYZER
Model : TELEDYNE API T300M Serial No. : 924
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.00	0.02
Low-Level Gas	54.22	54.16	54.23	0.07
Span Gas	79.82	80.14	80.23	0.09

Calibrated by

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 4 ISSUE DATE: 18/01/24

ALS Laboratory Group

Lot No. 2595696-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client :	Gulf BL Co., Ltd.	Location :	ปล่อง HRSG 12
Date :	22 Oct 25	Test Operator :	Boonyarith I.

O_2 ANALYZER
Cylinder Conc. (%) : 16.12 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	16.10	16.06	0.16	16.10	0.00	0.16

NO_X ANALYZER
Cylinder Conc. (ppm) : 80.73 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	80.64	80.67	0.03	80.74	0.10	0.07

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.43 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	79.39	79.28	0.11	79.29	0.10	0.01

CO ANALYZER
Cylinder Conc. (ppm) : 79.82 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.00	0.02	0.00	0.02	0.00
Upscale Gas	80.14	79.70	0.44	79.65	0.49	0.05

Calibrated by

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO.: F 06-063 REVISION NO.: 4 ISSUE DATE: 18/01/24

ALS Laboratory Group

CEMs Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 12

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	13:20	0.73	19.39	1.36	14.55	43.65
22 Oct 25	13:21	0.70	19.04	1.36	14.57	43.73
22 Oct 25	13:22	0.76	19.07	1.36	14.57	43.83
22 Oct 25	13:23	0.70	19.10	1.36	14.58	42.90
22 Oct 25	13:24	0.56	19.06	1.35	14.58	42.14
22 Oct 25	13:25	0.29	18.50	1.35	14.58	42.37
22 Oct 25	13:26	0.13	18.54	1.35	14.58	42.52
22 Oct 25	13:27	0.18	18.57	1.35	14.57	42.29
22 Oct 25	13:28	0.26	18.61	1.35	14.57	41.95
22 Oct 25	13:29	0.23	18.63	1.34	14.57	42.10
22 Oct 25	13:30	0.30	18.62	1.34	14.56	42.10
22 Oct 25	13:31	0.26	18.62	1.34	14.56	42.10
22 Oct 25	13:32	0.20	18.61	1.34	14.56	42.22
22 Oct 25	13:33	0.28	18.61	1.34	14.55	42.55
22 Oct 25	13:34	0.25	18.60	1.33	14.55	42.58
22 Oct 25	13:35	0.21	18.60	1.33	14.55	42.56
22 Oct 25	13:36	0.25	18.59	1.33	14.54	42.59
22 Oct 25	13:37	0.28	18.59	1.33	14.54	42.40
22 Oct 25	13:38	0.38	18.58	1.33	14.54	42.34
22 Oct 25	13:39	0.34	18.58	1.32	14.53	42.50
22 Oct 25	13:40	0.40	18.57	1.32	14.53	42.58
Max		0.76	19.39	1.36	14.58	43.83
Avg		0.37	18.72	1.34	14.56	42.67

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	13:41	0.42	18.57	1.32	14.53	42.77
22 Oct 25	13:42	0.57	18.56	1.32	14.52	43.26
22 Oct 25	13:43	0.54	18.56	1.32	14.52	43.07
22 Oct 25	13:44	0.50	18.55	1.31	14.52	42.88
22 Oct 25	13:45	0.60	18.55	1.31	14.51	42.73
22 Oct 25	13:46	0.61	18.54	1.31	14.51	42.70
22 Oct 25	13:47	0.65	18.53	1.31	14.51	42.68
22 Oct 25	13:48	0.68	18.53	1.30	14.50	42.58
22 Oct 25	13:49	0.72	18.52	1.30	14.50	42.44
22 Oct 25	13:50	0.68	18.51	1.30	14.50	42.45
22 Oct 25	13:51	0.67	18.50	1.30	14.49	42.36
22 Oct 25	13:52	0.62	18.49	1.30	14.50	42.70
22 Oct 25	13:53	0.53	18.48	1.29	14.50	42.68
22 Oct 25	13:54	0.67	18.47	1.29	14.50	42.35
22 Oct 25	13:55	0.55	18.46	1.29	14.51	42.38
22 Oct 25	13:56	0.51	18.48	1.29	14.51	42.35
22 Oct 25	13:57	0.64	18.53	1.29	14.51	42.16
22 Oct 25	13:58	0.69	18.59	1.28	14.52	42.56
22 Oct 25	13:59	0.54	18.65	1.28	14.52	42.39
22 Oct 25	14:00	0.39	18.70	1.28	14.53	42.25
22 Oct 25	14:01	0.39	18.76	1.28	14.53	42.24
Max		0.72	18.76	1.32	14.53	43.26
Avg		0.58	18.56	1.30	14.51	42.57

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:02	0.50	18.81	1.28	14.53	42.29
22 Oct 25	14:03	0.51	18.87	1.27	14.54	42.36
22 Oct 25	14:04	0.53	18.91	1.27	14.54	42.30
22 Oct 25	14:05	0.59	18.84	1.27	14.55	42.34
22 Oct 25	14:06	0.49	18.77	1.27	14.55	42.41
22 Oct 25	14:07	0.49	18.70	1.27	14.55	42.60
22 Oct 25	14:08	0.42	18.71	1.26	14.56	42.58
22 Oct 25	14:09	0.26	18.72	1.26	14.56	42.37
22 Oct 25	14:10	0.41	18.72	1.26	14.56	42.52
22 Oct 25	14:11	0.39	18.73	1.26	14.57	42.45
22 Oct 25	14:12	0.34	18.74	1.26	14.57	42.53
22 Oct 25	14:13	0.39	18.75	1.25	14.57	42.24
22 Oct 25	14:14	0.55	18.76	1.25	14.58	42.47
22 Oct 25	14:15	0.71	18.76	1.25	14.58	42.61
22 Oct 25	14:16	0.84	18.77	1.25	14.58	42.58
22 Oct 25	14:17	0.75	18.78	1.25	14.59	42.75
22 Oct 25	14:18	0.72	18.79	1.24	14.59	43.01
22 Oct 25	14:19	0.57	18.80	1.24	14.59	42.56
22 Oct 25	14:20	0.36	18.80	1.24	14.60	42.32
22 Oct 25	14:21	0.22	18.81	1.24	14.60	41.70
22 Oct 25	14:22	0.12	18.82	1.24	14.60	42.39
Max		0.84	18.91	1.28	14.60	43.01
Avg		0.48	18.78	1.26	14.57	42.45

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:23	0.18	18.80	1.23	14.60	42.96
22 Oct 25	14:24	0.23	18.77	1.23	14.60	42.47
22 Oct 25	14:25	0.28	18.73	1.23	14.59	42.20
22 Oct 25	14:26	0.44	18.70	1.23	14.59	42.39
22 Oct 25	14:27	0.59	18.67	1.22	14.59	42.17
22 Oct 25	14:28	0.84	18.63	1.22	14.59	42.37
22 Oct 25	14:29	0.83	18.60	1.22	14.59	42.30
22 Oct 25	14:30	0.76	18.56	1.22	14.59	42.46
22 Oct 25	14:31	0.70	18.53	1.22	14.59	42.42
22 Oct 25	14:32	0.65	18.55	1.21	14.59	42.33
22 Oct 25	14:33	0.70	18.59	1.21	14.59	42.49
22 Oct 25	14:34	0.50	18.63	1.21	14.58	42.50
22 Oct 25	14:35	0.36	18.66	1.21	14.58	42.54
22 Oct 25	14:36	0.43	18.70	1.21	14.58	42.58
22 Oct 25	14:37	0.37	18.74	1.20	14.58	42.40
22 Oct 25	14:38	0.50	18.77	1.20	14.58	42.54
22 Oct 25	14:39	0.64	18.80	1.20	14.58	42.62
22 Oct 25	14:40	0.79	18.78	1.20	14.58	42.54
22 Oct 25	14:41	0.83	18.76	1.20	14.58	42.74
22 Oct 25	14:42	0.76	18.74	1.19	14.57	42.37
22 Oct 25	14:43	0.64	18.72	1.19	14.57	42.54
Max		0.84	18.80	1.23	14.60	42.96
Avg		0.57	18.69	1.21	14.59	42.47

Run No: 5 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	14:44	0.53	18.73	1.19	14.57	42.57
22 Oct 25	14:45	0.57	18.74	1.19	14.57	42.58
22 Oct 25	14:46	0.51	18.76	1.19	14.57	42.60
22 Oct 25	14:47	0.40	18.78	1.18	14.57	42.51
22 Oct 25	14:48	0.39	18.80	1.18	14.57	42.48
22 Oct 25	14:49	0.37	18.81	1.18	14.57	42.83
22 Oct 25	14:50	0.34	18.83	1.18	14.57	42.49
22 Oct 25	14:51	0.39	18.85	1.18	14.56	42.58
22 Oct 25	14:52	0.48	18.86	1.17	14.56	42.55
22 Oct 25	14:53	0.70	18.88	1.17	14.56	42.52
22 Oct 25	14:54	0.75	18.89	1.17	14.56	42.64
22 Oct 25	14:55	0.72	18.90	1.17	14.56	42.78
22 Oct 25	14:56	0.71	18.91	1.17	14.56	42.75
22 Oct 25	14:57	0.66	18.93	1.16	14.56	42.61
22 Oct 25	14:58	0.60	18.94	1.16	14.56	42.41
22 Oct 25	14:59	0.52	18.97	1.16	14.55	42.45
22 Oct 25	15:00	0.46	19.00	1.16	14.55	42.35
22 Oct 25	15:01	0.43	19.02	1.15	14.55	42.43
22 Oct 25	15:02	0.35	19.05	1.15	14.56	42.29
22 Oct 25	15:03	0.34	19.07	1.15	14.56	42.21
22 Oct 25	15:04	0.28	19.10	1.15	14.56	42.38
Max		0.75	19.10	1.19	14.57	42.83
Avg		0.50	18.90	1.17	14.56	42.53

Run No: 6 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:05	0.22	19.13	1.15	14.57	42.29
22 Oct 25	15:06	0.16	19.15	1.14	14.57	42.14
22 Oct 25	15:07	0.21	19.18	1.14	14.58	42.42
22 Oct 25	15:08	0.29	19.11	1.14	14.58	42.55
22 Oct 25	15:09	0.40	19.05	1.14	14.58	42.27
22 Oct 25	15:10	0.60	18.98	1.14	14.58	42.26
22 Oct 25	15:11	0.67	18.91	1.13	14.57	42.35
22 Oct 25	15:12	0.65	18.84	1.13	14.57	42.40
22 Oct 25	15:13	0.54	18.79	1.13	14.57	42.44
22 Oct 25	15:14	0.50	18.81	1.13	14.57	42.39
22 Oct 25	15:15	0.54	18.83	1.13	14.57	42.51
22 Oct 25	15:16	0.47	18.85	1.12	14.57	42.28
22 Oct 25	15:17	0.38	18.87	1.12	14.57	42.39
22 Oct 25	15:18	0.34	18.90	1.12	14.57	42.51
22 Oct 25	15:19	0.29	18.92	1.12	14.57	42.51
22 Oct 25	15:20	0.31	18.94	1.12	14.57	42.77
22 Oct 25	15:21	0.36	18.96	1.11	14.57	43.06
22 Oct 25	15:22	0.45	18.98	1.11	14.57	42.72
22 Oct 25	15:23	0.68	19.01	1.11	14.57	42.88
22 Oct 25	15:24	0.62	19.03	1.11	14.57	42.88
22 Oct 25	15:25	0.42	19.05	1.11	14.57	42.85
Max		0.68	19.18	1.15	14.58	43.06
Avg		0.43	18.97	1.13	14.57	42.52

CEMs Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 12

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:26	0.18	19.10	1.10	14.57	42.73
22 Oct 25	15:27	0.02	19.15	1.10	14.57	42.52
22 Oct 25	15:28	0.03	19.17	1.10	14.57	42.48
22 Oct 25	15:29	0.04	19.07	1.10	14.57	42.75
22 Oct 25	15:30	0.07	18.97	1.10	14.57	42.69
22 Oct 25	15:31	0.14	18.87	1.09	14.57	42.64
22 Oct 25	15:32	0.41	18.77	1.09	14.57	42.48
22 Oct 25	15:33	0.61	18.75	1.09	14.57	42.51
22 Oct 25	15:34	0.55	18.77	1.09	14.57	42.44
22 Oct 25	15:35	0.49	18.79	1.09	14.57	42.25
22 Oct 25	15:36	0.47	18.80	1.08	14.57	41.93
22 Oct 25	15:37	0.39	18.82	1.08	14.57	42.40
22 Oct 25	15:38	0.35	18.83	1.08	14.56	42.51
22 Oct 25	15:39	0.28	18.85	1.08	14.56	42.74
22 Oct 25	15:40	0.29	18.86	1.07	14.56	42.52
22 Oct 25	15:41	0.24	18.88	1.07	14.56	42.35
22 Oct 25	15:42	0.15	18.90	1.07	14.56	42.42
22 Oct 25	15:43	0.17	18.91	1.07	14.56	42.52
22 Oct 25	15:44	0.24	18.89	1.07	14.56	42.40
22 Oct 25	15:45	0.47	18.81	1.06	14.56	42.16
22 Oct 25	15:46	0.60	18.72	1.06	14.56	42.32
Max		0.61	19.17	1.10	14.57	42.75
Avg		0.29	18.89	1.08	14.56	42.47

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	15:47	0.65	18.66	1.06	14.56	42.37
22 Oct 25	15:48	0.54	18.71	1.06	14.56	42.42
22 Oct 25	15:49	0.53	18.75	1.06	14.56	42.39
22 Oct 25	15:50	0.46	18.80	1.05	14.56	42.34
22 Oct 25	15:51	0.44	18.84	1.05	14.56	42.70
22 Oct 25	15:52	0.37	18.89	1.05	14.55	42.49
22 Oct 25	15:53	0.30	18.92	1.05	14.55	42.27
22 Oct 25	15:54	0.35	18.92	1.05	14.55	42.30
22 Oct 25	15:55	0.26	18.93	1.04	14.55	42.11
22 Oct 25	15:56	0.16	18.95	1.04	14.55	42.09
22 Oct 25	15:57	0.04	18.97	1.04	14.55	42.05
22 Oct 25	15:58	0.03	18.99	1.04	14.55	42.27
22 Oct 25	15:59	0.05	19.01	1.04	14.55	42.36
22 Oct 25	16:00	0.06	19.04	1.03	14.55	42.33
22 Oct 25	16:01	0.06	19.06	1.03	14.55	42.51
22 Oct 25	16:02	0.06	19.08	1.03	14.55	42.52
22 Oct 25	16:03	0.05	19.10	1.03	14.55	42.65
22 Oct 25	16:04	0.04	19.12	1.03	14.55	42.51
22 Oct 25	16:05	0.04	19.15	1.02	14.54	42.74
22 Oct 25	16:06	0.03	19.17	1.02	14.54	42.80
22 Oct 25	16:07	0.03	19.19	1.02	14.54	42.82
Max		0.65	19.19	1.06	14.56	42.82
Avg		0.22	18.96	1.04	14.55	42.43

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:08	0.10	19.18	1.02	14.54	42.95
22 Oct 25	16:09	0.52	19.12	1.02	14.54	42.85
22 Oct 25	16:10	0.56	19.05	1.01	14.54	42.82
22 Oct 25	16:11	0.49	18.99	1.01	14.54	42.72
22 Oct 25	16:12	0.43	18.93	1.01	14.54	42.84
22 Oct 25	16:13	0.43	18.86	1.01	14.54	42.75
22 Oct 25	16:14	0.40	18.80	1.00	14.54	42.64
22 Oct 25	16:15	0.40	18.81	1.00	14.54	42.58
22 Oct 25	16:16	0.35	18.92	1.00	14.54	42.69
22 Oct 25	16:17	0.27	19.03	1.00	14.54	42.69
22 Oct 25	16:18	0.15	19.13	1.00	14.54	42.64
22 Oct 25	16:19	0.20	19.24	0.99	14.54	42.61
22 Oct 25	16:20	0.15	19.26	0.99	14.54	42.56
22 Oct 25	16:21	0.22	19.23	0.99	14.54	42.82
22 Oct 25	16:22	0.29	19.20	0.99	14.54	42.82
22 Oct 25	16:23	0.45	19.17	0.99	14.53	43.03
22 Oct 25	16:24	0.58	19.14	0.98	14.53	42.90
22 Oct 25	16:25	0.52	19.12	0.98	14.53	42.86
22 Oct 25	16:26	0.41	19.09	0.98	14.53	42.84
22 Oct 25	16:27	0.49	19.06	0.98	14.53	43.15
22 Oct 25	16:28	0.43	19.03	0.98	14.53	43.19
Max		0.58	19.26	1.02	14.54	43.19
Avg		0.37	19.06	1.00	14.54	42.81

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:29	0.38	19.00	0.97	14.53	43.11
22 Oct 25	16:30	0.31	18.95	0.97	14.53	43.06
22 Oct 25	16:31	0.20	18.91	0.97	14.53	42.99
22 Oct 25	16:32	0.20	18.87	0.97	14.53	43.01
22 Oct 25	16:33	0.16	18.83	0.97	14.53	42.91
22 Oct 25	16:34	0.21	18.79	0.96	14.53	42.81
22 Oct 25	16:35	0.32	18.74	0.96	14.53	42.87
22 Oct 25	16:36	0.52	18.80	0.96	14.53	42.96
22 Oct 25	16:37	0.59	18.90	0.96	14.53	42.97
22 Oct 25	16:38	0.50	18.95	0.96	14.53	42.97
22 Oct 25	16:39	0.46	18.93	0.95	14.53	43.15
22 Oct 25	16:40	0.44	18.91	0.95	14.53	43.20
22 Oct 25	16:41	0.37	18.89	0.95	14.53	43.15
22 Oct 25	16:42	0.33	18.87	0.95	14.53	43.05
22 Oct 25	16:43	0.27	18.85	0.95	14.53	42.90
22 Oct 25	16:44	0.23	18.83	0.94	14.53	42.85
22 Oct 25	16:45	0.16	18.81	0.94	14.53	42.88
22 Oct 25	16:46	0.40	18.80	0.94	14.53	43.01
22 Oct 25	16:47	0.60	18.78	0.94	14.52	42.93
22 Oct 25	16:48	0.66	18.76	0.94	14.52	42.96
22 Oct 25	16:49	0.53	18.77	0.93	14.52	42.91
Max		0.66	19.00	0.97	14.53	43.20
Avg		0.37	18.85	0.95	14.53	42.98

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	16:50	0.43	18.80	0.93	14.52	42.80
22 Oct 25	16:51	0.44	18.82	0.93	14.52	43.05
22 Oct 25	16:52	0.36	18.84	0.93	14.52	43.01
22 Oct 25	16:53	0.38	18.86	0.92	14.52	42.93
22 Oct 25	16:54	0.35	18.88	0.92	14.52	42.91
22 Oct 25	16:55	0.20	18.90	0.92	14.52	42.89
22 Oct 25	16:56	0.31	18.92	0.92	14.52	42.93
22 Oct 25	16:57	0.40	18.94	0.92	14.52	42.96
22 Oct 25	16:58	0.65	18.95	0.91	14.52	42.91
22 Oct 25	16:59	0.59	18.95	0.91	14.52	42.90
22 Oct 25	17:00	0.58	18.96	0.91	14.52	42.94
22 Oct 25	17:01	0.44	18.97	0.91	14.52	42.86
22 Oct 25	17:02	0.45	18.98	0.91	14.52	42.61
22 Oct 25	17:03	0.45	18.99	0.90	14.52	42.64
22 Oct 25	17:04	0.46	19.00	0.90	14.52	42.81
22 Oct 25	17:05	0.38	19.01	0.90	14.52	42.75
22 Oct 25	17:06	0.28	19.02	0.90	14.52	42.70
22 Oct 25	17:07	0.25	19.02	0.90	14.52	42.67
22 Oct 25	17:08	0.40	18.85	0.89	14.52	42.62
22 Oct 25	17:09	0.58	18.66	0.89	14.52	42.81
22 Oct 25	17:10	0.68	18.58	0.89	14.52	42.78
Max		0.68	19.02	0.93	14.52	43.05
Avg		0.43	18.90	0.91	14.52	42.83

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
22 Oct 25	17:11	0.55	18.61	0.89	14.52	42.64
22 Oct 25	17:12	0.45	18.65	0.89	14.52	42.53
22 Oct 25	17:13	0.22	18.69	0.88	14.52	42.76
22 Oct 25	17:14	0.15	18.72	0.88	14.52	42.87
22 Oct 25	17:15	0.19	18.76	0.88	14.52	42.86
22 Oct 25	17:16	0.21	18.79	0.88	14.52	42.86
22 Oct 25	17:17	0.18	18.83	0.88	14.52	42.94
22 Oct 25	17:18	0.29	18.86	0.87	14.53	42.77
22 Oct 25	17:19	0.31	18.86	0.87	14.53	42.85
22 Oct 25	17:20	0.62	18.83	0.87	14.53	42.82
22 Oct 25	17:21	0.62	18.80	0.87	14.53	42.79
22 Oct 25	17:22	0.48	18.77	0.87	14.53	42.53
22 Oct 25	17:23	0.42	18.74	0.86	14.53	42.54
22 Oct 25	17:24	0.38	18.71	0.86	14.53	42.75
22 Oct 25	17:25	0.35	18.68	0.86	14.53	42.82
22 Oct 25	17:26	0.37	18.65	0.86	14.53	42.54
22 Oct 25	17:27	0.27	18.62	0.85	14.53	42.65
22 Oct 25	17:28	0.41	18.59	0.85	14.53	42.75
22 Oct 25	17:29	0.50	18.58	0.85	14.53	42.79
22 Oct 25	17:30	0.71	18.60	0.85	14.53	42.64
22 Oct 25	17:31	0.70	18.61	0.85	14.53	42.62
Max		0.71	18.86	0.89	14.53	42.94
Avg		0.40	18.71	0.87	14.53	42.73

Reference Method Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 12

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	13:20	0.96	19.92	0.61	14.04	3.72
22 Oct 25	13:21	0.94	21.11	0.61	14.12	3.71
22 Oct 25	13:22	0.93	21.10	0.62	14.13	3.68
22 Oct 25	13:23	0.94	20.72	0.57	14.12	3.68
22 Oct 25	13:24	0.93	20.75	0.58	14.11	3.68
22 Oct 25	13:25	0.90	20.76	0.60	14.13	3.69
22 Oct 25	13:26	0.89	20.39	0.52	14.15	3.68
22 Oct 25	13:27	0.89	19.89	0.52	14.15	3.67
22 Oct 25	13:28	0.86	19.83	0.57	14.13	3.67
22 Oct 25	13:29	0.86	19.94	0.57	14.11	3.67
22 Oct 25	13:30	0.85	19.88	0.56	14.14	3.68
22 Oct 25	13:31	0.86	19.73	0.52	14.15	3.68
22 Oct 25	13:32	0.83	19.71	0.51	14.14	3.67
22 Oct 25	13:33	0.85	19.77	0.49	14.15	3.67
22 Oct 25	13:34	0.86	19.76	0.52	14.15	3.67
22 Oct 25	13:35	0.84	19.80	0.51	14.14	3.67
22 Oct 25	13:36	0.83	19.89	0.50	14.11	3.68
22 Oct 25	13:37	0.85	19.90	0.51	14.14	3.68
22 Oct 25	13:38	0.83	19.82	0.52	14.14	3.67
22 Oct 25	13:39	0.80	19.83	0.56	14.14	3.68
22 Oct 25	13:40	0.81	19.84	0.54	14.15	3.68
Max		0.96	21.11	0.62	14.15	3.72
Avg		0.87	20.11	0.55	14.13	3.68

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	13:41	0.79	19.84	0.53	14.15	3.67
22 Oct 25	13:42	0.80	19.87	0.54	14.14	3.68
22 Oct 25	13:43	0.79	19.96	0.54	14.14	3.68
22 Oct 25	13:44	0.79	20.00	0.48	14.16	3.67
22 Oct 25	13:45	0.75	20.06	0.54	14.14	3.66
22 Oct 25	13:46	0.76	20.10	0.54	14.13	3.67
22 Oct 25	13:47	0.76	20.05	0.52	14.14	3.68
22 Oct 25	13:48	0.76	20.01	0.50	14.11	3.69
22 Oct 25	13:49	0.76	19.99	0.58	14.13	3.68
22 Oct 25	13:50	0.74	19.98	0.52	14.10	3.68
22 Oct 25	13:51	0.71	19.88	0.52	14.12	3.68
22 Oct 25	13:52	0.72	19.84	0.50	14.11	3.68
22 Oct 25	13:53	0.70	19.84	0.52	14.13	3.68
22 Oct 25	13:54	0.69	19.93	0.53	14.11	3.68
22 Oct 25	13:55	0.69	20.02	0.54	14.09	3.68
22 Oct 25	13:56	0.68	19.99	0.54	14.10	3.69
22 Oct 25	13:57	0.67	19.88	0.53	14.12	3.68
22 Oct 25	13:58	0.64	19.83	0.51	14.11	3.68
22 Oct 25	13:59	0.66	19.94	0.54	14.13	3.68
22 Oct 25	14:00	0.64	19.95	0.53	14.10	3.67
22 Oct 25	14:01	0.65	19.97	0.50	14.11	3.67
Max		0.80	20.10	0.58	14.16	3.69
Avg		0.72	19.96	0.53	14.12	3.68

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:02	0.87	19.98	0.54	14.11	3.67
22 Oct 25	14:03	0.89	19.91	0.55	14.10	3.68
22 Oct 25	14:04	0.85	19.93	0.54	14.12	3.68
22 Oct 25	14:05	0.86	19.96	0.59	14.11	3.68
22 Oct 25	14:06	0.85	19.96	0.58	14.09	3.68
22 Oct 25	14:07	0.85	19.90	0.56	14.12	3.68
22 Oct 25	14:08	0.83	19.81	0.55	14.08	3.68
22 Oct 25	14:09	0.85	19.78	0.52	14.11	3.68
22 Oct 25	14:10	0.81	19.87	0.54	14.11	3.67
22 Oct 25	14:11	0.82	19.91	0.53	14.09	3.67
22 Oct 25	14:12	0.81	19.94	0.58	14.12	3.68
22 Oct 25	14:13	0.81	19.90	0.55	14.10	3.68
22 Oct 25	14:14	0.82	19.87	0.53	14.09	3.68
22 Oct 25	14:15	0.81	19.86	0.55	14.11	3.68
22 Oct 25	14:16	0.79	19.84	0.55	14.12	3.68
22 Oct 25	14:17	0.78	19.82	0.54	14.11	3.67
22 Oct 25	14:18	0.79	19.88	0.58	14.11	3.68
22 Oct 25	14:19	0.82	19.95	0.53	14.11	3.67
22 Oct 25	14:20	0.81	19.94	0.55	14.09	3.67
22 Oct 25	14:21	0.78	19.96	0.59	14.09	3.68
22 Oct 25	14:22	0.78	19.84	0.54	14.09	3.69
Max		0.89	19.98	0.59	14.12	3.69
Avg		0.82	19.90	0.55	14.10	3.68

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:23	0.63	19.70	0.55	14.09	3.69
22 Oct 25	14:24	0.62	19.62	0.56	14.10	3.69
22 Oct 25	14:25	0.63	19.74	0.51	14.11	3.68
22 Oct 25	14:26	0.61	19.89	0.58	14.12	3.69
22 Oct 25	14:27	0.61	19.88	0.54	14.10	3.68
22 Oct 25	14:28	0.61	19.85	0.52	14.14	3.69
22 Oct 25	14:29	0.60	19.77	0.61	14.17	3.68
22 Oct 25	14:30	0.60	19.69	0.57	14.15	3.68
22 Oct 25	14:31	0.60	19.64	0.59	14.14	3.68
22 Oct 25	14:32	0.74	19.70	0.60	14.16	3.68
22 Oct 25	14:33	0.75	19.76	0.58	14.14	3.69
22 Oct 25	14:34	0.74	19.81	0.54	14.18	3.68
22 Oct 25	14:35	0.75	19.77	0.60	14.19	3.68
22 Oct 25	14:36	0.75	19.80	0.58	14.12	3.66
22 Oct 25	14:37	0.75	20.01	0.56	14.12	3.67
22 Oct 25	14:38	0.73	20.29	0.58	14.13	3.68
22 Oct 25	14:39	0.72	20.39	0.54	14.14	3.68
22 Oct 25	14:40	0.75	20.38	0.55	14.13	3.67
22 Oct 25	14:41	0.73	20.36	0.56	14.13	3.67
22 Oct 25	14:42	0.71	20.35	0.57	14.14	3.68
22 Oct 25	14:43	0.72	20.29	0.61	14.12	3.68
Max		0.75	20.39	0.61	14.19	3.69
Avg		0.68	19.94	0.57	14.13	3.68

Run No: 5 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	14:44	0.75	20.25	0.59	14.10	3.69
22 Oct 25	14:45	0.72	20.26	0.65	14.14	3.68
22 Oct 25	14:46	0.71	20.19	0.61	14.14	3.67
22 Oct 25	14:47	0.70	20.18	0.62	14.12	3.67
22 Oct 25	14:48	0.72	20.16	0.60	14.12	3.68
22 Oct 25	14:49	0.71	20.16	0.59	14.09	3.68
22 Oct 25	14:50	0.70	20.09	0.64	14.13	3.68
22 Oct 25	14:51	0.70	20.09	0.56	14.13	3.67
22 Oct 25	14:52	0.69	20.12	0.66	14.12	3.67
22 Oct 25	14:53	0.70	20.22	0.63	14.12	3.67
22 Oct 25	14:54	0.70	20.21	0.63	14.12	3.68
22 Oct 25	14:55	0.69	20.16	0.61	14.13	3.68
22 Oct 25	14:56	0.68	20.11	0.64	14.12	3.68
22 Oct 25	14:57	0.67	20.11	0.64	14.12	3.67
22 Oct 25	14:58	0.68	20.20	0.63	14.13	3.67
22 Oct 25	14:59	0.67	20.26	0.69	14.12	3.67
22 Oct 25	15:00	0.66	20.21	0.65	14.12	3.68
22 Oct 25	15:01	0.66	20.22	0.57	14.11	3.68
22 Oct 25	15:02	0.76	20.13	0.60	14.12	3.68
22 Oct 25	15:03	0.75	20.03	0.59	14.11	3.67
22 Oct 25	15:04	0.74	20.06	0.62	14.10	3.68
Max		0.76	20.26	0.69	14.14	3.69
Avg		0.70	20.16	0.62	14.12	3.68

Run No: 6 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:05	0.75	20.08	0.59	14.12	3.68
22 Oct 25	15:06	0.75	20.02	0.58	14.13	3.68
22 Oct 25	15:07	0.76	20.07	0.54	14.11	3.68
22 Oct 25	15:08	0.76	20.14	0.59	14.11	3.67
22 Oct 25	15:09	0.73	20.18	0.61	14.11	3.67
22 Oct 25	15:10	0.73	20.25	0.60	14.13	3.67
22 Oct 25	15:11	0.71	20.29	0.58	14.10	3.68
22 Oct 25	15:12	0.70	20.24	0.61	14.12	3.68
22 Oct 25	15:13	0.72	20.15	0.64	14.12	3.68
22 Oct 25	15:14	0.71	20.14	0.65	14.09	3.67
22 Oct 25	15:15	0.72	20.15	0.64	14.12	3.67
22 Oct 25	15:16	0.70	20.13	0.63	14.12	3.67
22 Oct 25	15:17	0.71	20.14	0.64	14.12	3.67
22 Oct 25	15:18	0.71	20.22	0.67	14.11	3.67
22 Oct 25	15:19	0.70	20.22	0.67	14.13	3.67
22 Oct 25	15:20	0.69	20.22	0.64	14.12	3.66
22 Oct 25	15:21	0.67	20.22	0.60	14.10	3.66
22 Oct 25	15:22	0.66	20.28	0.61	14.12	3.66
22 Oct 25	15:23	0.68	20.35	0.64	14.13	3.67
22 Oct 25	15:24	0.65	20.38	0.62	14.14	3.67
22 Oct 25	15:25	0.65	20.37	0.65	14.12	3.66
Max		0.76	20.38	0.67	14.14	3.68
Avg		0.71	20.20	0.62	14.12	3.67

Reference Method Data

Client Name: Gulf BL Co., Ltd. Date: 22 Oct 25
Plant Name: GBL Location: ปล่อง HRSG 12

Run No: 7 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:26	0.64	20.33	0.65	14.12	3.66
22 Oct 25	15:27	0.65	20.36	0.62	14.12	3.66
22 Oct 25	15:28	0.64	20.35	0.64	14.13	3.67
22 Oct 25	15:29	0.64	20.29	0.59	14.14	3.67
22 Oct 25	15:30	0.61	20.24	0.60	14.11	3.67
22 Oct 25	15:31	0.60	20.25	0.55	14.12	3.67
22 Oct 25	15:32	0.74	20.28	0.60	14.12	3.67
22 Oct 25	15:33	0.75	20.36	0.61	14.13	3.67
22 Oct 25	15:34	0.72	20.35	0.59	14.11	3.69
22 Oct 25	15:35	0.72	20.31	0.62	14.11	3.69
22 Oct 25	15:36	0.72	20.27	0.64	14.13	3.69
22 Oct 25	15:37	0.70	20.23	0.64	14.13	3.67
22 Oct 25	15:38	0.70	20.15	0.59	14.10	3.67
22 Oct 25	15:39	0.68	20.18	0.60	14.12	3.67
22 Oct 25	15:40	0.70	20.26	0.58	14.11	3.67
22 Oct 25	15:41	0.67	20.31	0.59	14.10	3.68
22 Oct 25	15:42	0.67	20.31	0.59	14.13	3.67
22 Oct 25	15:43	0.67	20.29	0.59	14.13	3.67
22 Oct 25	15:44	0.69	20.25	0.63	14.12	3.67
22 Oct 25	15:45	0.67	20.21	0.60	14.13	3.69
22 Oct 25	15:46	0.67	20.17	0.55	14.11	3.69
Max		0.75	20.36	0.65	14.14	3.69
Avg		0.68	20.27	0.60	14.12	3.68

Run No: 8 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	15:47	0.65	20.12	0.62	14.13	3.69
22 Oct 25	15:48	0.67	20.13	0.61	14.12	3.68
22 Oct 25	15:49	0.64	20.19	0.64	14.10	3.68
22 Oct 25	15:50	0.62	20.26	0.61	14.12	3.68
22 Oct 25	15:51	0.62	20.34	0.60	14.11	3.68
22 Oct 25	15:52	0.63	20.37	0.62	14.11	3.68
22 Oct 25	15:53	0.60	20.36	0.61	14.12	3.67
22 Oct 25	15:54	0.60	20.30	0.61	14.12	3.69
22 Oct 25	15:55	0.60	20.20	0.62	14.11	3.68
22 Oct 25	15:56	0.61	20.17	0.61	14.10	3.69
22 Oct 25	15:57	0.59	20.18	0.64	14.10	3.69
22 Oct 25	15:58	0.58	20.20	0.61	14.09	3.69
22 Oct 25	15:59	0.58	20.17	0.64	14.09	3.69
22 Oct 25	16:00	0.58	20.17	0.64	14.10	3.69
22 Oct 25	16:01	0.58	20.15	0.64	14.11	3.69
22 Oct 25	16:02	0.73	20.15	0.63	14.12	3.69
22 Oct 25	16:03	0.74	20.16	0.61	14.12	3.69
22 Oct 25	16:04	0.73	20.24	0.62	14.11	3.68
22 Oct 25	16:05	0.71	20.30	0.67	14.11	3.68
22 Oct 25	16:06	0.73	20.27	0.65	14.13	3.68
22 Oct 25	16:07	0.72	20.20	0.65	14.10	3.68
Max		0.74	20.37	0.67	14.13	3.69
Avg		0.64	20.22	0.63	14.11	3.68

Run No: 9 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:08	0.71	20.22	0.64	14.12	3.68
22 Oct 25	16:09	0.70	20.32	0.65	14.12	3.69
22 Oct 25	16:10	0.70	20.42	0.64	14.11	3.67
22 Oct 25	16:11	0.70	20.45	0.56	14.12	3.68
22 Oct 25	16:12	0.69	20.46	0.60	14.12	3.67
22 Oct 25	16:13	0.69	20.41	0.60	14.12	3.68
22 Oct 25	16:14	0.66	20.31	0.62	14.16	3.68
22 Oct 25	16:15	0.65	20.20	0.57	14.14	3.69
22 Oct 25	16:16	0.67	20.15	0.61	14.11	3.68
22 Oct 25	16:17	0.68	20.21	0.60	14.11	3.68
22 Oct 25	16:18	0.65	20.31	0.59	14.13	3.68
22 Oct 25	16:19	0.66	20.26	0.57	14.16	3.68
22 Oct 25	16:20	0.63	20.13	0.52	14.16	3.69
22 Oct 25	16:21	0.65	20.06	0.53	14.15	3.68
22 Oct 25	16:22	0.63	20.03	0.59	14.18	3.68
22 Oct 25	16:23	0.63	20.03	0.48	14.16	3.66
22 Oct 25	16:24	0.64	20.16	0.51	14.18	3.68
22 Oct 25	16:25	0.63	20.22	0.52	14.17	3.67
22 Oct 25	16:26	0.62	20.28	0.56	14.11	3.68
22 Oct 25	16:27	0.60	20.34	0.51	14.11	3.68
22 Oct 25	16:28	0.61	20.34	0.55	14.13	3.69
Max		0.71	20.46	0.65	14.18	3.69
Avg		0.66	20.25	0.57	14.14	3.68

Run No: 10 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:29	0.60	20.33	0.54	14.12	3.67
22 Oct 25	16:30	0.57	20.33	0.56	14.11	3.67
22 Oct 25	16:31	0.58	20.36	0.51	14.12	3.67
22 Oct 25	16:32	0.75	20.40	0.54	14.13	3.67
22 Oct 25	16:33	0.74	20.34	0.58	14.12	3.67
22 Oct 25	16:34	0.74	20.31	0.52	14.12	3.68
22 Oct 25	16:35	0.74	20.32	0.57	14.10	3.68
22 Oct 25	16:36	0.73	20.30	0.55	14.14	3.70
22 Oct 25	16:37	0.72	20.20	0.60	14.17	3.68
22 Oct 25	16:38	0.73	20.12	0.55	14.17	3.67
22 Oct 25	16:39	0.71	20.16	0.55	14.16	3.67
22 Oct 25	16:40	0.70	20.28	0.57	14.17	3.67
22 Oct 25	16:41	0.70	20.25	0.54	14.17	3.67
22 Oct 25	16:42	0.70	20.18	0.58	14.16	3.66
22 Oct 25	16:43	0.69	20.13	0.53	14.16	3.67
22 Oct 25	16:44	0.69	20.11	0.52	14.15	3.68
22 Oct 25	16:45	0.67	20.10	0.51	14.15	3.67
22 Oct 25	16:46	0.66	20.11	0.53	14.16	3.68
22 Oct 25	16:47	0.65	20.14	0.45	14.17	3.69
22 Oct 25	16:48	0.66	20.18	0.49	14.18	3.69
22 Oct 25	16:49	0.66	20.28	0.50	14.18	3.67
Max		0.75	20.40	0.60	14.18	3.70
Avg		0.69	20.24	0.54	14.15	3.68

Run No: 11 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	16:50	0.62	20.31	0.52	14.16	3.67
22 Oct 25	16:51	0.62	20.27	0.48	14.16	3.66
22 Oct 25	16:52	0.60	20.20	0.55	14.14	3.70
22 Oct 25	16:53	0.60	20.21	0.53	14.15	3.70
22 Oct 25	16:54	0.58	20.19	0.55	14.16	3.68
22 Oct 25	16:55	0.58	20.21	0.48	14.17	3.69
22 Oct 25	16:56	0.57	20.21	0.50	14.16	3.69
22 Oct 25	16:57	0.52	20.22	0.49	14.16	3.69
22 Oct 25	16:58	0.51	20.28	0.53	14.17	3.69
22 Oct 25	16:59	0.50	20.29	0.49	14.16	3.68
22 Oct 25	17:00	0.51	20.31	0.51	14.17	3.68
22 Oct 25	17:01	0.51	20.30	0.53	14.17	3.68
22 Oct 25	17:02	0.67	20.34	0.56	14.17	3.69
22 Oct 25	17:03	0.66	20.37	0.52	14.16	3.69
22 Oct 25	17:04	0.65	20.34	0.49	14.17	3.69
22 Oct 25	17:05	0.66	20.26	0.52	14.17	3.69
22 Oct 25	17:06	0.63	20.27	0.51	14.18	3.69
22 Oct 25	17:07	0.61	20.27	0.52	14.18	3.69
22 Oct 25	17:08	0.62	20.29	0.55	14.15	3.69
22 Oct 25	17:09	0.60	20.21	0.55	14.17	3.70
22 Oct 25	17:10	0.60	20.13	0.56	14.17	3.70
Max		0.67	20.37	0.56	14.18	3.70
Avg		0.59	20.26	0.52	14.16	3.69

Run No: 12 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
22 Oct 25	17:11	0.59	20.17	0.50	14.14	3.70
22 Oct 25	17:12	0.58	20.23	0.52	14.16	3.69
22 Oct 25	17:13	0.58	20.28	0.55	14.16	3.68
22 Oct 25	17:14	0.56	20.21	0.56	14.19	3.68
22 Oct 25	17:15	0.55	20.14	0.47	14.15	3.69
22 Oct 25	17:16	0.56	20.18	0.50	14.15	3.70
22 Oct 25	17:17	0.53	20.25	0.48	14.13	3.69
22 Oct 25	17:18	0.53	20.22	0.54	14.17	3.69
22 Oct 25	17:19	0.52	20.22	0.53	14.17	3.68
22 Oct 25	17:20	0.50	20.21	0.46	14.17	3.68
22 Oct 25	17:21	0.50	20.16	0.56	14.16	3.69
22 Oct 25	17:22	0.49	20.18	0.53	14.16	3.69
22 Oct 25	17:23	0.50	20.19	0.55	14.14	3.70
22 Oct 25	17:24	0.48	20.18	0.55	14.16	3.69
22 Oct 25	17:25	0.46	20.15	0.58	14.16	3.69
22 Oct 25	17:26	0.46	20.17	0.52	14.16	3.69
22 Oct 25	17:27	0.45	20.19	0.51	14.16	3.69
22 Oct 25	17:28	0.43	20.23	0.56	14.17	3.69
22 Oct 25	17:29	0.44	20.22	0.53	14.15	3.70
22 Oct 25	17:30	0.40	20.16	0.56	14.17	3.68
22 Oct 25	17:31	0.40	20.10	0.55	14.16	3.69
Max		0.59	20.28	0.58	14.19	3.70
Avg		0.50	20.19	0.53	14.16	3.69

PM CEMs Data at 7%O2

Client Name: Gulf BL Co., Ltd. Date: 22-Oct-25
Plant Name: GBL Location: ปล่อง HRSG 11

Run No.1			Run No.2			Run No.3		
Time	O_2 (%)	Dust (mg/m^3)	Time	O_2 (%)	Dust (mg/m^3)	Time	O_2 (%)	Dust (mg/m^3)
13:30	14.84	3.48	14:25	14.77	3.48	15:20	14.81	3.49
13:31	14.84	3.48	14:26	14.78	3.48	15:21	14.81	3.49
13:32	14.84	3.48	14:27	14.78	3.48	15:22	14.81	3.49
13:33	14.84	3.48	14:28	14.78	3.48	15:23	14.81	3.49
13:34	14.84	3.48	14:29	14.78	3.48	15:24	14.81	3.49
13:35	14.84	3.48	14:30	14.78	3.48	15:25	14.82	3.49
13:36	14.84	3.48	14:31	14.78	3.48	15:26	14.82	3.49
13:37	14.84	3.48	14:32	14.78	3.48	15:27	14.82	3.49
13:38	14.84	3.48	14:33	14.78	3.48	15:28	14.82	3.49
13:39	14.84	3.48	14:34	14.78	3.48	15:29	14.82	3.49
13:40	14.84	3.48	14:35	14.78	3.48	15:30	14.82	3.49
13:41	14.84	3.48	14:36	14.78	3.48	15:31	14.82	3.49
13:42	14.84	3.48	14:37	14.78	3.48	15:32	14.82	3.49
13:43	14.84	3.48	14:38	14.78	3.48	15:33	14.82	3.49
13:44	14.84	3.48	14:39	14.78	3.48	15:34	14.82	3.49
13:45	14.84	3.48	14:40	14.79	3.48	15:35	14.82	3.49
13:46	14.84	3.48	14:41	14.79	3.48	15:36	14.82	3.49
13:47	14.83	3.48	14:42	14.79	3.48	15:37	14.82	3.49
13:48	14.83	3.48	14:43	14.79	3.48	15:38	14.82	3.49
13:49	14.83	3.48	14:44	14.79	3.48	15:39	14.82	3.49
13:50	14.83	3.48	14:45	14.79	3.48	15:40	14.82	3.49
13:51	14.83	3.48	14:46	14.79	3.48	15:41	14.82	3.49
13:52	14.83	3.48	14:47	14.79	3.48	15:42	14.82	3.49
13:53	14.83	3.48	14:48	14.79	3.48	15:43	14.83	3.49
13:54	14.83	3.48	14:49	14.79	3.48	15:44	14.83	3.49
13:55	14.83	3.48	14:50	14.79	3.48	15:45	14.83	3.49
13:56	14.84	3.48	14:51	14.79	3.48	15:46	14.83	3.49
13:57	14.84	3.48	14:52	14.79	3.48	15:47	14.83	3.49
13:58	14.85	3.48	14:53	14.79	3.48	15:48	14.83	3.49
13:59	14.85	3.48	14:54	14.80	3.48	15:49	14.83	3.49
14:00	14.85	3.48	14:55	14.80	3.48	15:50	14.83	3.49
14:01	14.85	3.48	14:56	14.80	3.48	15:51	14.83	3.49
14:02	14.85	3.48	14:57	14.80	3.48	15:52	14.83	3.49
14:03	14.85	3.48	14:58	14.80	3.48	15:53	14.83	3.49
14:04	14.84	3.48	14:59	14.80	3.48	15:54	14.83	3.49
14:05	14.84	3.48	15:00	14.80	3.48	15:55	14.83	3.49
14:06	14.84	3.48	15:01	14.80	3.48	15:56	14.83	3.49
14:07	14.83	3.48	15:02	14.80	3.48	15:57	14.83	3.49
14:08	14.83	3.48	15:03	14.80	3.48	15:58	14.83	3.49
14:09	14.82	3.48	15:04	14.80	3.48	15:59	14.83	3.49
14:10	14.82	3.48	15:05	14.80	3.48	16:00	14.83	3.49
14:11	14.82	3.48	15:06	14.80	3.48	16:01	14.84	3.49
14:12	14.81	3.48	15:07	14.80	3.48	16:02	14.84	3.49
14:13	14.81	3.48	15:08	14.81	3.48	16:03	14.84	3.49
14:14	14.81	3.48	15:09	14.81	3.48	16:04	14.84	3.49
14:15	14.80	3.48	15:10	14.81	3.48	16:05	14.84	3.49
14:16	14.80	3.48	15:11	14.81	3.48	16:06	14.84	3.49
14:17	14.79	3.48	15:12	14.81	3.48	16:07	14.84	3.49
14:18	14.79	3.48	15:13	14.81	3.48	16:08	14.84	3.49
Avg.	**14.83**	**3.48**	**Avg.**	**14.79**	**3.48**	**Avg.**	**14.83**	**3.49**

PM CEMs Data at 7% O_2

Client Name: Gulf BL Co., Ltd. Date: 22-Oct-25
Plant Name: GBL Location: ปล่อง HRSG 12

Run No.1			Run No.2			Run No.3		
Time	O_2 (%)	Dust (mg/m^3)	Time	O_2 (%)	Dust (mg/m^3)	Time	O_2 (%)	Dust (mg/m^3)
13:20	14.55	4.27	14:18	14.59	4.16	15:20	14.57	3.88
13:21	14.57	4.26	14:19	14.59	4.16	15:21	14.57	3.88
13:22	14.57	4.26	14:20	14.60	4.17	15:22	14.57	3.87
13:23	14.58	4.25	14:21	14.60	4.17	15:23	14.57	3.86
13:24	14.58	4.25	14:22	14.60	4.17	15:24	14.57	3.85
13:25	14.58	4.24	14:23	14.60	4.17	15:25	14.57	3.85
13:26	14.58	4.23	14:24	14.60	4.17	15:26	14.57	3.84
13:27	14.57	4.23	14:25	14.59	4.17	15:27	14.57	3.83
13:28	14.57	4.22	14:26	14.59	4.17	15:28	14.57	3.83
13:29	14.57	4.22	14:27	14.59	4.17	15:29	14.57	3.82
13:30	14.56	4.21	14:28	14.59	4.17	15:30	14.57	3.81
13:31	14.56	4.21	14:29	14.59	4.17	15:31	14.57	3.81
13:32	14.56	4.20	14:30	14.59	4.17	15:32	14.57	3.82
13:33	14.55	4.19	14:31	14.59	4.17	15:33	14.57	3.84
13:34	14.55	4.19	14:32	14.59	4.17	15:34	14.57	3.87
13:35	14.55	4.18	14:33	14.59	4.17	15:35	14.57	3.90
13:36	14.54	4.18	14:34	14.58	4.17	15:36	14.57	3.92
13:37	14.54	4.17	14:35	14.58	4.17	15:37	14.57	3.95
13:38	14.54	4.16	14:36	14.58	4.17	15:38	14.56	3.98
13:39	14.53	4.16	14:37	14.58	4.17	15:39	14.56	4.00
13:40	14.53	4.15	14:38	14.58	4.17	15:40	14.56	4.03
13:41	14.53	4.15	14:39	14.58	4.17	15:41	14.56	4.06
13:42	14.52	4.14	14:40	14.58	4.16	15:42	14.56	4.09
13:43	14.52	4.14	14:41	14.58	4.15	15:43	14.56	4.11
13:44	14.52	4.13	14:42	14.57	4.15	15:44	14.56	4.12
13:45	14.51	4.12	14:43	14.57	4.14	15:45	14.56	4.12
13:46	14.51	4.12	14:44	14.57	4.13	15:46	14.56	4.12
13:47	14.51	4.11	14:45	14.57	4.13	15:47	14.56	4.12
13:48	14.50	4.11	14:46	14.57	4.12	15:48	14.56	4.12
13:49	14.50	4.10	14:47	14.57	4.11	15:49	14.56	4.11
13:50	14.50	4.09	14:48	14.57	4.11	15:50	14.56	4.11
13:51	14.49	4.09	14:49	14.57	4.10	15:51	14.56	4.11
13:52	14.50	4.08	14:50	14.57	4.09	15:52	14.55	4.11
13:53	14.50	4.08	14:51	14.56	4.08	15:53	14.55	4.11
13:54	14.50	4.07	14:52	14.56	4.08	15:54	14.55	4.11
13:55	14.51	4.08	14:53	14.56	4.07	15:55	14.55	4.11
13:56	14.51	4.08	14:54	14.56	4.06	15:56	14.55	4.11
13:57	14.51	4.09	14:55	14.56	4.06	15:57	14.55	4.11
13:58	14.52	4.10	14:56	14.56	4.05	15:58	14.55	4.11
13:59	14.52	4.10	14:57	14.56	4.04	15:59	14.55	4.11
14:00	14.53	4.11	14:58	14.56	4.04	16:00	14.55	4.11
14:01	14.53	4.12	14:59	14.55	4.03	16:01	14.55	4.11
14:02	14.53	4.12	15:00	14.55	4.02	16:02	14.55	4.11
14:03	14.54	4.13	15:01	14.55	4.01	16:03	14.55	4.11
14:04	14.54	4.13	15:02	14.56	4.01	16:04	14.55	4.11
14:05	14.55	4.14	15:03	14.56	4.00	16:05	14.54	4.11
14:06	14.55	4.15	15:04	14.56	3.99	16:06	14.54	4.10
14:07	14.55	4.15	15:05	14.57	3.99	16:07	14.54	4.10
14:08	14.56	4.16	15:06	14.57	3.98	16:08	14.54	4.10
Avg.	**14.54**	**4.16**	**Avg.**	**14.58**	**4.11**	**Avg.**	**14.56**	**4.01**

Airgas. an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E04NI99E3HA0066 Reference Number: 160-402138464-1
Cylinder Number: ND11215 Cylinder Volume: 247.2 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN 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.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	56.16 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	55.00 PPM	54.22 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	55.00 PPM	56.16 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.1% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

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, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003838	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT

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

Approved for Release

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Airgas. an Air Liquide company

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

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E04NI99E3HA0002 Reference Number: 160-402340013-1
Cylinder Number: GN0027199 Cylinder Volume: 247.2 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12022 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN 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.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.73 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	80.00 PPM	79.82 PPM	G1	+/- 0.6% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	80.73 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	79.43 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022, 02/11/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	CC733106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	CC708044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889139	CC323707	4.097 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

ANALYTICAL EQUIPMENT

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

Approved for Release

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Airgas. an Air Liquide company

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

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02NI92E3HA0000 Reference Number: 160-402340009-1
Cylinder Number: GN0027038 Cylinder Volume: 248.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12022 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Feb 10, 2022

Expiration Date: Feb 10, 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.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	7.979 %	G1	+/- 0.5% NIST Traceable	02/10/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010635	K022176	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Jan 27, 2022

Triad Data Available Upon Request

NOTES: Gross Weight: 48.3 Kg
Net Weight: 8.1 Kg

Approved for Release

Page 1 of 160-402340009-1

Airgas. an Air Liquide company

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

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02NI84E3HA0001 Reference Number: 160-402830555-1
Cylinder Number: GN0029544 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-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. 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 Dates
OXYGEN	16.00 %	16.12 %	G1	+/- 0.5% NIST Traceable	09/05/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010205	K001516	23.2 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Aug 16, 2023

Triad Data Available Upon Request

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

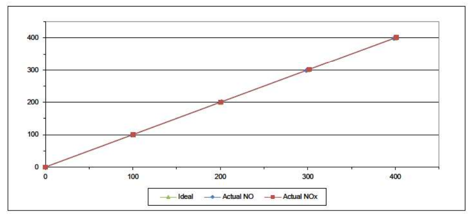
Approved for Release

Page 1 of 1

MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-25	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	PHD13MC7	Equipment ID	BKK_FS1072
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.40	1.40	0.70	200.50	0.50	0.25
3	300.00	298.30	-1.70	-0.57	301.80	1.80	0.60
4	400.00	398.50	-1.50	-0.38	401.40	1.40	0.35
AVERAGE (%)				-0.27			0.36



Calibrated By
(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

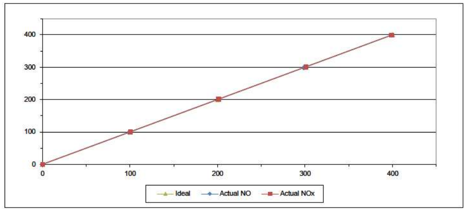
Approved By
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-25	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	X9RAXH0D	Equipment ID	BKK_FS0803
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.50	1.50	0.75	201.20	1.20	0.60
3	300.00	298.40	-1.60	-0.53	301.10	1.10	0.37
4	400.00	398.50	-1.50	-0.38	398.70	-1.30	-0.33
AVERAGE (%)				-0.25			0.25



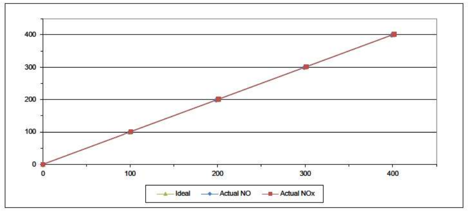
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-25	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	V9L01NF0	Equipment ID	BKK_FS1457
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	101.10	1.10	1.10
2	200.00	198.30	-1.70	-0.85	201.20	1.20	0.60
3	300.00	299.00	-1.00	-0.33	301.50	1.50	0.50
4	400.00	398.80	-1.20	-0.30	401.50	1.50	0.38
AVERAGE (%)				-0.36			0.53



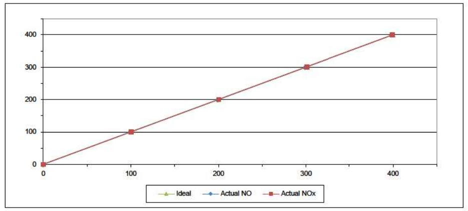
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-25	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	TLTATGDW	Equipment ID	BKK_FS0785
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.30	0.30	0.30
2	200.00	199.40	-0.60	-0.30	200.50	0.50	0.25
3	300.00	299.00	-1.00	-0.33	301.00	1.00	0.33
4	400.00	398.70	-1.30	-0.33	399.30	-0.70	-0.17
AVERAGE (%)				-0.37			0.16



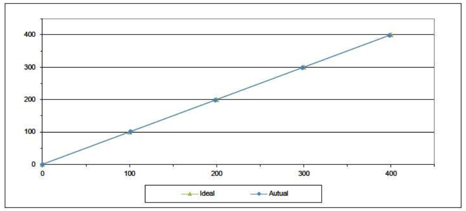
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-25	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	R0H40S60	Equipment ID	BKK_FS1071
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	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.20	1.20	1.20
2	200.00	198.30	-1.70	-0.85
3	300.00	298.40	-1.60	-0.53
4	400.00	398.20	-1.80	-0.45
AVERAGE (%)				-0.11



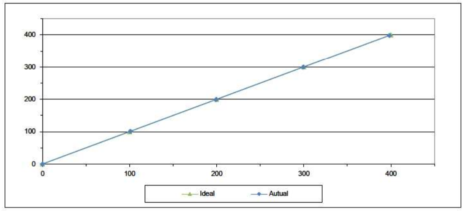
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-25	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	2SSLA6G0	Equipment ID	BKK_FS0802
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	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.10	1.10	1.10
2	200.00	199.40	-0.60	-0.30
3	300.00	299.30	-0.70	-0.23
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				0.05



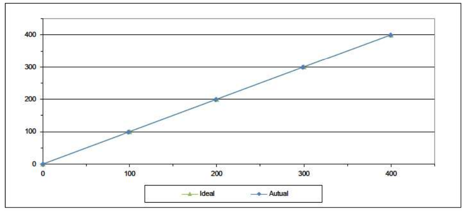
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-25	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	LRB7V6X	Equipment ID	BKK_FS1456
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	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.60	-1.40	-1.40
2	200.00	198.80	-1.20	-0.60
3	300.00	298.80	-1.20	-0.40
4	400.00	399.50	-0.50	-0.13
AVERAGE (%)				-0.48



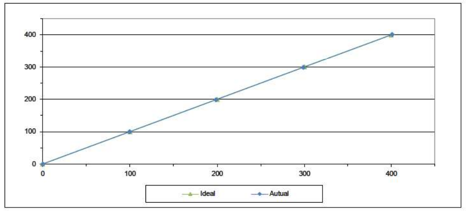
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-25	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	3C72K8HB	Equipment ID	BKK_FS0784
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	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	198.60	-1.40	-0.70
3	300.00	298.70	-1.30	-0.43
4	400.00	401.20	1.20	0.30
AVERAGE (%)				-0.23



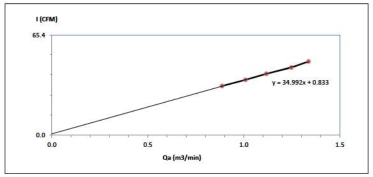
Calibrated By: (Mr.Jirawut Sakarn) Field Environmental Scientist (3)

Approved By: (Mr.Sarayuth Jittranont) Assistant General Manager

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	รพ.สต. บ้านหว้า	Temperature (°C) :	33.0
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS0384
CalibrationSheet No.:	C-171025-BKK_FS0384	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4788
Calibrator Model :	TE-5028A	Calibrator Slope :	1.03002
Calibrator S/N :	2584	Calibrator Intercept :	-0.01418

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.0	0.886	32	Slope :	34.9917
2	2.6	1.009	36	Intercept :	0.8330
3	3.2	1.117	40	Correlation Coefficient :	0.9986
4	4.0	1.248	44		
5	4.6	1.337	48		



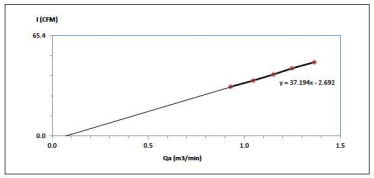
Calibrated by: K.Taweerat (Mr. Keerati Taweerat) BKK Field Services Scientist (1)

Approved by: (Mr. Warakorn Pookrak) Field Services Supervisor

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	โรงเรียนเจ้าพิทยังาง	Temperature (°C) :	33.0
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS0385
CalibrationSheet No.:	C-17102S-BKK_FS0385	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4789
Calibrator Model :	TE-5028A	Calibrator Slope :	1.03002
Calibrator S/N :	2584	Calibrator Intercept :	-0.01418

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	0.929	32	Slope : 37.1939
2	2.8	1.046	36	Intercept : -2.6920
3	3.4	1.151	40	Correlation Coefficient : 0.9994
4	4.0	1.248	44	
5	4.8	1.365	48	



Calibrated by: K Taweerat — { Mr. Keerati Taweerat } BKK Field Services Scientist (1)

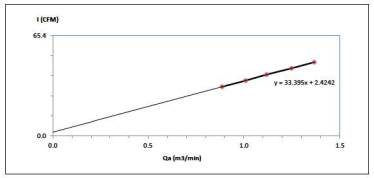
Approved by: Narakorn P. — { Mr. Warakorn Pookrak } Field Services Supervisor

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

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	หมู่ที่ 3 ตำบลบำเหน็จ	Temperature (°C) :	33.1
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS0383
CalibrationSheet No.:	C-17102S-BKK_FS0383	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4787
Calibrator Model :	TE-5028A	Calibrator Slope :	1.03002
Calibrator S/N :	2584	Calibrator Intercept :	-0.01418

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.0	0.886	32	Slope : 33.3950
2	2.6	1.009	36	Intercept : 2.4242
3	3.2	1.118	40	Correlation Coefficient : 0.9997
4	4.0	1.248	44	
5	4.8	1.365	48	



Calibrated by: K Taweerat — { Mr. Keerati Taweerat } BKK Field Services Scientist (1)

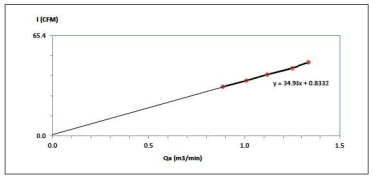
Approved by: Narakorn P. — { Mr. Warakorn Pookrak } Field Services Supervisor

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

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	หมู่ที่ 2 ตำบลบำเหน็จ	Temperature (°C) :	33.2
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS1487
CalibrationSheet No.:	C-17102S-BKK_FS1487	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	6432
Calibrator Model :	TE-5028A	Calibrator Slope :	1.03002
Calibrator S/N :	2584	Calibrator Intercept :	-0.01418

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.0	0.887	32	Slope : 34.9803
2	2.6	1.009	36	Intercept : 0.8332
3	3.2	1.118	40	Correlation Coefficient : 0.9986
4	4.0	1.248	44	
5	4.6	1.337	48	



Calibrated by: K Taweerat — { Mr. Keerati Taweerat } BKK Field Services Scientist (1)

Approved by: Narakorn P. — { Mr. Warakorn Pookrak } Field Services Supervisor

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

SARTORIUS

Accredited by

NSC-TISI-TIS 17025

Calibration 0426

NSC-TISI-TIS 17025 CALIBRATION 0426

Calibration certificate

Calibration Certificate No. 25BCI0197

Object	Electronic non-automatic weighing instrument
Manufacturer	Ohaus
Type	EX225D/AD
Serial | QM Ident. no.	C309774648 | BKK_EN0403
Customer	ALS Laboratory Group (Thailand)Co., Ltd.
	104 Phatthanakarn 40,Phattanakarn Rd.,Khwaeng Phatthanakarn ,Khet Suan Luang,Bangkok 10250
Order no.	261969
Number of pages	6
Date of calibration	30 May 2025

This calibration certificate documents the traceability to national standards.

Uncertainties of measurements are taken into account when only statements of compliance are made.

This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.

This certificate relate and apply this equipment only.

REVIEW BY ....Linda K.....

APPROVED BY...Sirlak P.....

NEXT CAL DATE.....30/05/26.....

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date	Approval of the Calibration Certificate	Person in charge
30 May 2025	Mr. Chonchai Inthana	Chonchai Inthana

Calibration object

Multi range instrument

Model	EX225D/AD	
Serial Number	C309774648	
QM Ident. no | Inventory no.	BKK_EN0403 | ---	
Range	1	2
Maximum capacity (Max. load)	120.00000 g	220.0000 g
Measured range	120.00000 g	220.0000 g
Scale interval	0.00001 g	0.0001 g

Place of calibration

Address	According to page 1
Department | Cost center	Environment Department. | ---
Building | Floor	--- | 1st Floor.
Room	Laboratory Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	Testo 174(Traceable to Si unit through ENTECH)	11 Nov 2025
Test weight set OIML R111 E2	Certificate No.M230819TS ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Range 1

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	30 May 2025
Temperature at place of calibration | Temp. diff. $T_{weights}$ - T_{place}	21.7 °C | 0.5 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 60.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal): 1 g | 100 g		
	1 g	100 g
1	0.99993 g	99.99971 g
2	0.99991 g	99.99971 g
3	0.99992 g	99.99974 g
4	0.99993 g	99.99973 g
5	0.99992 g	99.99974 g
6	0.99991 g	99.99970 g
7	0.99993 g	99.99973 g
8	0.99994 g	99.99972 g
9	0.99995 g	99.99971 g
10	0.99995 g	99.99969 g
	s = 0.000014 g	s = 0.000017 g

Eccentricity

Test load (nominal):	50 g
Center	49.99996 g
Front left	49.99993 g
Back left	49.99993 g
Back right	49.99994 g
Front right	49.99990 g
Maximum deviation from centric loading indication |Δ|ecc| max = 0.00006 g	

Error of indication

Testload L	Indication I	Error E	Expansion factor k	Uncertainty $U(E)$	Uncertainty relative $U_{rel}(E)$
0.00000 g	0.00000 g	0.00000 g	2.00	0.000030 g	---
0.01000 g	0.00995 g	-0.00005 g	2.00	0.000037 g	0.37 %
0.10000 g	0.09991 g	-0.00009 g	2.00	0.000038 g	0.038 %
0.50000 g	0.49985 g	-0.00015 g	2.00	0.000040 g	0.0080 %
1.00000 g	0.99991 g	-0.00009 g	2.00	0.000041 g	0.0041 %
5.00002 g	4.99997 g	-0.00005 g	2.00	0.000050 g	0.0010 %
10.00002 g	10.00003 g	0.00001 g	2.00	0.000069 g	0.00069 %
30.00002 g	49.99972 g	-0.00030 g	2.00	0.000091 g	0.00010 %
70.00004 g	69.99975 g	-0.00029 g	2.00	0.00017 g	0.00024 %
100.00001 g	99.99958 g	-0.00043 g	2.00	0.00017 g	0.00017 %
115.00006 g	114.99966 g	-0.00040 g	2.00	0.00028 g	0.00024 %
Maximum error of indication		|E|max = 0.00043 g			

$U_{rel}(E)$ is the quotient of $U(E)$ and test load L. The uncertainty of measurement $U(E)$ is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Range 2

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	30 May 2025
Temperature at place of calibration | Temp. diff. $T_{weights}$ - T_{place}	21.7 °C | 0.5 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 60.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal): 200 g	
	200 g
1	199.9998 g
2	199.9998 g
3	199.9998 g
4	200.0000 g
5	199.9998 g
6	199.9999 g
7	199.9999 g
8	200.0000 g
9	199.9998 g
10	199.9999 g
	s = 0.00008 g

Eccentricity

Test load (nominal):	100 g
Center	99.99984 g
Front left	99.99990 g
Back left	99.99983 g
Back right	99.99979 g
Front right	99.99979 g
Maximum deviation from centric loading indication |Δ|ecc| max = 0.00006 g	

Error of indication

Testload L	Indication I	Error E	Expansion factor k	Uncertainty $U(E)$	Uncertainty relative $U_{rel}(E)$
0.00000 g	0.00000 g	0.00000 g	2.00	0.000030 g	---
20.00002 g	19.99986 g	-0.00016 g	2.00	0.000069 g	0.00034 %
50.00002 g	49.99978 g	-0.00024 g	2.00	0.000091 g	0.00018 %
70.00004 g	69.99981 g	-0.00023 g	2.00	0.00017 g	0.00024 %
90.00007 g	89.99976 g	-0.00031 g	2.00	0.00018 g	0.00020 %
110.00003 g	109.99986 g	-0.00017 g	2.00	0.00028 g	0.00025 %
130.0001 g	129.9999 g	-0.0002 g	2.00	0.00028 g	0.00022 %
150.0000 g	149.9999 g	-0.0001 g	2.00	0.00028 g	0.00019 %
170.0000 g	170.0000 g	0.0000 g	2.00	0.00028 g	0.00016 %
200.0000 g	199.9998 g	-0.0002 g	2.00	0.00028 g	0.00014 %
220.0000 g	219.9999 g	-0.0001 g	2.00	0.00029 g	0.00013 %
Maximum error of indication		|E|max = 0.0003 g			

$U_{rel}(E)$ is the quotient of $U(E)$ and test load L. The uncertainty of measurement $U(E)$ is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate

Uncertainty of measurement in use

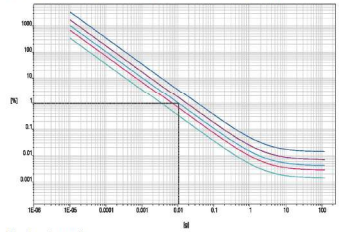
Range 1

Device adjusted before measurement	Yes
Temperature deviation considered	5 K
Temperature coefficient considered	$2 \cdot 10^{-6}$/K
Uncertainty of the weighing result $U_{pl}(W)$	$U_{pl}(W) = 0.000035\ g + 1.38 \cdot 10^{-5} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication R	Uncertainty $U_{pl}(W)$	Uncertainty relative $U_{pl}(W)_{rel}$
1 %	1.20000 g	0.000052 g	0.0043 %
25 %	30.00000 g	0.00045 g	0.0015 %
50 %	60.00000 g	0.00086 g	0.0014 %
75 %	90.00000 g	0.0013 g	0.0014 %
100 %	120.00000 g	0.0017 g	0.0014 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.01045 g

Uncertainty of measurement in use

Range 2

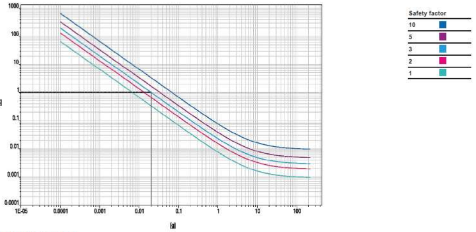
Device adjusted before measurement	Yes
Temperature deviation considered	5 K
Temperature coefficient considered	$2 \cdot 10^{-6}$/K

Uncertainty of the weighing result $U_{gl}(W)$ $U_{gl}(W) = 0.000067\ g + 9.52 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication R	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	2.20000 g	0.000088 g	0.0040 %
25 %	55.00000 g	0.00059 g	0.0011 %
50 %	110.00000 g	0.0011 g	0.0010 %
75 %	165.0000 g	0.0016 g	0.00099 %
100 %	220.0000 g	0.0022 g	0.00098 %

Graphic realization of the relative uncertainty of measurement | process accuracy



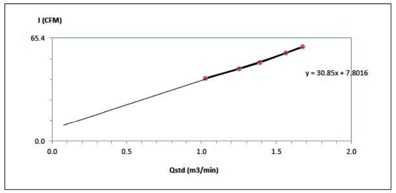
Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.02019 g

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	รพ.สต. บ้านหว้า	Temperature (°C) :	33.0
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS0370
CalibrationSheet No.:	C-171025-BKK_FS0370	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4798
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64456
Calibrator S/N :	2584	Calibrator Intercept :	-0.02267

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.8	1.0257	40	Slope :	30.8495
2	4.2	1.2511	46	Intercept :	7.8016
3	5.2	1.3896	50	Correlation Coefficient :	0.9976
4	6.6	1.5626	56		
5	7.6	1.6752	60		



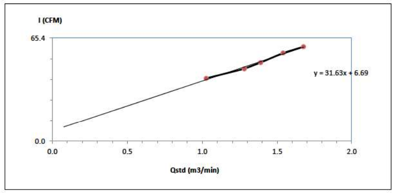
Calibrated by K.Taweerat
(Mr. Keerati Taweerat)
BKK Field Services Scientist (1)

Approved by : Warakorn P.
(Mr. Warakorn Pookrak)
Field Services Supervisor

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	โรงเรียนเจ้าฟ้าสร้าง	Temperature (°C) :	33.0
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS1375
CalibrationSheet No.:	C-171025-BKK_FS1375	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	6256
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64456
Calibrator S/N :	2584	Calibrator Intercept :	-0.02267

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.8	1.0257	40	Slope :	31.6299
2	4.4	1.2800	46	Intercept :	6.6900
3	5.2	1.3896	50	Correlation Coefficient :	0.9939
4	6.4	1.5391	56		
5	7.6	1.6752	60		



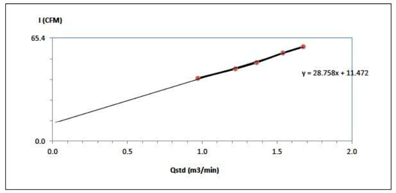
Calibrated by K.Taweerat
(Mr. Keerati Taweerat)
BKK Field Services Scientist (1)

Approved by : Warakorn P.
(Mr. Warakorn Pookrak)
Field Services Supervisor

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	หมู่ที่ 3 ตำบลบ้านเลน	Temperature (°C) :	33.1
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS0372
CalibrationSheet No.:	C-171025-BKK_FS0372	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5332
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64456
Calibrator S/N :	2584	Calibrator Intercept :	-0.02267

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.5	0.9703	40	Slope :	28.7576
2	4.0	1.2213	46	Intercept :	11.4724
3	5.0	1.3628	50	Correlation Coefficient :	0.9972
4	6.4	1.5389	56		
5	7.6	1.6749	60		



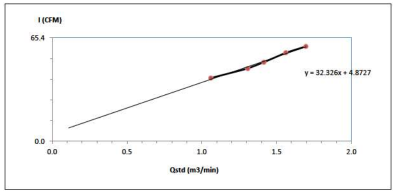
Calibrated by K.Taweerat
(Mr. Keerati Taweerat)
BKK Field Services Scientist (1)

Approved by : Warakorn P.
(Mr. Warakorn Pookrak)
Field Services Supervisor

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BL Co., Ltd.	Barometric Pressure (mm Hg) :	758.4
Calibrate Location :	หมู่ที่ 2 ตำบลบ้านหว้า	Temperature (°C) :	33.2
Calibrate Date :	17-Oct-25	High Volume ID :	BKK_FS1485
CalibrationSheet No.:	C-171025-BKK_FS1485	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	6430
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64456
Calibrator S/N :	2584	Calibrator Intercept :	-0.02267

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	3.0	1.0606	40	Slope :	32.3257
2	4.6	1.3079	46	Intercept :	4.8727
3	5.4	1.4152	50	Correlation Coefficient :	0.9942
4	6.6	1.5621	56		
5	7.8	1.6962	60		



Calibrated by K.Taweerat
(Mr. Keerati Taweerat)
BKK Field Services Scientist (1)

Approved by : Warakorn P.
(Mr. Warakorn Pookrak)
Field Services Supervisor

JIRANATEE ASSOCIATES CO.,LTD.

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

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

Air speed measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWS-043-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6066
Data logger: A6066
ID NUMBER : BKK_FS1440
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 18 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

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

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

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Wind direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.8) °C, (43.0) %RH and (1007.6) hPa.

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

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0065-24

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ......
Mr. Parinya Booncharoen
Calibration Department Manager

REVIEW BY ...... Warakorn P.
APPROVED BY ......
NEXT CAL DATE 18/03/26

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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

Jiranatee Associates Co., Ltd.

Certificate Number
CWS-043-67

MEASUREMENT RESULTS [5]

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
1.118	24.92	24.95	1.0	-0.1	0.31
2.272	24.90	24.95	2.1	-0.2	0.31
3.121	24.70	24.95	3.0	-0.1	0.31
4.231	24.74	24.95	4.0	-0.2	0.31
4.94	24.80	24.95	5.0	0.1	0.31
5.95	24.54	24.95	6.0	0.0	0.31
7.03	24.64	24.95	7.0	0.0	0.31
7.96	24.42	24.95	8.0	0.0	0.31
9.03	24.52	24.95	9.0	0.0	0.31
9.97	24.90	24.95	10.0	0.0	0.34
10.97	25.04	24.95	11.0	0.0	0.31
12.02	25.22	24.95	12.0	0.0	0.42
12.95	24.92	24.95	13.1	0.1	0.38
14.03	25.20	24.95	14.0	-0.1	0.31
15.01	24.94	24.95	15.0	0.0	0.37
15.96	25.20	24.95	16.1	0.1	0.39

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] 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 imaging geometry.

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

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

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E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Wind direction measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWD-043-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6066
Data logger: A6066
ID NUMBER : BKK_FS1440
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 18 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.8)°C, (48.2) %RH and (999.8) hPa.

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0036-23.

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ......
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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

Jiranatee Associates Co., Ltd.

Certificate Number
CWD-043-67

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.04	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	133	-2	0.80
	180.000	181	1	0.80
	225.000	228	3	0.80
	270.000	273	3	0.80
	315.000	318	3	0.80

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD

Jiranatee Associates Co., Ltd.

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
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Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-169-67

MEASUREMENT ITEM	: Data Logger with Temperature sensor
MANUFACTURER	: Novalynx
MODEL/TYPE	: 110-WS-25DL-D
SERIAL NUMBER	: A6066
ID NUMBER	: BKK_FS1440
CONDITION AS-RECEIVED	: New 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 Sep 2024
MEASUREMENT DATE	: 14 Sep 2024
ISSUE DATE	: 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

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

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

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
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'

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai 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

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-169-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:
Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: W2920790.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.061	19.9	-0.2	0.099
80	25.054	24.8	-0.3	0.099
80	30.040	29.8	-0.2	0.099
80	35.028	34.8	-0.2	0.099
80	40.025	39.8	-0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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Web site: www.jiranatee.com

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

Relative humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-038-67

MEASUREMENT ITEM	: Relative humidity with data logger
MANUFACTURER	: Novalynx
MODEL/TYPE	: Data Logger: 110-WS-25DL-D Sensor: HMP60
SERIAL NUMBER	: Data Logger: A6066 Sensor: W2920790
ID NUMBER	: BKK_FS1440
CONDITION AS-RECEIVED	: New 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 Sep 2024
MEASUREMENT DATE	: 18 Sep 2024
ISSUE DATE	: 01 Oct 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 Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-038-67

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
29.82	19.50	17.7	-1.8	0.83
29.83	50.35	47.8	-2.5	1.3
29.82	81.54	78.7	-2.8	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration

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NSC-TISI-TIS 17025
CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-016-67

MEASUREMENT ITEM	: Digital barometer
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: 110-WS-25BP Data logger: 110-WS-25DL-D
SERIAL NUMBER	: Sensor: BP-A6066 Data logger: A6066
ID NUMBER	: BKK_FS1440
CONDITION AS-RECEIVED	: New 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 Sep 2024
MEASUREMENT DATE	: 26 Sep 2024
ISSUE DATE	: 01 Oct 2024

Calibration procedure:
The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

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'

CONDITION OF THIS RESULT OF CALIBRATION:
1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0009-24	27 Dec 2024

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition : ☑ Normal ☐ Abnormal
   Pressure transmitting medium : Air
   ρ_{fl} (20°C, 1 bar) : 1.19 kg/m³
   H_{amb} : (55±15) %
   t_{amb} : (23±3) °C
   p_{amb} : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-016-67

MEASUREMENT RESULTS : ☐ Without adjustment ☑ With adjustment
CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below.

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.05	950.5	0.5	0.37
970.07	970.4	0.3	0.37
990.06	990.2	0.2	0.37
1010.04	1009.9	-0.2	0.37
1030.05	1030.0	-0.1	0.37
1050.03	1049.7	-0.3	0.37

Note: UUC* Unit Under Calibration
: To convert the result in report unit to Pa should be multiply by 100

End of certificate

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWS-041-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: WS-02FA Data logger: 110-WS-25DL-D
SERIAL NUMBER	: Sensor: WSD-A6061 Data logger: A6061
ID NUMBER	: BKK_FS1438
CONDITION AS-RECEIVED	: New 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 Sep 2024
MEASUREMENT DATE	: 17 Sep 2024
ISSUE DATE	: 01 Oct 2024

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

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

CALIBRATION CONDITIONS			
	: Wind tunnel cross-section area[1]	900	cm²
	Wind direction frontal area[2]	100	cm²
	Diameter of mounting pipe[3]	-	mm
	Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.6) °C, (42.6) %RH and (1006.1) hPa.

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

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0065-24

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

REVIEW BY ..... Narakorn P.
APPROVED BY .....
NEXT CAL DATE 17/03/26

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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
CWS-041-67

MEASUREMENT RESULTS [5]

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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_{std} [6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc} [7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.979	22.96	22.90	0.9	-0.1	0.31
2.196	22.82	22.90	2.0	-0.2	0.31
3.017	22.74	22.90	3.0	-0.1	0.31
4.206	22.76	22.90	4.0	-0.2	0.31
5.02	22.72	22.90	5.0	-0.1	0.31
6.02	22.82	22.90	6.0	0.0	0.31
7.07	22.54	22.90	7.0	0.0	0.31
8.02	22.52	22.90	8.0	0.0	0.31
9.07	22.48	22.90	9.0	-0.1	0.31
10.00	22.40	22.90	10.0	0.0	0.31
11.02	22.50	22.90	11.0	0.0	0.31
12.06	22.48	22.90	12.1	0.0	0.31
12.98	22.60	22.90	13.1	0.1	0.31
13.99	22.50	22.90	14.1	0.1	0.31
15.02	22.56	22.90	15.1	0.1	0.31
15.95	22.50	22.90	16.0	0.1	0.31

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] 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 imaging geometry.

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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Jiranatee Associates Co.,Ltd
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Web site: www.jiranatee.com

Accredited calibration laboratory
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NSC-TISI-TIS 17025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWD-041-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6061
Data logger: A6061
ID NUMBER : BKK_FS1438
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 17 Sep 2024
ISSUE DATE : 01 Oct 2024

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

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

CALIBRATION CONDITION : Wind tunnel cross-section area[1] 900 cm²
Wind direction frontal area[2] 129 cm²
Diameter of mounting pipe[3] - mm
Blockage ratio of test object[4] 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.9)°C, (47.2) %RH and (1000.8) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0036-23.

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

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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Certificate Number
CWD-041-67

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.03	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	133	-2	0.80
	180.000	181	1	0.80
	225.000	228	3	0.80
	270.000	273	3	0.80
	315.000	319	4	0.80

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-167-67

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novalynx
MODEL/TYPE : 110-WS-25DL-D
SERIAL NUMBER : A6061
ID NUMBER : BKK_FS1438
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 13 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

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

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

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
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'

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-167-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:
Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: W2920781.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.057	19.9	-0.2	0.099
80	25.051	24.8	-0.3	0.099
80	30.042	29.8	-0.2	0.099
80	35.030	34.8	-0.2	0.099
80	40.017	39.8	-0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

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Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Relative humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-036-67

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novalynx
MODEL/TYPE : Data Logger: 110-WS-25DL-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: A6061
Sensor: W2920781
ID NUMBER : BKK_FS1438
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 17 Sep 2024
ISSUE DATE : 01 Oct 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 Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-036-67

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ± (%RH)
29.84	19.48	18.4	-1.1	0.83
29.85	50.33	49.5	-0.9	1.3
29.85	81.48	81.0	-0.5	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
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Web site: www.jiranatee.com

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

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-014-67

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A6061
Data logger: A6061
ID NUMBER : BKK_FS1438
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 25 Sep 2024
ISSUE DATE : 01 Oct 2024

Calibration procedure:
The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

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'

CONDITION OF THIS RESULT OF CALIBRATION:
1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0009-24	27 Dec 2024

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition : ☑ Normal ☐ Abnormal
Pressure transmitting medium : Air
ρ_{fl} (20°C, 1 bar) : 1.19 kg/m³
H_{amb} : (55±15) %
t_{amb} : (23±3) °C
p_{amb} : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-014-67

MEASUREMENT RESULTS : ☐ Without adjustment ☑ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below.

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.08	950.8	0.7	0.37
970.07	970.7	0.7	0.37
990.07	990.5	0.5	0.37
1010.05	1010.0	-0.1	0.37
1030.04	1029.8	-0.2	0.37
1050.03	1049.7	-0.4	0.37

Note: UUC* Unit Under Calibration
: To convert the result in report unit to Pa should be multiply by 100

End of certificate

JIRANATEE ASSOCIATES CO.,LTD

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

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Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWS-042-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6065
Data logger: A6065
ID NUMBER : BKK_FS1439
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 17 Sep 2024
ISSUE DATE : 01 Oct 2024

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

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

CALIBRATION CONDITIONS : Wind tunnel cross-section area[1] 900 cm²
Wind direction frontal area[2] 100 cm²
Diameter of mounting pipe[3] - mm
Blockage ratio of test object[4] 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.9) °C, (40.8) %RH and (1002.2) hPa.

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0065-24

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'

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

REVIEW BY ....
APPROVED BY ....
NEXT CAL DATE 17/03/26

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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

Jiranatee Associates Co., Ltd.

Certificate Number
CWS-042-67

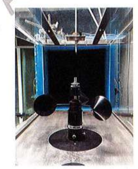
MEASUREMENT RESULTS [5]

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
1.000	23.20	23.25	0.9	-0.1	0.31
2.203	23.28	23.25	2.0	-0.2	0.31
3.072	23.00	23.25	3.0	-0.1	0.31
4.209	23.04	23.25	4.0	-0.2	0.31
4.95	22.80	23.25	5.0	0.0	0.31
6.10	22.82	23.25	6.0	-0.1	0.31
7.03	22.72	23.25	7.0	0.0	0.31
7.96	22.60	23.25	8.0	0.1	0.31
9.02	22.86	23.25	8.9	-0.1	0.31
9.97	22.58	23.25	9.9	0.0	0.31
10.96	22.90	23.25	10.9	0.0	0.31
12.01	22.70	23.25	12.1	0.1	0.31
12.95	22.98	23.25	13.0	0.1	0.31
13.95	22.80	23.25	14.1	0.1	0.35
14.97	22.92	23.25	15.0	0.0	0.31
15.92	22.90	23.25	16.1	0.1	0.31

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] 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 imaging geometry.

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

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Web site: www.jiranatee.com

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

Wind direction measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWD-042-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6065
Data logger: A6065
ID NUMBER : BKK_FS1439
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 17 Sep 2024
ISSUE DATE : 01 Oct 2024

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

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

CALIBRATION CONDITION : Wind tunnel cross-section area[1] 900 cm²
Wind direction frontal area[2] 129 cm²
Diameter of mounting pipe[3] - mm
Blockage ratio of test object[4] 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.8)°C, (42.3) %RH and (1001.6) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0036-23.

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

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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

Jiranatee Associates Co., Ltd.

Certificate Number
CWD-042-67

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	180	0	0.80
	225.000	227	2	0.80
	270.000	273	3	0.80
	315.000	318	3	0.80

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

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Web site: www.jiranatee.com

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

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-168-67

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novalynx
MODEL/TYPE : 110-WS-25DL-D
SERIAL NUMBER : A6065
ID NUMBER : BKK_FS1439
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 13 Sep 2024
ISSUE DATE : 01 Oct 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.*

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-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
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'

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai 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

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-168-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:
Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: W2920779.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.057	19.9	-0.1	0.14
80	25.051	24.8	-0.2	0.16
80	30.041	29.8	-0.2	0.099
80	35.030	34.8	-0.2	0.099
80	40.017	39.8	-0.2	0.099

UUC*: Unit Under Calibration
Remark: 1. 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%.
2. The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

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

Relative humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-037-67

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novalynx
MODEL/TYPE : Data Logger: 110-WS-25DL-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: A6065
Sensor: W2920779
ID NUMBER : BKK_FS1439
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 17 Sep 2024
ISSUE DATE : 01 Oct 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.*

Calibration procedure:
The Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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'

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-037-67

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
29.85	19.48	18.4	-1.1	0.83
29.85	50.33	49.5	-0.9	1.4
29.85	81.47	81.0	-0.5	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

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Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-015-67

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A6065
Data logger: A6065
ID NUMBER : BKK_FS1439
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 25 Sep 2024
ISSUE DATE : 01 Oct 2024

Calibration procedure:
The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

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'

CONDITION OF THIS RESULT OF CALIBRATION:
1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0009-24	27 Dec 2024

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition : ☑ Normal ☐ Abnormal
Pressure transmitting medium : Air
ρ_{fl} (20°C, 1 bar) : 1.19 kg/m³
H_{amb} : (55±15) %
t_{amb} : (23±3) °C
p_{amb} : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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

JIRANATEE ASSOCIATES CO.,LTD.

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Accredited calibration laboratory
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CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-015-67

MEASUREMENT RESULTS : ☐ Without adjustment ☑ With adjustment
CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below.

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.07	950.6	0.5	0.37
970.04	970.4	0.4	0.37
990.05	990.3	0.3	0.37
1010.05	1010.0	-0.1	0.37
1030.03	1029.9	-0.1	0.37
1050.05	1049.8	-0.3	0.37

Note: UUC* Unit Under Calibration
: To convert the result in report unit to Pa should be multiply by 100

End of certificate

JNAC JIRANATEE ASSOCIATES CO.,LTD

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CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWS-044-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6067
Data logger: A6067
ID NUMBER : BKK_FS1441
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 18 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

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

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

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm²
Wind direction frontal area[2]	100	cm²
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (25.0) °C, (51.7) %RH and (1008.9) hPa.

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

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0065-24

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

REVIEW BY ....
APPROVED BY ....
NEXT CAL DATE 18/03/26

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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
CWS-044-67

MEASUREMENT RESULTS [5]

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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_{std} [6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc} [7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.998	24.96	25.15	0.9	-0.1	0.31
2.193	25.12	25.15	2.0	-0.2	0.31
3.061	25.06	25.15	3.0	-0.1	0.31
4.232	25.02	25.15	4.0	-0.2	0.31
4.95	24.80	25.15	5.0	0.0	0.31
5.95	25.16	25.15	6.0	0.0	0.31
6.91	24.86	25.15	7.0	0.1	0.31
7.89	25.04	25.15	8.0	0.1	0.31
8.99	25.10	25.15	9.0	0.0	0.31
9.97	24.74	25.15	10.0	0.1	0.31
10.98	25.02	25.15	11.0	0.1	0.31
12.03	24.90	25.15	12.0	0.0	0.31
12.96	24.72	25.15	13.0	0.1	0.31
14.00	25.18	25.15	14.0	0.0	0.31
14.97	24.82	25.15	15.1	0.1	0.31
15.89	25.00	25.15	16.0	0.1	0.31

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] 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 imaging geometry.

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD

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CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

Certificate Number
CWD-044-67

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A6067
Data logger: A6067
ID NUMBER : BKK_FS1441
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 18 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

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

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

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm²
Wind direction frontal area[2]	129	cm²
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (22.9)°C, (52.8) %RH and (1000.1) hPa.

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0036-23.

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

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] 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
CWD-044-67

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.02	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	181	1	0.80
	225.000	227	2	0.80
	270.000	273	3	0.80
	315.000	319	4	0.80

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD

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

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-170-67

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novalynx
MODEL/TYPE : 110-WS-25DL-D
SERIAL NUMBER : A6067
ID NUMBER : BKK_FS1441
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 14 Sep 2024
ISSUE DATE : 01 Oct 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH

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

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

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

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
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'

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-170-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ˚C to 40 ˚C

Function:
Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: W2920791.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (˚C)	UUC Reading (˚C)	Error (˚C)	Uncertainty (˚C)
80	20.061	19.9	-0.2	0.099
80	25.054	24.9	-0.2	0.099
80	30.039	29.8	-0.2	0.099
80	35.028	34.8	-0.2	0.099
80	40.025	39.8	-0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

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Jiranatee Associates Co., Ltd.

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CALIBRATION 0367

Relative humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-039-67

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novalynx
MODEL/TYPE : Data Logger: 110-WS-25DL-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: A6067
Sensor: W2920791
ID NUMBER : BKK_FS1441
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 18 Sep 2024
ISSUE DATE : 01 Oct 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 Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruengrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-039-67

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 ˚C are reported in table below.
Calibration Range: 20%RH to 80%RH

Air Temperature (˚C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
29.82	19.49	17.5	-2.0	0.83
29.83	50.35	47.9	-2.5	1.3
29.82	81.50	78.8	-2.7	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD

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CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

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CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-017-67

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A6067
Data logger: A6067
ID NUMBER : BKK_FS1441
CONDITION AS-RECEIVED : New 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 Sep 2024
MEASUREMENT DATE : 26 Sep 2024
ISSUE DATE : 01 Oct 2024

Calibration procedure:
The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

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'

CONDITION OF THIS RESULT OF CALIBRATION:
1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0009-24	27 Dec 2024

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition : ☑ Normal ☐ Abnormal
Pressure transmitting medium : Air
ρ_{fl}(20˚C, 1 bar) : 1.19 kg/m³
H_{amb} : (55±15) %
t_{amb} : (23±3) ˚C
p_{amb} : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO.,LTD

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

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CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.

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CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CPR-017-67

MEASUREMENT RESULTS : ☐ Without adjustment ☑ With adjustment
CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below.

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.07	950.8	0.7	0.37
970.04	970.6	0.5	0.37
990.05	990.4	0.4	0.37
1010.03	1010.0	0.0	0.37
1030.03	1029.9	-0.2	0.37
1050.02	1049.7	-0.3	0.37

Note: UUC* Unit Under Calibration
: To convert the result in report unit to Pa should be multiply by 100

End of certificate

JNAC JIRANATEE ASSOCIATES CO.,LTD

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CALIBRATION LABORATORY

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ilac-MRA
NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC24077

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178118
ID No.: BKK_FS0631

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) %

REVIEW BY ....
APPROVED BY ....
NEXT CAL DATE.... 16/12/25

Received Date : 06 DECEMBER 2024
Calibration Date : 16 DECEMBER 2024
Date of Issue : 17 DECEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)

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CALIBRATION 0394

Cert. No. : ACC24077
Job No. : VC68AC0045

Calibration Procedure : CP-AC-03

Calibration Method :
This equipment was calibrated by follow 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-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	33461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25
Audio Analyzer	AVR-3360A	V744B6069	EF-0009-24	09-FEB-25

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

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CALIBRATION 0394

Cert. No. : ACC24077
Job No. : VC68AC0045

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	93.97	-0.03	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1001.7	0.2	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
1.63	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

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NSC-TISI-TIS 17025 CALIBRATION 0394

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572563 / 170399 / 72900
ID No.: BKK_FS0879

Condition As Found : GOOD

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

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

Received Date : 06 DECEMBER 2024
Calibration Date : 13-16 DECEMBER 2024
Date of Issue : 16 DECEMBER 2024

REVIEW BY .....
APPROVED BY .....
NEXT CAL DATE 13/12/25

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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.

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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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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
13.8

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

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

3. Acoustical signal tests of frequency weightings
Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.5	0.5	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	-0.9	-0.8	-0.7	±5.0

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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	0.0	±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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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
135.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.1	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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

T. Petch.

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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	133.4	0.0	±3.0

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

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

T. Petch.

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NSC-TISI-TIS 17025 CALIBRATION 0394

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572552 / 170384 / 72890
ID No.: BKK_FS0877

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 NOVEMBER 2024
Calibration Date : 03-04 DECEMBER 2024
Date of Issue : 04 DECEMBER 2024

REVIEW BY .....
APPROVED BY.....
NEXT CAL DATE.....03/12/25.....

Calibrated by : Tanadej Chaimongkol

Approved by :
(Thanakul Petchurai)

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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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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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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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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Weighting (dB)
A - weight	10.8
C - weight	17.4
Flat	23.2

3. Acoustical signal tests of frequency weightings
Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.2	-1.1	-1.1	±5.0

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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	0.0	±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

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7. Level linearity on the reference level range

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

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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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.0	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	128.0	0.0	±1.0

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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	130.0	130.0	0.0	±3.0
One	133.4	133.3	-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		
89.5	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	137.1	137.1	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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Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00858527 / 157781 / 48096
ID No.: BKK_FS0117

Condition As Found : GOOD

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

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

Received Date : 06 DECEMBER 2024
Calibration Date : 13-16 DECEMBER 2024
Date of Issue : 16 DECEMBER 2024

REVIEW BY .....
APPROVED BY .....
NEXT CAL DATE.....13/12/25.....

Calibrated by : Nathakorn Pisutpaisan

Approved by : (Thanakul Petchurai)

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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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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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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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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.5

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

Frequency Weighting	Weighting (dB)
A - weight	13.1
C - weight	19.0
Flat	24.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.7	0.7	0.7	± 1.5
1000	0.3	0.3	0.3	± 1.0
8000	-0.6	-0.5	-0.5	±5.0

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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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	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.0	0.0	±1.1

9. Tone burst response

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

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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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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		
89.6	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

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NSC-TISI-TIS 17025 CALIBRATION 0394

Cert. No. : ACC24069
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34425567
ID No.: BKK_FS0618

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 NOVEMBER 2024
Calibration Date : 04 DECEMBER 2024
Date of Issue : 04 DECEMBER 2024

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL DATE 04/12/25

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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Cert. No. : ACC24069
Job No. : VC67AC0170
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :
This equipment was calibrated by follow 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-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	33461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25
Audio Analyzer	AVR-3360A	V744B6069	EF-0009-24	09-FEB-25

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.

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Cert. No. : ACC24069
Job No. : VC67AC0170
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	94.03	0.03	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1004.8	0.5	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
1.67	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

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Cert. No. : ACL25070
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597162 / 171618 / 72790
ID No.: BKK_FS0997

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 JANUARY 2025
Calibration Date : 21 - 23 JANUARY 2025
Date of Issue : 24 JANUARY 2025

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL DATE 21/01/26

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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Cert. No. : ACL25070
Job No. : VC68AC0058
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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. : ACL25070
Job No. : VC68AC0058
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	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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Cert. No. : ACL25070
Job No. : VC68AC0058
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	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	Weighting (dB)
A - weight	9.9
C - weight	16.8
Flat	22.6

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	0.1	0.1	0.1	±5.0

T. Petch.

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Cert. No. : ACL25070
Job No. : VC68AC0058
Pages : 5 of 8

4. Electrical signal tests of frequency weightings
Weighting network response with relative to 1 kHz.

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

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	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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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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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

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

11. Overload indication

Measured value (dB) Positive one-half cycle	Measured value (dB) Negative one-half cycle	Deviated Value (dB)	Acceptance Limits (dB)
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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Sirinthorn Road, Bangbumru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiphorn.com

SITHIPORN associates ilac-MRA NSC-TISI-TIS 17025 CALIBRATION 0394

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597164 / 180407 / 88177
ID No.: BKK_FS0999

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) %

REVIEW BY Narakorn P.
APPROVED BY
NEXT CAL DATE 14/11/25

Received Date : 05 NOVEMBER 2024
Calibration Date : 14-18 NOVEMBER 2024
Date of Issue : 18 NOVEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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.

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. Petch.

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	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	Weighting (dB)
A - weight	11.6
C - weight	17.6
Flat	23.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB) Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.0	1.1	1.1	±5.0

T. Petch.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB) Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	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	0.0	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	94.1	0.1	± 0.3

T. Petch.

Cert. No. : ACL24354
Job No. : VC68AC0029
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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	29.1	0.1	± 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	25.2	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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.5	0.5	±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

Cert. No. : ACL24354
Job No. : VC68AC0029
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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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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		
89.5	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

Cert. No. : ACL24380
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623382 / 198628 / 26410
ID No.: BKK_FS1215

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) %

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL DATE 03/12/25

Received Date : 15 NOVEMBER 2024
Calibration Date : 03-04 DECEMBER 2024
Date of Issue : 04 DECEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : (Thanakul Petchurai)

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

Cert. No. : ACL24380
Job No. : VC68AC0032
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

Cert. No. : ACL24380
Job No. : VC68AC0032
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	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

Cert. No. : ACL24380
Job No. : VC68AC0032
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Weighting (dB)
A - weight	10.8
C - weight	16.8
Flat	22.5

3. Acoustical signal tests of frequency weightings
Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.2	-0.1	-0.1	±5.0

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

Cert. No. : ACL24380
Job No. : VC68AC0032
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Petch.

Cert. No. : ACL24380
Job No. : VC68AC0032
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	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

T. Petch.

Cert. No. : ACL24380
Job No. : VC68AC0032
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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		
89.6	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

Cert. No. : ACL24381
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623383 / 198629 / 26411
ID No.: BKK_FS1216

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 NOVEMBER 2024
Calibration Date : 03-04 DECEMBER 2024
Date of Issue : 04 DECEMBER 2024

REVIEW BY ..... Nanakorn P.
APPROVED BY .....
NEXT CAL DATE..... 03/12/25

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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Cert. No. : ACL24381
Job No. : VC68AC0032
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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.

Cert. No. : ACL24381
Job No. : VC68AC0032
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	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. Petch.

Cert. No. : ACL24381
Job No. : VC68AC0032
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Weighting (dB)
A - weight	10.8
C - weight	17.0
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	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.2	± 1.0
8000	-0.6	-0.5	-0.5	±5.0

T. Petch.

Cert. No. : ACL24381
Job No. : VC68AC0032
Pages : 5 of 8

4. Electrical signal tests of frequency weightings
Weighting network response with relative to 1 kHz.

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

T. Petch.

Cert. No. : ACL24381
Job No. : VC68AC0032
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Petch.

Cert. No. : ACL24381
Job No. : VC68AC0032
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	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

T. Petch.

Cert. No. : ACL24381
Job No. : VC68AC0032
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	±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		
89.5	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

Cert. No. : ACL24357
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623381 / 198627 / 26409
ID No.: BKK_FS1214

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) %

REVIEW BY Nrakon P.
APPROVED BY
NEXT CAL DATE 14/11/25

Received Date : 05 NOVEMBER 2024
Calibration Date : 14-18 NOVEMBER 2024
Date of Issue : 18 NOVEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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Cert. No. : ACL24357
Job No. : VC68AC0029
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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.

Cert. No. : ACL24357
Job No. : VC68AC0029
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	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. Petch.

Cert. No. : ACL24357
Job No. : VC68AC0029
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Weighting (dB)
A - weight	10.8
C - weight	17.2
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	0.3	**0.3**	**0.3**	± 1.5
1000	0.2	**0.2**	**0.2**	± 1.0
8000	0.6	**0.7**	**0.7**	±5.0

T. Petch.

Cert. No. : ACL24357
Job No. : VC68AC0029
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	**-0.1**	**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

T. Petch.

Cert. No. : ACL24357
Job No. : VC68AC0029
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	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	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

T. Petch

Cert. No. : ACL24357
Job No. : VC68AC0029
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	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

T. Petch

Cert. No. : ACL24357
Job No. : VC68AC0029
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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		
89.6	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch

Cert. No. : ACL24353
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597163 / 180406 / 88176
ID No.: BKK_FS0998

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) %

REVIEW BY ..... Nanakorn P.
APPROVED BY.....
NEXT CAL DATE..... 14/11/25

Received Date : 05 NOVEMBER 2024
Calibration Date : 14-18 NOVEMBER 2024
Date of Issue : 18 NOVEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch
(Thanakul Petchurai)

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Cert. No. : ACL24353
Job No. : VC68AC0029
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

Cert. No. : ACL24353
Job No. : VC68AC0029
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	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. Petch

Cert. No. : ACL24353
Job No. : VC68AC0029
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	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	Weighting (dB)
A - weight	11.6
C - weight	17.2
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	0.4	0.3	0.3	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	0.4	0.5	0.4	±5.0

T. Petch

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Job No. : VC68AC0029
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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	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch

Cert. No. : ACL24353
Job No. : VC68AC0029
Pages : 6 of 8

7. Level linearity on the reference level range

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

Cert. No. : ACL24353
Job No. : VC68AC0029
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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

Cert. No. : ACL24353
Job No. : VC68AC0029
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.3	-0.1	±3.0

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

11. Overload indication

Measured value (dB) Positive one-half cycle	Measured value (dB) Negative one-half cycle	Deviated Value (dB)	Acceptance Limits (dB)
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 lavel of confidence of approximately 95 %

End of Calibration Certificate

Certificate of Calibration

Customer

Name : ALS Laboratory Group Thailand Co., Ltd. **Certificate No** : 25-ACT-009
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang, Bangkok 10250 **Request No** : Req-2025-0090

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1
Manufacturer : RION Range : 94 dB / 1000 Hz
Model : NC-74 Instrument Status : Used
Serial Number : 34178119
ID : BKK_FS0632

REVIEW BY ....
APPROVED BY........
NEXT CAL DATE........16/01/26........

Calibration Environment and Details

Temperature : (23 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ±10.0 hPa)
Received Date : 15 January 2025
Calibration Date : 16 January 2025
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	12 June 2025
THD Multimeter	2015	1047765	NIMT	16 January 2025

Traceability : This certificate providoes traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor k =2, providing a level of confidence approximately 95 %.

Calibrated By : Mr. Noppadon Luangart, Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn, Calibration Engineer Supervisor

Issue Date : 16 January 2025

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate No : 25-ACT-009
Request No : Req-2025-0090

Sound pressure level — **Calibration Results :** Without Adjustment

Calibration Range (dB)	Without Adjustment (dB) Measured	Without Adjustment (dB) Deviated value	Adjustment (dB) Measured	Adjustment (dB) Deviated value	Uncertainty (± dB)	Acceptance limit Class 1 (± dB)	Result
94 dB / 1000 Hz	93.82	-0.18	-	-	0.13	0.25	Pass

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment Measured (Hz)	Without Adjustment Deviated	Adjustment Measured (Hz)	Adjustment Deviated	Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70	Pass

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

Calibration Range (Hz)	Without Adjustment Measured (%)	Adjustment Measured (%)	Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
94 dB / 1000 Hz	0.71	-	0.40	2.5	Pass

Note :

Function	Maximum-permitted Uncertainty of measurement
Sound pressure level	0.15 dB
Frequency	0.20%
Total distortion+noise	0.50%

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibrator pressure correction
- The calibration results exclude the microphone volume correction

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate No : 25-ACT-009
Request No : Req-2025-0090

Decision Rule for Statements of Conformity

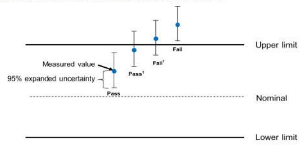
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass[1] = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail[1] = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Cert. No. : ACL25068
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572566 / 142140 / 22309
ID No.: BKK_FS0875

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) %

REVIEW BY ....
APPROVED BY........
NEXT CAL DATE........21/01/26........

Received Date : 07 JANUARY 2025
Calibration Date : 21 - 23 JANUARY 2025
Date of Issue : 24 JANUARY 2025

Calibrated by : Nathakorn Pisutpaisan

Approved by : (Thanakul Petchurai)

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

Cert. No. : ACL25068
Job No. : VC68AC0058
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

Cert. No. : ACL25068
Job No. : VC68AC0058
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	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

Cert. No. : ACL25068
Job No. : VC68AC0058
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (91.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.8

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

Frequency Weighting	Weighting (dB)
A - weight	15.4
C - weight	21.7
Flat	27.2

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	0.7	0.7	0.7	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	-0.1	-0.1	-0.1	±5.0

Cert. No. : ACL25068
Job No. : VC68AC0058
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	-0.1	±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

Cert. No. : ACL25068
Job No. : VC68AC0058
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	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.2	0.2	± 1.1
27.0	27.2	0.2	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 1.1

Cert. No. : ACL25068
Job No. : VC68AC0058
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.0	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

Cert. No. : ACL25068
Job No. : VC68AC0058
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

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

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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Sikrinthorn Road, Bangbumru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiphorn.com

Cert. No. : ACL25067
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572565 / 170402 / 72903
ID No.: BKK_FS0874

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 JANUARY 2025
Calibration Date : 21 - 23 JANUARY 2025
Date of Issue : 24 JANUARY 2025

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL DATE 21/01/26

Calibrated by : Nathakorn Fisutpaisan

Approved by : (Thanakul Petchurai)

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

Cert. No. : ACL25067
Job No. : VC68AC0058
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	3346 1A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	3346 1A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

Cert. No. : ACL25067
Job No. : VC68AC0058
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	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

Cert. No. : ACL25067
Job No. : VC68AC0058
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.5

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

Frequency Weighting	Weighting (dB)
A - weight	14.8
C - weight	21.2
Flat	26.7

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	0.1	0.1	0.1	± 1.0
8000	1.1	1.1	1.1	±5.0

Cert. No. : ACL25067
Job No. : VC68AC0058
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	0.0	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

Cert. No. : ACL25067
Job No. : VC68AC0058
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	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.2	0.2	± 1.1

Cert. No. : ACL25067
Job No. : VC68AC0058
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.1	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	128.1	0.1	±1.0

Cert. No. : ACL25067
Job No. : VC68AC0058
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.3	-0.1	±3.0

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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.4	-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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Silrinthorn Road, Bangbumru, Banggkud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiporn.com

Cert. No. : ACL25245
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00658244 / 158766 / 58768
ID No.: BKK_FS0101

Condition As Found : GOOD

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

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

Received Date : 06 JUNE 2025
Calibration Date : 17 JUNE 2025
Date of Issue : 18 JUNE 2025

REVIEW BY .....
APPROVED BY .....
NEXT CAL DATE.....17/06/26.....

Calibrated by : Nathakorn Pisutpaisan

Approved by : Wichok R.
(Wichok Ekpongpradit)

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. : ACL25245
Job No. : VC68AC0118
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-0011-25	11-FEB-26
Waveform Generator	33511B	MY52302742	EF-0012-25	11-FEB-26
Digital Multimeter	33461A	MY53220104	EEL.BP 24/0268	22-APR-26
Digital Multimeter	33461A	MY53220076	EEL.BP 23/0268	22-APR-26
Digital Multimeter	34461A	MY60024273	CA20251206A	18-MAR-26
Programmable Attenuator	MAT-1070	62100114	EF-0006-25	11-FEB-26
Condenser Microphone	4180	2977900	AA-1002-25	19-FEB-26
Measuring Amplifier	NA-42KAI	34560495	AA-3002-25	19-FEB-26

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).
   3.3 Electrical And Electronics Institute (EEI).

Cert. No. : ACL25245
Job No. : VC68AC0118
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	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

Cert. No. : ACL25245
Job No. : VC68AC0118
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	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	Weighting (dB)
A - weight	12.6
C - weight	18.5
Flat	24.4

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

Cert. No. : ACL25245
Job No. : VC68AC0118
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Cert. No. : ACL25245
Job No. : VC68AC0118
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	131.9	-0.1	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

Cert. No. : ACL25245
Job No. : VC68AC0118
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	1.0 ; -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

Cert. No. : ACL25245
Job No. : VC68AC0118
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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		
89.6	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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Sirinthorn Road, Bangbumru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiphorn.com

NSC-TISI-TIS 17025 CALIBRATION 0394

Cert. No. : ACL25282
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00710639 / 180405 / 10640
ID No.: BKK_FS0023

REVIEW BY .... Nanakom P.
APPROVED BY ....
NEXT CAL DATE 20/07/26

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 JULY 2025
Calibration Date : 21-23 JULY 2025
Date of Issue : 25 JULY 2025

Calibrated by : Nathakorn Pisutpaisan

Approved by : Wichok B.
(Wichok Ekpongpradit)

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. : ACL25282
Job No. : VC68AC0144
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-0011-25	11-FEB-26
Waveform Generator	33511B	MY52302742	EF-0012-25	11-FEB-26
Digital Multimeter	33461A	MY53220104	EEL.BP 24/0268	22-APR-26
Digital Multimeter	33461A	MY53220076	EEL.BP 23/0268	22-APR-26
Digital Multimeter	34461A	MY60024273	CA2025120EA	18-MAR-26
Programmable Attenuator	MAT-1070	62100114	EF-0006-25	11-FEB-26
Condenser Microphone	4180	2977900	AA-1002-25	19-FEB-26
Measuring Amplifier	NA-42KAI	34560495	AA-3002-25	19-FEB-26

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).
   - 3.3 Electrical And Electronics Institute (EEI).

Cert. No. : ACL25282
Job No. : VC68AC0144
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	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

Cert. No. : ACL25282
Job No. : VC68AC0144
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (91.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.7

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

Frequency Weighting	Weighting (dB)
A - weight	12.0
C - weight	18.3
Flat	23.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.2	1.3	1.3	±5.0

Cert. No. : ACL25282
Job No. : VC68AC0144
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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

Cert. No. : ACL25282
Job No. : VC68AC0144
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	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

Cert. No. : ACL25282
Job No. : VC68AC0144
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.0 ; -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

Cert. No. : ACL25282
Job No. : VC68AC0144
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

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

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Sirinthorn Road, Bangburnru, Banggkud, Bangkok, 10700 Thailand
Tel. +66 2433 0331 Email : calibration@sithiphorn.com

Cert. No. : ACL25008
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572551 / 158776 / 58777
ID No.: BKK_FS0876

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 2024
Calibration Date : 09 - 10 JANUARY 2025
Date of Issue : 13 JANUARY 2025

REVIEW BY .....
APPROVED BY .....
NEXT CAL DATE.....09/01/26.....

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)

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

Cert. No. : ACL25008
Job No. : VC68AC0052
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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

Cert. No. : ACL25008
Job No. : VC68AC0052
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	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

Cert. No. : ACL25008
Job No. : VC68AC0052
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.8

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

Frequency Weighting	Weighting (dB)
A - weight	11.6
C - weight	17.7
Flat	23.5

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	2.4	2.5	2.5	±5.0

Cert. No. : ACL25008
Job No. : VC68AC0052
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

Cert. No. : ACL25008
Job No. : VC68AC0052
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	59.0	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	34.1	0.1	± 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

Cert. No. : ACL25008
Job No. : VC68AC0052
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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

Cert. No. : ACL25008
Job No. : VC68AC0052
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.3	-0.1	±3.0

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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.4	-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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY
451-451/1 Sirinthorn Road, Bangbumru, Bangplud, Bangkok, 10700 Thailand
Tel.+66 2433 8331 Email : calibration@sithiphorn.com

Cert. No. : ACL25348
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00658242 / 157782 / 48097
ID No.: BKK_FS0099

Condition As Found : GOOD

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

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

Received Date : 22 AUGUST 2025
Calibration Date : 04 SEPTEMBER 2025
Date of Issue : 05 SEPTEMBER 2025

REVIEW BY
APPROVED BY
NEXT CAL DATE 03/09/26

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Nitinun Srihawan)

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. : ACL25348
Job No. : VC68AC0172
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-0011-25	11-FEB-26
Waveform Generator	33511B	MY52302742	EF-0012-25	11-FEB-26
Digital Multimeter	33461A	MY53220104	EEL.BP 24/0268	22-APR-26
Digital Multimeter	33461A	MY53220076	EEL.BP 23/0268	22-APR-26
Digital Multimeter	34461A	MY60024273	CA2025120EA	18-MAR-26
Programmable Attenuator	MAT-1070	62100114	EF-0006-25	11-FEB-26
Condenser Microphone	4180	2977900	AA-1002-25	19-FEB-26
Measuring Amplifier	NA-42KAI	34560495	AA-3002-25	19-FEB-26

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).
   3.3 Electrical And Electronics Institute (EEI).

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
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	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

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
Page : **4 of 8**

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.4

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

Frequency Weighting	Weighting (dB)
A - weight	15.7
C - weight	21.5
Flat	27.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.8	-1.7	-1.7	±5.0

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
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	0.0	±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

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
Pages : **6 of 8**

7. Level linearity on the reference level range

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

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-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	1.0 ; -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

Cert. No. : **ACL25348**
Job No. : **VC68AC0172**
Pages : **8 of 8**

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	130.0	130.0	0.0	±3.0
One	133.4	133.2	-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

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

JNAC
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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

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CALIBRATION 0367

REVIEW BY ....
APPROVED BY...........
NEXT CAL DATE.....06/06/26.......

Page 1 of 2 Pages

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-090-68

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15036132
ID NUMBER : BKK_FS0680
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 : 15 May 2025
MEASUREMENT DATE : 06 Jun 2025
ISSUE DATE : 10 Jun 2025

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 WiCL-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-1013-25, Certificate number: ER-0061-25.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 9 Apr 2026
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 Apr 2026

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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

Jiranatee Associates Co., Ltd.

Continuation of Certificate of Calibration Number CDT-090-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 15015846.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.057	20.1	0.0	0.099
80	25.046	25.1	0.1	0.099
80	30.036	30.1	0.1	0.099
80	35.019	35.1	0.1	0.099
80	40.002	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 15015972.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.057	20.0	-0.1	0.099
110	25.046	25.0	0.0	0.099
110	30.036	30.0	0.0	0.099
110	35.019	35.0	0.0	0.099
110	40.002	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 14032362.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.057	20.3	0.2	0.099
75	25.046	25.1	0.1	0.099
75	30.036	30.0	0.0	0.099
75	35.019	34.9	-0.1	0.099
75	40.002	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co., Ltd.

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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-196-67

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15036021
ID NUMBER : BKK_FS0679
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 15 Nov 2024
MEASUREMENT DATE : 21 Nov 2024
ISSUE DATE : 25 Nov 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 Narakorn P.
APPROVED BY
NEXT CAL DATE 21/11/25

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 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-0047-24, Certificate number: ER-0113-24

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 21 Oct 2025

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Jiranatee Associates Co., Ltd.

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Continuation of Certificate of Calibration Number CDT-196-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 16008209.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.067	20.0	-0.1	0.099
80	25.059	25.0	-0.1	0.099
80	30.049	29.9	-0.1	0.099
80	35.041	34.9	-0.1	0.099
80	40.028	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 16008203.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.067	20.1	0.0	0.099
110	25.059	25.1	0.0	0.099
110	30.049	30.1	0.1	0.099
110	35.041	35.1	0.1	0.099
110	40.028	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 15037322.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.067	20.1	0.0	0.099
75	25.059	25.0	-0.1	0.099
75	30.049	29.9	-0.1	0.099
75	35.041	34.8	-0.2	0.099
75	40.028	39.7	-0.3	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

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Jiranatee Associates Co., Ltd.

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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

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CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-112-68

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15036018
ID NUMBER : BKK_FS0677
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 26 Jun 2025
MEASUREMENT DATE : 07 Jul 2025
ISSUE DATE : 08 Jul 2025

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 Narakorn P.
APPROVED BY
NEXT CAL DATE 07/07/26

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-1013-25, Certificate number: ER-0061-25.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 9 Apr 2026
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 Apr 2026

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Jiranatee Associates Co., Ltd.

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Continuation of Certificate of Calibration Number CDT-112-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 22035256.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.045	19.9	-0.1	0.099
80	25.049	24.9	-0.1	0.099
80	30.034	29.9	-0.1	0.099
80	35.019	34.9	-0.1	0.099
80	40.006	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 22035463.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.045	20.0	0.0	0.099
110	25.049	25.0	0.0	0.099
110	30.034	30.1	0.1	0.099
110	35.019	35.0	0.0	0.099
110	40.006	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 15037318.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.045	20.1	0.1	0.099
75	25.049	24.9	-0.1	0.099
75	30.034	29.8	-0.2	0.099
75	35.019	34.7	-0.3	0.099
75	40.006	39.6	-0.4	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co., Ltd.

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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-050-68

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15036019
ID NUMBER : BKK_FS0678
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 2025
MEASUREMENT DATE : 10 Feb 2025
ISSUE DATE : 12 Feb 2025

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 Narakorn P.
APPROVED BY
NEXT CAL DATE 10/02/26

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-0047-24, Certificate number: ER-0113-24

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 21 Oct 2025

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Jiranatee Associates Co., Ltd.

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Continuation of Certificate of Calibration Number CDT-050-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 13035045.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.072	20.1	0.0	0.099
80	25.061	25.1	0.0	0.099
80	30.056	30.1	0.0	0.099
80	35.039	35.1	0.1	0.099
80	40.025	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 15022053.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.072	20.1	0.0	0.099
110	25.061	25.1	0.0	0.099
110	30.056	30.1	0.0	0.099
110	35.039	35.1	0.1	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: 16010556.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.071	20.2	0.1	0.099
75	25.062	25.1	0.0	0.099
75	30.056	30.0	-0.1	0.099
75	35.040	35.0	0.0	0.099
75	40.025	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-198-67

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 16002005
ID NUMBER : BKK_FS0682
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 : 15 Nov 2024
MEASUREMENT DATE : 22 Nov 2024
ISSUE DATE : 25 Nov 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 Narakorn P.
APPROVED BY
NEXT CAL DATE 22/11/25

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 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-0047-24, Certificate number: ER-0113-24

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 21 Oct 2025

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol
☑ Miss Ruangrumpai Phoommit

JNAC JIRANATEE ASSOCIATES CO.,LTD.

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

Jiranatee Associates Co., Ltd.

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-198-67

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 16008205.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.068	20.0	-0.1	0.099
80	25.057	24.9	-0.2	0.099
80	30.048	29.9	-0.1	0.099
80	35.044	34.9	-0.1	0.099
80	40.030	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 16008196.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.067	20.1	0.0	0.099
110	25.057	25.1	0.0	0.099
110	30.048	30.1	0.1	0.099
110	35.044	35.1	0.1	0.099
110	40.031	40.0	0.0	0.16

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 16009355.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.068	20.1	0.0	0.099
75	25.057	24.9	-0.2	0.099
75	30.048	29.8	-0.2	0.099
75	35.043	34.7	-0.3	0.099
75	40.030	39.6	-0.4	0.099

UUC*: Unit Under Calibration
Remark: The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

End of Certificate of Calibration

JNAC JIRANATEE ASSOCIATES CO.,LTD.

JIRANATEE ASSOCIATES CO.,LTD.
Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6639840812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : **CDT-194-68**

MEASUREMENT ITEM	: Heat Stress Monitor
MANUFACTURER	: Delta OHM
MODEL/TYPE	: HD32.2
SERIAL NUMBER	: 15006708
ID NUMBER	: BKK_FS0671
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 Nov 2025
MEASUREMENT DATE	: 19 Nov 2025
ISSUE DATE	: 19 Nov 2025

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 ....
APPROVED BY ....
NEXT CAL DATE.....18/11/26

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-1013-25, Certificate number: FR-0061-25.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 9 Apr 2026
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 Apr 2026

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

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

JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-194-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 10 °C to 45 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 15015843.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	10.066	10.1	0.0	0.099
80	20.059	20.1	0.0	0.099
80	25.054	25.1	0.0	0.099
80	30.044	30.1	0.1	0.099
80	35.029	35.1	0.1	0.099
80	45.010	45.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 22035454.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	10.066	10.1	0.0	0.099
110	20.059	20.0	-0.1	0.099
110	25.054	25.0	-0.1	0.099
110	30.044	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	45.010	45.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 16009383.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	10.066	10.4	0.3	0.099
75	20.059	20.0	-0.1	0.099
75	25.054	25.0	-0.1	0.099
75	30.044	29.9	-0.1	0.099
75	35.029	34.8	-0.2	0.099
75	45.010	44.8	-0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.
Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : **CDT-049-68**

MEASUREMENT ITEM	: Heat Stress Monitor
MANUFACTURER	: Delta OHM
MODEL/TYPE	: HD32.2
SERIAL NUMBER	: 15006710
ID NUMBER	: BKK_FS0672
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 2025
MEASUREMENT DATE	: 10 Feb 2025
ISSUE DATE	: 12 Feb2025

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 ....
APPROVED BY ....
NEXT CAL DATE.....10/02/26

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-0043-24, Certificate number: FR-0113-24

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 21 Oct 2025

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

Approved signatory: .....
Mr. Parinya Booncharoen
Calibration Department Manager

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JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-049-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 15015852.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.071	20.0	-0.1	0.099
80	25.062	25.0	-0.1	0.099
80	30.056	30.0	-0.1	0.099
80	35.039	35.0	0.0	0.099
80	40.025	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 15021832.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.071	20.1	0.0	0.099
110	25.062	25.0	-0.1	0.099
110	30.056	30.0	-0.1	0.099
110	35.039	35.0	0.0	0.099
110	40.025	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 14036714.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.071	20.1	0.0	0.099
75	25.062	25.0	-0.1	0.099
75	30.056	29.9	-0.2	0.099
75	35.039	34.8	-0.2	0.099
75	40.025	39.7	-0.3	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.
Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : **CDT-125-68**

MEASUREMENT ITEM	: Heat Stress Monitor
MANUFACTURER	: Delta OHM
MODEL/TYPE	: HD32.2
SERIAL NUMBER	: 15006704
ID NUMBER	: BKK_FS0670
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	: 14 Jul 2025
MEASUREMENT DATE	: 24 Jul 2025
ISSUE DATE	: 24 Jul 2025

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 ....
APPROVED BY ....
NEXT CAL DATE.....23/07/26

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-1013-25, Certificate number: FR-0061-25.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09, Due date: 9 Apr 2026
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 Apr 2026

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

Calibrated by:
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

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

JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-125-68

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2, S/N: 20030502.
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.2	0.2	0.099
80	25.053	25.2	0.1	0.099
80	30.027	30.1	0.1	0.099
80	35.013	35.1	0.1	0.099
80	39.995	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2, S/N: 15021838.
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.050	20.1	0.0	0.099
110	25.053	25.1	0.0	0.099
110	30.027	30.1	0.1	0.099
110	35.013	35.1	0.1	0.099
110	39.995	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2, S/N: 15015488.
Dimension: Diameter 14 mm. length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.050	20.2	0.1	0.099
75	25.053	25.1	0.0	0.099
75	30.027	30.0	0.0	0.099
75	35.013	35.0	0.0	0.099
75	39.995	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration

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 24 FAX. 0 2719 9484

NSC-TISI-TIS17025
CALIBRATION 0008

Certificate of Calibration

Certificate No. : 25PH13
Page : 1 of 2

Equipment :	Lux Meter
Manufacturer:	Extech
Model :	407026
Serial No.:	A.060282
ID No.:	BKK_FS1344
Condition As-Received:	Used Item
Received Date:	09 January 2025
Calibration Date:	14 January 2025
Reference:	2501-0276WSC
Ambient Temperature:	(23 ± 2) °C
Relative Humidity:	(50 ± 15) %

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.

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encorder	LMguide 9,6 m	120RC003	DL-0064-22	20 Jul 2025
2) STANDARD LAMP	OL FEL-U	F-1784	TP-1007-24	02 Mar 2025

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 : 16221394).
4.Test Equipment : Illuminance Meter (Model : 51002, S/N : 080129).
5.The certificate is valid only to the item calibrated on date and place of calibration.
6.This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Metrology Thailand (NIMT)
National Institute of Metrology (Thailand), NSC ONSC Accredited No. Calibration 0144

REVIEW BY ....
APPROVED BY ....
NEXT CAL DATE.....14/01/26

Calibrated by : Nivat Nitas
Issue Date : 15 January 2025

Approved Signatory : .....
[ ] Phalinee Prabpaipal
[ ] Chatchawan Khunpluek
[✓] Nuntawat Khamchai

Cert. No.: 25PH13
Page.: 2 of 2

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

Function : Illuminance Measurement **Range :** 2000 lx

Standard Value (lx)	UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
0	0	0	-
15	14	-1	0.60
100	100	0	1.3
500	499	-1	6.5
1000	998	-2	13
1500	1496	-4	20
1900	1895	-5	25

Function : Illuminance Measurement **Range :** 20000 lx

Standard Value (lx)	UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
2000	1940	-60	26
3000	2930	-70	39
4000	3850	-150	52
5000	4780	-220	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 %

Light source factor setting mode : L
UUC* = Unit Under Calibration.

-oOo-

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

NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Certificate No. : 25PH14
Page : 1 of 2

Equipment : Lux Meter
Manufacturer: Extech
Model : 407026
Serial No.: A.060287
ID No.: BKK_FS1345
Condition As-Received: Used Item
Received Date: 09 January 2025
Calibration Date: 14 January 2025

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2501-0276WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %

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

Procedure used: Calibration were conducted using 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 & Encorder	LMguide 9,6 m	120RC003	DL-0064-22	20 Jul 2025
2) STANDARD LAMP	OL FEL-U	F-1784	TP-1007-24	02 Mar 2025

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 : 162213394)
4.Test Equipment : Illuminance Meter (Model : 51002, S/N : 080129).
5.The certificate is valid only to the item calibrated on date and place of calibration.
6.This certification is traceable to the international system of unit maintained through:-
-National Institute of Metrology Thailand (NIMT)
-National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144

REVIEW BY Warakorn P.
APPROVED BY
NEXT CAL DATE 14/01/26

Calibrated by : Nivat Nitas
Issue Date : 15 January 2025

Approved Signatory :
[ ] Phalinee Prabpaipal
[ ] Chatchawan Khunpluek
[✓] Nuntawat Khamchai

Cert. No.: 25PH14
Page.: 2 of 2

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

Function : Illuminance Measuement **Range :** 2000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
0	0	0	-
15	13	-2	0.60
100	100	0	1.3
500	499	-1	6.5
1000	997	-3	13
1500	1496	-4	20
1900	1894	-6	25

Function : Illuminance Measuement **Range :** 20000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
2000	1940	-60	26
3000	2920	-80	39
4000	3850	-150	52
5000	4780	-220	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 %

Light source factor setting mode : L
UUC* = Unit Under Calibration

-o0o-

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

NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Cert.No.: 25CH742
Page.: 1 of 3

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : C312875331
ID No. : BKK_LG0076
Condition As-Received: Used Item
Received Date : 23 June 2025
Calibration Date : 24 June 2025
Reference : 2506-0741DSC-12
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand

REVIEW BY Chayathorn P.
APPROVED BY Warakorn P.
NEXT CAL DATE 24/06/26

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage standard and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lerngagtrakul
Approved by : Saithip
Approved Signatory

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 25 June 2025

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.

Cert.No.: 25CH742
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	24E2759	25 Aug 2025
2) Ref. Standard Thermometer	4982054	110RC044	24I757	14 July 2025

- This measurement result is traceable to SI throught 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 4.007	CPA chem	1066665	18 Jan 2027
pH 6.965	CPA chem	1066667	18 Jan 2026
pH 10.010	CPA chem	1114385	08 June 2026

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 Document Process Calibrator at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.00	177.48	178	4.00	0.58	2.00
S/N.: C312875331	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.00	0.58	2.00

Cert.No.: 25CH742
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	4.007	4.01	190	0.0079	2.00
S/N.: 2484158	6.965	7.00	14	0.0099	2.00
	10.010	10.01	-163	0.0096	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;
- Model : InLab®Expert Go-ISM
- Serial No. : 2484158

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	24.9	-0.103	0.13	2.00
45.0	45.004	44.9	-0.104	0.13	2.00

Remark - UUC* = Unit Under Calibration

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

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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

NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Cert.No.: 25CH1162
Page.: 1 of 3

Equipment : pH Meter
Manufacturer : Hach
Model : HQ411d
Serial No. : 200100031163
ID No. : BKK_EN0342
Condition As-Received: Used Item
Received Date : 08 October 2025
Calibration Date : 09 October 2025
Reference : 2510-0271DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand

REVIEW BY Linda K.
APPROVED BY Sihluk P.
NEXT CAL DATE 09/10/26

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Walalak Sirithean
Approved by : Saithip
Approved Signatory

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 10 October 2025

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 25CH1162
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Ref. Standard Thermometer	4982054	110RC044	25I703	03 July 2026

- This measurement result is traceable to SI throught 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 4.007	CPA chem	1114384	12 June 2027
pH 6.965	CPA chem	1066667	18 Jan 2026
pH 10.010	CPA chem	1135355	16 Aug 2026

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

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	4.007	3.996	176.6	0.0046	2.00
S/N.: 252063043080	6.965	6.974	1.1	0.0084	2.00
	10.010	9.996	-176.9	0.0070	2.00

Remark - Can not connect the BNC because the plug does not match with the socket.

Cert.No.: 25CH1162
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;
- Model : PHC281
- Serial No. : 252063043080

Dimension of probe
- Length : 103 mm.
- Diameter : 12 mm.
- Immersion Depth : 90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.001	25.0	-0.001	0.13	2.00

Remark - UUC* = Unit Under Calibration

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

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SARTORIUS

Accredited by

NSC-TISI-TIS 17025
Calibration 0426

Calibration certificate

Calibration Certificate No. 25BCI0265

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	MSE224S-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial | QM Ident. no.	27405555 | BKK_EN0003	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand)Co., Ltd. 104 Phatthanakarn 40,Phattanakarn Rd.,Khwaeng Phatthanakarn ,Khet Suan Luang,Bangkok 10250	
Order no.	265054	
Number of pages	4	
Date of calibration	17 Jul 2025	

REVIEW BY Linda K.
APPROVED BY Siriluk P.
NEXT CAL DATE 17/07/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date of issue	Approval of the Calibration Certificate	Person in charge
17 Jul 2025	Mr. Chonchai Inthana	Chonchai Inthana

Calibration object

Single range instrument

Model	MSE224S-100-DU
Serial Number	27405555
QM Ident. no | Inventory no.	BKK_EN0003 | ---
Maximum capacity (Max. load)	220.0000 g
Measured up to	220.0000 g
Scale interval	0.0001 g

Place of calibration

Address	According to page 1
Department | Cost center	ENVI Department | ---
Building | Floor	--- | 1st Floor.
Room	Laboratory Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET Calibration Guide No. 13, Version 4.0 (11/2015) - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	Testo 174(Traceable to SI unit through ENTECH)	11 Nov 2025
Test weight set OIML R111 E2	Certificate No M23081975 ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	17 Jul 2025
Temperature at place of calibration | Temp. diff. $T_{weights} - T_{place}$	22.5 °C | 0.7 K
Measuring conditions	The installation site is suitable. The device is level. Balance was loaded up to Max before test.
Comments	Humidity 58.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal): 10 g | 200 g		
	10 g	200 g
1	10.0000 g	200.0000 g
2	10.0000 g	199.9999 g
3	10.0000 g	200.0000 g
4	10.0000 g	200.0000 g
5	10.0001 g	199.9999 g
6	10.0000 g	200.0000 g
7	10.0000 g	200.0000 g
8	10.0001 g	200.0000 g
9	10.0000 g	200.0000 g
10	10.0000 g	199.9999 g
	s = 0.00004 g	s = 0.00005 g

Eccentricity

Test load (nominal):	100 g
Center	100.0000 g
Front left	100.0001 g
Back left	100.0000 g
Back right	100.0001 g
Front right	100.0001 g
Maximum deviation from centric loading indication |Δ|ecc max = 0.0001 g	

Error of indication

Testload L	Indication I	Error E	Expansion factor k	Uncertainty $U(E)$	Uncertainty relative $U_{rel}(E)$
0.0100 g	0.0100 g	0.0000 g	2.00	0.00012 g	1.2 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
2.0000 g	2.0000 g	0.0000 g	2.00	0.00013 g	0.0065 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00013 g	0.0026 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00013 g	0.0013 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00068 %
50.0000 g	50.0000 g	0.0000 g	2.00	0.00015 g	0.00029 %
100.0000 g	100.0000 g	0.0000 g	2.00	0.00018 g	0.00018 %
200.0000 g	200.0000 g	0.0000 g	2.00	0.00028 g	0.00014 %
220.0000 g	220.0001 g	0.0001 g	2.00	0.00032 g	0.00015 %
Maximum error of indication		$\lvert E\rvert_{max}$ = 0.0001 g			

$U_{rel}(E)$ is the quotient of $U(E)$ and test load L. The uncertainty of measurement $U(E)$ is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.2. There is a 95 % probability that the value of the measurand will lie in the assigned value range.

End of calibration certificate

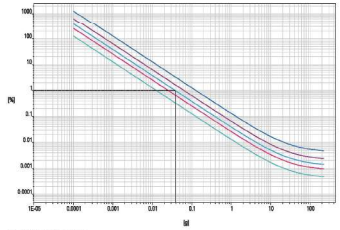
Uncertainty of measurement in use

Device adjusted before measurement	Yes
Temperature deviation considered	1.5 K (isoCAL active)
Temperature coefficient considered	1 · 10⁻⁶/K
Uncertainty of the weighing result $U_{gl}(W)$	$U_{gl}(W) = 0.00013\ g + 4.19 \cdot 10^{-4} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication R	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	2.2000 g	0.00014 g	0.0063 %
25 %	55.0000 g	0.00036 g	0.00066 %
50 %	110.0000 g	0.00059 g	0.00054 %
75 %	165.0000 g	0.00082 g	0.00050 %
100 %	220.0000 g	0.0011 g	0.00048 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.0380 g

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NSC-TISI-TIS17025 CALIBRATION 0998

Certificate of Calibration

Cert. No.: 25TM528
Page : 1 of 3

Equipment :	Water Bath
Manufacturer :	Memmert
Model :	WNE 29
Serial No. :	L622.0282
ID No. :	BKK_EN0439
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Location :	Organic Preparation Lab
Received Order :	08 October 2025
Calibration Date :	09 October 2025
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Kunchit Promprat
Approved by :	Approved Signatory

REVIEW BY Linda K.
APPROVED BY Siriluk P.
NEXT CAL DATE 09/10/26

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Suwit Imjai

Issue Date : 28 October 2025

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 : 2510-0042OC-13
Procedure Used :-

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:-

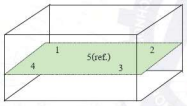
Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY58041391	25LM20	TPA	08 Feb 2026

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This measurement result is traceable to the International System of Unit maintained through :

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

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Heat transfer medium used : Water

	Environmental (°C)	Environmental (%R.H.)	AC Voltage Supply (Volt)
Beginning of Calibration	24	63	224
Finished of Calibration	24	58	224



Front

Position :	Ref. Std. ID No.:
1	70RC143
2	70RC144
3	70RC145
4	70RC146
5(ref.)	70RC147

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2510-0042OC-13
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 25TM528
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C) Position 1	2	3	4	5 (ref.)	Uncertainty (± °C)
85.0	85.0	85.0	84.863	84.748	84.869	84.990	84.966	0.21

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.33	0.12	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors anc the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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SCG

Metrology Center

SCI ECO Services Company Limited
51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260
Bangkok Tel : +668 9205 6851 , +669 81924 0059
Saraburi Tel : +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T251785 Page 1 of 3

Certificate of Calibration

Equipment	:	Chamber (Oven)
Manufacturer	:	Memmert
Model	:	UF110
Serial No.	:	B423.1549
Customer Code	:	BKK_EN0425
ID No.	:	T4671A5
Customer	:	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	:	Oven Room
Date of Receipt	:	1 October 2025
Calibrated By	:	Sujjar Naknakred (Site Calibration Manager)
Approved By	:	Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	:	10 OCT 2025

REVIEW BY Linda K.
APPROVED BY Siriluk P.
NEXT CAL. DATE 06/10/26

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-TL06 I02/27-03-68

SCG
Metrology Center
SCI ECO Services Company Limited
51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260
NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report

Equipment	:	**Chamber (Oven)**
Date of Calibration	:	**6 October 2025**
Environment	:	**Temperature : 24.4-25.8 °C**
		Line Voltage : 220.5-225.2 V
		Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine resistance thermometer detectors into its chamber , the other one resistance thermometer detector use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2019) 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 :

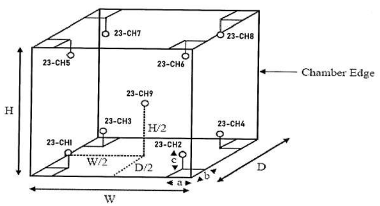
Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	23-(CH1-10)	T250314	6 April 2026
DATA LOGGER	34970A	T195	T250314	6 April 2026

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 14 Minute At 104 °C
   Fresh Air Damper [X] Open [X] Min [ ] Medium [ ] Max
   [ ] Close
   [ ] Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By. ________

SCG
Metrology Center
SCI ECO Services Company Limited
51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260
NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report



Remark : Internal Dimensions of Chamber : W (Width) = 56 cm. , H (Height) = 48 cm. and D (Depth) = 40 cm.
Size of Installed Standard sensor number 23-CH1 to number 23-CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.
Size of Installed Standard sensor number 23-CH9 : W/2 = 56 cm./2 , H/2 = 48 cm./2 and D/2 = 40cm./2

Measurement Results

Calibration Point	Average Standard Reading at each position (°C) 23-CH1	23-CH2	23-CH3	23-CH4	23-CH5	23-CH6	23-CH7	23-CH8	23-CH9
104	104.13	103.54	103.92	104.37	104.40	104.51	104.18	103.86	103.80
180	180.05	179.82	179.64	179.52	181.20	180.29	180.19	179.35	179.89

Chamber (Oven) Setting °C	Reading (°C) Min , Max	Reading (°C) Average	Temperature Distribution Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	-	104.0	104.08	0.28	0.87	0.45	2.00
180.0	180.0 , 180.1	180.0	179.99	0.37	1.49	0.61	2.00

* The quoted uncertainty exclude "uniformity"
The calibration result apply only the above calibrated item.
The result of test was found accurate as shown on date and place of test only.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

End of Certificate.

Approved By. ________

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

Certificate of Testing

REVIEW BY Jinda K
APPROVED BY Siriluk P
NEXT CAL DATE 25/01/27

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5100
Serial No. :	15L103204
ID No. :	BKK_EN0205
Received Date :	24 July 2025
Test Date :	25 July 2025
Reference :	2507-0836DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	Saithip — Approved Signatory

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 25 July 2025

Condition of this result of calibration

1. Reference Standard Instruments :
   This measurement result is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	ID No.	Certificate No.	Due Date
1. Burette	130BU10	25CG1126	18 Mar 2027
2. Balance	140RC001	24MM601/1	16 Sep 2025

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%

Result : **Dissolved Oxygen Meter Adjustment With Air 100 %**
Dissolved Oxygen Probe No.: 23L100673

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0055

This report was certified only for the instrument we tested.It is allowable to use for study 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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TEL.0-2717-3000-29 FAX.0-2719-9484
ilac-MRA
NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Equipment :	DO Meter with Sensor
Manufacturer :	YSI
Model :	5100
Serial No. :	15L103204
ID No. :	BKK_EN0205
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Location :	TPA On Site Calibration Laboratory
Received Order :	24 July 2025
Calibrated Date :	25 July 2025
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Warakorn Lerngagtrakul
Approved by :	Kunchit — Approved Signatory

( ) Chakrit Waewwanjua
( ) Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 31 July 2025

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 :	DO Meter with Sensor
Condition As-Received :	Used Item
Reference :	2507-0836DSC-2

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

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	24I1022	TPA	17 Sep 2025

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This measurement result is traceable to the International System of Unit maintained through :
   Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment
Function : Temperature measurement.
This instrument was connected with temperature sensor, S/N.: 23L100673

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	80	20.003	19.74	-0.263	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-

SCG
Metrology
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate of Calibration

REVIEW BY Jinda K
APPROVED BY Siriluk P
NEXT CAL. DATE 04/03/26.

Equipment	:	Chamber (Incubator)
Manufacturer	:	Memmert
Model	:	ICP 750
Serial No.	:	F819.0021
Customer Code	:	BKK_EN0304
ID No.	:	T9572A4
Customer	:	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	:	Wet Chemistry Lab 2
Date of Receipt	:	26 February 2025
Calibrated By	:	Atiphong Rongrat (Technician)
Approved By	:	________ / Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	:	17 MAR 2025

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.

SCG
Metrology
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report

Equipment	:	**Chamber (Incubator)**
Date of Calibration	:	**4 March 2025**
Environment	:	**Temperature : 24.5-24.7 °C**
		Line Voltage : 221.4-224.7 V
		Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 12 resistance thermometer detectors into its chamber , the other one resistance thermometer detector use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2019) 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
RTD	100 ohm	31-(CH1-10)	T240399	16 March 2025
RTD	100 ohm	32-(CH1-10)	T240399	16 March 2025
DATA LOGGER	34970A	T193	T240399	16 March 2025

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 10 Minute At 20 °C
   Fresh Air Damper [ ] Open [ ] Min [ ] Medium [ ] Max
   [ ] Close
   [X] Not Available
5. Adjustment :
   (X) without adjustment ( ) after adjustment

Approved By. ________

SCG

Metrology

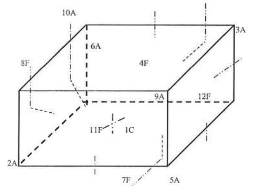
SCI ECO Services Company Limited

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250356

Calibration Report



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

1C	= 31-CH1
2A	= 31-CH2
3A	= 31-CH3
4F	= 31-CH4
5A	= 31-CH5
6A	= 31-CH6
7F	= 31-CH7
8F	= 31-CH8
9A	= 31-CH9
10A	= 31-CH10
11F	= 32-CH1
12F	= 32-CH2

Approved By. ____________

SCG

Metrology

SCI ECO Services Company Limited

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250356

Calibration Report

Measurement Results :

Calibration Point	Average Standard Reading at each position (°C)											
	31-CH1	31-CH2	31-CH3	31-CH4	31-CH5	31-CH6	31-CH7	31-CH8	31-CH9	31-CH10	32-CH1	32-CH2
20	20.02	20.42	19.96	20.23	19.83	19.44	19.71	20.01	20.06	20.04	20.13	19.98

Chamber (Incubator)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min , Max	Average					
20.0	-	20.0	19.99	0.10	0.43	0.38	2.02

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 % .

End of Certificate

Approved By. ____________

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

ilac-MRA   NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Cert.No.: 25CG3385

REVIEW BY Jinda K
APPROVED BY Siriluk P
NEXT CAL DATE 03/09/26

Equipment :	Burette
Capacity :	50 mL
Serial No. :	-
ID. No. :	BKK_EN0422
Manufacturer :	Witeg
Made in :	Germany
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(20 ± 2.5) °C
Relative Humidity :	(50 ± 10) %
Barometric Pressure :	753 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Srisuda Khamtha

Approved by :

Approved Signatory

( ) Ponpan Paipim
(✓) Chakrit Waewwanjua

Issue Date : 3 September 2025

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 :	Burette
Received Date :	1 September 2025
Condition As-Received :	Used Item
Calibration Date :	3 September 2025
Reference :	2509-0049DSC-1

Cert.No.: 25CG3385

Condition of this result of calibration

1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID. No.	Certificate No.	Traceability	Due date
1) Balance	MS204TS	C226356983	140RC010	24MM603	TPA	10 Oct 2025
2) Data Logger	HL-20D	20683159	140EC012	24H2129	TPA	15 Oct 2025
3) Digital Thermometer	HH376	230806555	140EC013	25I1740	TPA	17 Jan 2026

This measurement result is traceable to SI Unit

2. The certificate is valid only to the item calibrated on date and place of calibration.
3. True value is converted to true volume at the standard temperature of 20 °C

Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty (± mL)	k Factor
10	9.9941	0.0082	2.00
25	24.9804	0.0087	2.00
50	49.9819	0.010	2.00

Remark mL = cm^3

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

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HACH Be Right™

REVIEW BY Chayathron P.
APPROVED BY Wanlaya P.
NEXT CAL. DATE 19/02/26.

Test Report

Customers :	ALS Laboratory Group (Thailand) Co., Ltd.		
Equipment :	Colorimeter	Manufacturer :	HACH
Controller Model :	☑ DR300 ☐ Pocket II	ID No. :	BKK_LG0042
Controller Serial No. :	22080B000054	Sensor Serial No. :	-
Date of test :	19/02/2025	Period :	1 Year
Environment temperature :	25.5 °C	Humidity :	64.2 %RH

Results

Instrument Checked

Item	Characteristic	Before	After	Remark
1	Visual Inspect	☑ Pass ☐ Fail	☑ Pass ☐ Fail	
2	Power Supply (4.5 – 6.0 VDC)	5.8 VDC	5.8 VDC	
3	Display Check	☑ Pass ☐ Fail	☑ Pass ☐ Fail	
4	Keyboard Check	☑ Pass ☐ Fail	☑ Pass ☐ Fail	
5	Function System Program	☑ Pass ☐ Fail	☑ Pass ☐ Fail	

Warning and Error Checked

Item	Event	Before	After
6	Error list	☑ None ☐ Appear	☑ None ☐ Appear

Check with Standard

Item	Characteristic		Before	After	Remark
	DPD-CHLORINE-LR				
7	Blank	(0.0 mg/l)	0.00 mg/l	0.00 mg/l	
8	Standard Cl2 No. 1	(0.24 ± 0.09 mg/l)	0.26 mg/l	0.26 mg/l	
9	Standard Cl2 No. 2	(0.91 ± 0.1 mg/l)	0.91 mg/l	0.91 mg/l	
10	Standard Cl2 No. 3	(1.59 ± 0.14 mg/l)	1.59 mg/l	1.58 mg/l	
	DPD-CHLORINE-HR				
11	Blank	(0.0 mg/l)	0.0 mg/l	0.0 mg/l	
12	Standard Cl2 No. 1	(2.3 ± 0.2 mg/l)	2.3 mg/l	2.3 mg/l	
13	Standard Cl2 No. 2	(3.9 ± 0.3 mg/l)	3.9 mg/l	3.9 mg/l	
14	Standard Cl2 No. 3	(7.1 ± 0.6 mg/l)	6.9 mg/l	6.9 mg/l	

Summary of checked

HACH Be Right™

☐ The instrument can work normally and efficiently. (เครื่องมือวัดสามารถทำงานได้ปกติและมีประสิทธิภาพ)
☑ The instrument can work but it's requiring to maintenance. (เครื่องมือวัดสามารถทำงานได้แต่ต้องบำรุงรักษา)
☐ The instrument could not work it's requiring to repair. (เครื่องมือวัดไม่สามารถทำงานได้และต้องการซ่อมบำรุง)

Remark:

ฝาครอบด้านหน้าและด้านหลังชำรุดเสียหาย ทำให้ตัวเลขที่หน้าจอขาด แนะนำให้เปลี่ยนฝาครอบด้านหน้าและด้านหลังใหม่

Standard Equipment Used

Equipment	Equipment I.D.	
Standard Absorbance DPD-CHLORINE-LR	Lot No. A4150	Exp date : Jun-26
Standard Absorbance DPD-CHLORINE-HR	Lot No. A4162	Exp date : Jun-26
Digital multi meter	S/N: 97820680	Due date: 15-Jul-25
Thermo hygrometer	S/N: 41432443	Due date: 29-Oct-25

Test By : (Mr.Putthipong Duangsawat) Service Engineer

Approved by : (Suanun Sartyangkool) Assistant Service Division Manager

SCG

Metrology Center

SCI ECO Services Company Limited

51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260

Bangkok Tel : +668 9205 6851 , +669 81924 0059

Saraburi Tel : +669 8247 2360

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250873

Certificate of Calibration

REVIEW BY Jinda K
APPROVED BY Siriluk P
NEXT CAL DATE 04/12/26

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 Room
Date of Receipt	:	28 May 2025
Calibrated By	:	Atiphong Rongrat (Technician)
Approved By	:	/ Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	:	19 JUN 2025

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.

SCG

Metrology Center

SCI ECO Services Company Limited

51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250873

Calibration Report

Equipment	:	**Chamber (Cooling Room)**
Date of Calibration	:	**4 June 2025**
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. Thisequipment 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	TN91-TN100	T242036	3 December 2025
TC	TYPE T	TN101-TN110	T242036	3 December 2025
DATA LOGGER	34970A	T121	T242036	3 December 2025

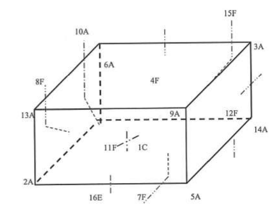
3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 20 Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   (X) without adjustment ( ) after adjustment

Approved By. ____________

SCG
Metrology Center
SCI ECO Services Company Limited
51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250873

Calibration Report



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

Position	Sensor
1C	= TN91
2A	= TN92
3A	= TN93
4F	= TN94
5A	= TN95
6A	= TN96
7F	= TN97
8F	= TN98
9A	= TN99
10A	= TN100
11F	= TN101

Position	Sensor
12F	= TN102
13A	= TN103
14A	= TN104
15F	= TN105
16E	= TN106

Approved By.

SCG
Metrology Center
SCI ECO Services Company Limited
51 Moo 8, Tubkwang, Kaeng Khoi, Saraburi, Thailand 18260
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T250873

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN91	TN92	TN93	TN94	TN95	TN96	TN97	TN98	TN99	TN100	TN101	TN102
3.0	2.95	2.92	3.09	2.92	3.16	3.50	3.40	3.03	3.14	2.98	3.44	3.13
	TN103	TN104	TN105	TN106								
	3.19	3.06	3.46	2.92								

Chamber (Cooling Room)			Temperature Distribution				
Setting (°C)	Reading (°C) Min , Max	Reading (°C) Average	Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor *k*
3.0	2.8 , 3.9	3.4	3.14	1.20	1.30	1.90	2.04

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.

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 FAX. 0-2719-9484

Certificate of Testing

Cert.No.: 25TW128
Page.: 1 of 2

Equipment : DO Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S9
Serial No. : C315969633
ID No. : BKK_LG0079
Received Date : 23 June 2025
Test Date : 24 June 2025
Reference : 2506-0741DSC-7
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by : Approved Signatory

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 25 June 2025

REVIEW BY ....
APPROVED BY ....
NEXT CAL DATE........24/06/26

Cert.No.: 25TW128
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :
   This measurement result 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	25CG1126	18 Mar 2027
2. Balance	14233821	110RC001	24MM131	04 July 2025

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%

Result : **Dissolved Oxygen Meter Adjustment With Air 100 %**
Dissolved Oxygen Probe No.: 976209

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0045

This report was certified only for the instrument we tested.It is allowable to use for study 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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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
ilac-MRA NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Cert. No.: 25LM109
Page.: 1 of 2

Equipment : DO Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go S9
Serial No. : C315969633
ID No. : BKK_LG0079
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 23 June 2025
Calibrated Date : 24 June 2025
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Warakorn Lerngagtrakul
Approved by : Approved Signatory

( ) Chakrit Waewwanjua
( ) Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 27 June 2025

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 : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2506-0741DSC-8

Cert. No.: 25LM109
Page.: 2 of 2

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

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	24I1022	TPA	17 Sep 2025

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This measurement result is traceable to the International System of Unit maintained through :
   Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment
Function : Temperature measurement.
This instrument was connected with temperature sensor, S/N.: 976209

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor *k*
20.0	80	20.003	20.1	0.097	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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BKK_EL0037

Agilent Technologies
Agilent Technologies (Thailand) Limited
U CHU LIANG BLDG. 22/F UNIT A,D
968 RAMA 4 ROAD, SILOM, BANGRAK
Bangkok 10500 Thailand
Tel. +662 637 6363
Fax: +662 632 4334
Email: ccc-smt@agilent.com
Website: www.agilent.com/chem

SERVICE REPORT

Customer Contact:
ALS Laboratory Group (Thailand) Co Ltd Head Office
104 Phatthanakan 40 Phatthanakan Rd Khwaeng Phatthanakan Khet Suan
TAX ID : 0105540004859
Chanattagarn.lmchom@alsglobal.com
27603068

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 6006676091	Service Confirmation: 6905876103

Invoice To:
ALS Laboratory Group (Thailand) Co Ltd Head Office
104 Phatthanakan 40 Phatthanakan Rd Khwaeng Phatthanakan Khet Suan

REVIEW BY ....Honphen C.
APPROVED BY ....
NEXT CAL. DATE 23 Mar 2026

Delivery Site:
ALS Laboratory Group (Thailand) Co Ltd Head Office
104 Phatthanakan 40 Phatthanakan Rd Khwaeng Phatthanakan Khet Suan

Direct Inquiries to:
Contact Name: Customer Contact Center
Contact E-mail: ccc-smt@agilent.com
Contact Telephone: +662 637 6363
Contact Fax: +662 632 4334

Location:
Room
Bldg
Lab
Dept

products | applications | software | services

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Agilent Technologies (Thailand) Limited. Head Office
U Chu Liang Bldg. 22/F Unit A,D
968 Rama 4 Road, Silom, Bangrak,
Bangkok 10500 Thailand
Tax ID : 0105542068218

Citibank N.A. Bangkok Branch
399 Interchange 21 Building, Sukhumvit Road, Klongtoey Nau
Sub-district, Wattana District, Bangkok 10110 Thailand
Acc. No: 012-4452-007 ,
THB:Krung Thai Bank PCL
Siam Square Br.,416/1-2 Rama I Rd.,Pathumwan, BKK 10330
Thailand

ORIGINAL

Service Confirmation Number: 6905876103
Service Confirmation Date: 23.09.2024

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IO-5100	ICP-OES 5100/5110 System			
G8010A	Agilent 5100 SVDV ICP-OES Spectrometer	MY16010005	ICP OES 5100	SYS-IO-5100
G8410A	SPS 4 Autosampler	AU15440764	ICP OES 5100	SYS-IO-5100

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EOQ	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	22.09.2024	23.09.2024
1010	6610030100	Bottle ICP-OES Wavecal soln 500mL 5 ppm	1.00	Agreement Entitlement - 100 % covered		
1020	5190-7001	Calibration blank solution 5pct HNO3	1.00	Agreement Entitlement - 100 % covered		

Additional Information:

Service Confirmation Number: 5905876103
Service Confirmation Date: 23.09.2024

Service Information:

Problem Description: WU-OQ-IO-5100-5001253655		
Service Provided: Complete OQHW 5100ICPOES Equipment ID: BKK_EL0037, all test passed		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 4.0	**Travel Hours:** 2.0	
Customer Field Service Representative Name: Suwan Onkhom	**Customer Field Service Representative Signature:** Suwan O.	**Date:** 23 Sep 2024
Customer Name: CHANATTAGARN IMCHOM	**Customer Signature:** Prompiten C	**Date:** 23 Sep 2024
Additional Comments:		

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

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	:	26 February 2025
Calibrated By	:	Atiphong Rongrat (Technician)
Approved By	:	/ Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	:	17 MAR 2025

REVIEW BY Tattaporn C.
APPROVED BY Suwan N.
NEXT CAL. DATE ~~04/09/26~~ 04/09/26 Suwan N.

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

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

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Calibration Report

Equipment	:	**HEATING BLOCK**
Date of Calibration	:	**4 March 2025**
Environment	:	**Temperature : 24.4-24.9 °C** **Line Voltage : 221.6-226.3 V** **Relative Humidity : 55 - 65 %RH**

Condition of this results of calibration :

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

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T240712	19 April 2025
TC	TYPE T	TN231-TN240	T240712	19 April 2025
TC	TYPE T	TN241-TN250	T240401	16 March 2025
TC	TYPE T	TN251-TN260	T240401	16 March 2025
DATA LOGGER	34970A	T193	T240401	16 March 2025

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 40 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
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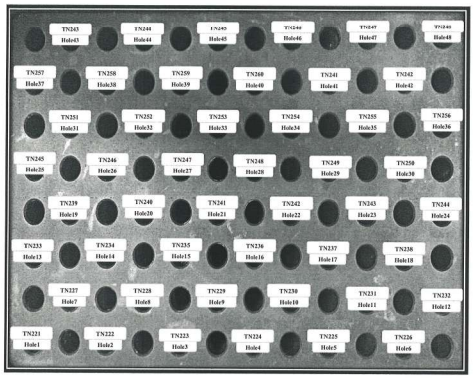
Calibration Report



FRONT CONTROL

Approved By,

Metrological Center
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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		**TN221**	**TN222**	**TN223**	**TN224**	**TN225**	**TN226**
CAL POINT	Max	94.85	95.37	95.03	95.25	95.52	94.75
95	Min	94.17	94.66	94.38	94.63	94.87	94.12
	Average	94.51	95.02	94.70	94.94	95.20	94.43
R2 Hole7-Hole12		**TN227**	**TN228**	**TN229**	**TN230**	**TN231**	**TN232**
	Max	94.71	94.56	94.79	95.32	95.44	95.06
	Min	94.05	93.88	94.10	94.65	94.90	94.65
	Average	94.38	94.22	94.44	94.99	95.17	94.85
R3 Hole13-Hole18		**TN233**	**TN234**	**TN235**	**TN236**	**TN237**	**TN238**
	Max	95.26	95.43	95.40	95.71	95.41	95.06
	Min	94.54	94.64	94.71	95.10	94.86	94.42
	Average	94.90	95.03	95.06	95.41	95.13	94.74
R4 Hole19-Hole24		**TN239**	**TN240**	**TN241**	**TN242**	**TN243**	**TN244**
	Max	95.13	95.06	95.68	96.16	95.35	95.80
	Min	94.39	94.43	94.86	95.51	94.88	95.12
	Average	94.76	94.75	95.27	95.83	95.12	95.46
R5 Hole25-Hole30		**TN245**	**TN246**	**TN247**	**TN248**	**TN249**	**TN250**
	Max	94.95	95.81	95.39	95.82	95.66	95.66
	Min	94.47	95.03	94.67	94.99	94.84	94.87
	Average	94.71	95.42	95.03	95.41	95.25	95.27
R6 Hole31-Hole36		**TN251**	**TN252**	**TN253**	**TN254**	**TN255**	**TN256**
	Max	96.07	95.34	96.28	95.39	94.95	95.12
	Min	95.28	94.55	95.51	94.62	94.13	94.35
	Average	95.67	94.95	95.90	95.00	94.54	94.73
R7 Hole37-Hole42		**TN257**	**TN258**	**TN259**	**TN260**	**TN241**	**TN242**
	Max	95.15	95.63	96.11	95.09	95.34	95.51
	Min	94.38	94.88	95.32	94.28	94.54	94.72
	Average	94.76	95.25	95.71	94.69	94.94	95.11
R8 Hole43-Hole48		**TN243**	**TN244**	**TN245**	**TN246**	**TN247**	**TN248**
	Max	95.84	95.87	95.44	95.72	95.65	95.75
	Min	95.06	95.10	94.60	94.95	94.87	94.98
	Average	95.45	95.48	95.02	95.34	95.26	95.36

Approved By,

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		**TN221**	**TN222**	**TN223**	**TN224**	**TN225**	**TN226**
CAL POINT	Max	104.48	104.40	104.60	105.27	105.24	105.19
105	Min	104.15	104.02	104.25	104.94	104.91	104.93
	Average	104.32	104.21	104.42	105.10	105.08	105.06
R2 Hole7-Hole12		**TN227**	**TN228**	**TN229**	**TN230**	**TN231**	**TN232**
	Max	105.20	105.45	105.58	105.96	105.81	106.03
	Min	104.92	105.14	105.29	105.64	105.53	105.79
	Average	105.06	105.29	105.43	105.80	105.67	105.91
R3 Hole13-Hole18		**TN233**	**TN234**	**TN235**	**TN236**	**TN237**	**TN238**
	Max	106.09	106.14	105.83	106.25	105.97	105.88
	Min	105.80	105.89	105.57	106.00	105.69	105.65
	Average	105.94	106.01	105.70	106.13	105.83	105.77
R4 Hole19-Hole24		**TN239**	**TN240**	**TN241**	**TN242**	**TN243**	**TN244**
	Max	105.87	105.75	105.30	105.07	105.22	105.66
	Min	105.62	105.52	105.13	104.90	105.05	105.49
	Average	105.74	105.63	105.21	104.98	105.14	105.57
R5 Hole25-Hole30		**TN245**	**TN246**	**TN247**	**TN248**	**TN249**	**TN250**
	Max	105.62	105.54	105.52	105.75	105.97	105.69
	Min	105.45	105.35	105.31	105.57	105.81	105.49
	Average	105.53	105.44	105.41	105.66	105.89	105.59
R6 Hole31-Hole36		**TN251**	**TN252**	**TN253**	**TN254**	**TN255**	**TN256**
	Max	106.19	106.34	106.47	105.96	105.76	105.35
	Min	106.02	106.16	106.31	105.77	105.58	105.18
	Average	106.10	106.25	106.39	105.87	105.67	105.27
R7 Hole37-Hole42		**TN257**	**TN258**	**TN259**	**TN260**	**TN241**	**TN242**
	Max	106.21	105.59	105.45	105.36	106.08	106.09
	Min	106.04	105.42	105.28	105.20	105.90	105.92
	Average	106.12	105.51	105.37	105.28	105.99	106.00
R8 Hole43-Hole48		**TN243**	**TN244**	**TN245**	**TN246**	**TN247**	**TN248**
	Max	106.54	106.33	105.78	105.38	105.42	105.69
	Min	106.38	106.16	105.60	105.20	105.25	105.52
	Average	106.46	106.25	105.69	105.29	105.33	105.61

Approved By,

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Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C) Min , Max	Reading (°C) Average	Stability (±°C)	Uncertainty (±°C)
102.0	-	102.0	0.43	0.83
107.0	-	107.0	0.20	0.70

*** 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,

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Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID:	BKK_EN0059(GM-7)
Organization Name:	ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location:	104 Patthanakarn 40, Patthanakarn Rd., Khwang Suan Luang, Khet Suan Luang, Bangkok
Date:	June 25, 2025 8:40:18 PM
EQP Name:	AgilentRecommended , AgilentRecommended
EQP Revision:	GC.02.50, GCMS.02.50
Overall Qualification Status:	Pass

REVIEW BY
APPROVED BY
NEXT CAL. DATE 25 - Dec - 26

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 SSL
Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.2	psi
Accuracy:			0.2	psi
Agilent Recommended:			<= 1.2	

Overall Inlet Pressure Accuracy Test Status
Pass

GC Oven Temperature Accuracy

Date: June 25, 2025 8:40:18 PM
System ID: BKK_EN0059(GM-7)

Name: 7890

Setpoint Status: Pass

Zone: Oven

	Setpoint/Actual					
Temperature:	230.0	228.8	°C			
Accuracy:		-1.2	°C			
Agilent Recommended:	>=	-1.0	% setpoint in K	(	-5.0	°C)
	<=	1.0	% setpoint in K	(	5.0	°C)

Setpoint Status: Pass

Zone: Oven

	Setpoint/Actual					
Temperature:	100.0	100.8	°C			
Accuracy:		0.8	°C			
Agilent Recommended:	>=	-1.0	% setpoint in K	(	-3.7	°C)
	<=	1.0	% setpoint in K	(	3.7	°C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

	Setpoint/Average		
Temperature:	100.0	101.0	°C
Stability:		0.0	°C
Agilent Recommended:	<=	0.5	

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1 Front SSL / External SQ

Name: 5977A

Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front SSL / External SQ

Name: 5977A

Setpoint Status: Pass

Amu:	1050	m/z	Drift After Five Minutes:				RFPA Voltage:		
			2	mV			462	mV	
Agilent Recommended:	>=	-100	and	<=	100		<=	1100	

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front SSL / External SQ

Name: 5977A

Setpoint Status: Pass

Filament: 1

Setpoint Status: Pass

Filament: 2

Overall Tune EI Test Status

Pass

Signal to Noise EI

Tested Combination1 Front SSL / External SQ

Name: 5977A

Source: EI - Extractor Filament: 1

Setpoint Status: Pass

Signal to Noise:		35794093956
Agilent Recommended:	>=	1200

Source: EI - Extractor Filament: 2

Setpoint Status: Pass

Signal to Noise:		32894968229
Agilent Recommended:	>=	1200

Overall Signal to Noise EI Test Status

Pass

NOTE: This test's 0 comment(s) and 3 deviation(s) are available in the Attachments section.

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System	
System ID	BKK_EN0059(GM-7)
Manufacturer	Agilent Technologies
Name	7890
Tested Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN14133181
Firmware Revision	B.02.03
Oven Type	Standard

Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	SQ
Name	5977A
Serial Number	US1415M209
Firmware Revision	5977 6.00.21
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Electronic Signature

Purpose

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 logon 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:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	June 25, 2025
Reason for Signature:	Executed protocol and published this original version of document

ACE Self Qualification Status

The installed version of ACE used to deliver this service passed qualification; the results conform with expected values. The self qualification summary report is available in the session folder location SDS\ClearStore\AceSelfQualification.

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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User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKC

System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 13, 2025 10:01:23 AM	Audit	SessionCreated	Session	Host Name: SCG1115HKC, Drive Serial Number: C2C31778
June 13, 2025 10:01:24 AM	start	Configuration	Session	None
June 13, 2025 10:01:24 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 13, 2025 10:04:40 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [PhotocalPacks/Gc/Configurations/02.50/Gc.02.50.eqp], EQP File Name: [Gc.02.50.eqp], EQP Name: [AgilentRecommended],Protocol Revision: [Gc.02.50] EQP details for hyphenated technique [GcMs] - File path: [PhotocalPacks/GcMs/Configurations/02.50/GcMs.02.50.eqp], EQP File Name: [GcMs.02.50.eqp], EQP Name: [AgilentRecommended]
June 13, 2025 10:04:51 AM	End	Configuration	Session	None
June 13, 2025 10:05:03 AM	start	Qualification	Session	OQ
June 13, 2025 10:05:09 AM	start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
June 13, 2025 10:05:35 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1

Page 1 / 9

User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKC

System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 13, 2025 10:06:49 AM	start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
June 13, 2025 10:06:56 AM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
June 13, 2025 10:07:00 AM	start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
June 13, 2025 10:07:30 AM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
June 13, 2025 10:07:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
June 13, 2025 10:07:59 AM	start	Execution	RFPA - 5977A SQ - Source: EI - Extractor	None
June 13, 2025 10:11:14 AM	start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
June 13, 2025 10:12:12 AM	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
June 13, 2025 10:12:17 AM	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

Page 2 / 9

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 13, 2025 10:12:19 AM	start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
June 13, 2025 10:30:39 AM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
June 13, 2025 10:30:45 AM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
June 13, 2025 10:30:56 AM	start	Execution	Log Amp - 5977A SQ: - Source: EI - Extractor	None
June 13, 2025 10:31:15 AM	End	Execution	Log Amp - 5977A SQ: - Source: EI - Extractor	Run Count : 1
June 13, 2025 10:34:14 AM	Audit	AceClosed	Session	None
June 16, 2025 11:55:53 AM	Audit	AceRestarted	Session	Host Name: DESKTOP-6PKI2AL, Drive Serial Number: 9494EA83
June 16, 2025 11:55:55 AM	Audit	SessionReloaded	Session	None
June 16, 2025 11:58:07 AM	start	Qualification	Session	OQ
June 16, 2025 5:47:31 PM	Audit	AceClosed	Session	None
June 17, 2025 1:34:47 PM	Audit	AceRestarted	Session	Host Name: DESKTOP-6PKI2AL, Drive Serial Number: 9494EA83
June 17, 2025 1:39:58 PM	Audit	AceClosed	Session	None
June 17, 2025 1:52:55 PM	Audit	AceRestarted	Session	Host Name: DESKTOP-6PKI2AL, Drive Serial Number: 9494EA83
June 17, 2025 2:03:56 PM	Audit	SessionReloaded	Session	None
June 17, 2025 2:03:58 PM	start	Qualification	Session	OQ
June 17, 2025 2:04:08 PM	Audit	AceClosed	Session	None

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 3:07:51 PM	Audit	AceRestarted	Session	Host Name: 5CG1115HKC, Drive Serial Number: C2031778
June 25, 2025 3:07:54 PM	Audit	SessionReloaded	Session	None
June 25, 2025 3:09:13 PM	start	Qualification	Session	OQ
June 25, 2025 3:09:36 PM	start	Execution	RFPA - 5977A SQ: - Source: EI - Extractor	None
June 25, 2025 3:10:29 PM	End	Execution	RFPA - 5977A SQ: - Source: EI - Extractor	Run Count : 1
June 25, 2025 3:10:35 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 25, 2025 3:10:40 PM	start	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
June 25, 2025 4:10:20 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 25, 2025 4:10:23 PM	start	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
June 25, 2025 4:10:43 PM	End	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
June 25, 2025 4:10:45 PM	start	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 4:11:08 PM	End	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	Run Count : 1
June 25, 2025 4:11:11 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 25, 2025 4:30:52 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 25, 2025 5:23:59 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F1_001.D
June 25, 2025 5:24:19 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over
June 25, 2025 5:26:41 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F1_001.D
June 25, 2025 5:27:29 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 -- [Integration Type: Injection;Baseline Correction Mode: Advanced;Initial Slope Sensitivity: 10;Initial Peak Width: 0.01;Initial Area Reject: 0;Initial Height Reject: 20000;Integration: Off at 0;Integration: On at 4]

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 5:29:45 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 1
June 25, 2025 5:31:32 PM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 1
June 25, 2025 5:31:32 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 25, 2025 5:34:18 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F1_001.D
June 25, 2025 5:35:03 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over
June 25, 2025 5:37:01 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F1_001.D
June 25, 2025 5:37:47 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 -- [Integration Type: Injection;Baseline Correction Mode: Advanced;Initial Slope Sensitivity: 10;Initial Peak Width: 0.01;Initial Area Reject: 0;Initial Height Reject: 25000;Integration: OFF at 0;Integration: ON at 4]

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 5:40:08 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 2
June 25, 2025 5:41:09 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 25, 2025 5:44:37 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_001.D
June 25, 2025 5:48:28 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 1
June 25, 2025 5:49:39 PM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 1
June 25, 2025 5:49:40 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 25, 2025 5:57:10 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_001.D
June 25, 2025 5:57:46 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 5:59:51 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_001.D
June 25, 2025 6:00:02 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over
June 25, 2025 6:02:07 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_001.D
June 25, 2025 6:02:24 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over
June 25, 2025 6:19:36 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over
June 25, 2025 6:27:38 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_002.D
June 25, 2025 6:33:07 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 2
June 25, 2025 6:34:17 PM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 2
June 25, 2025 6:34:17 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None

User Name: supasak.nimsongtham
Report Generated by Hostname: 5CG1115HKC
System Id: BKK_EN0059(GM-7)
Print Date: June 25, 2025 8:40:20 PM

GM-7-2025 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 25, 2025 6:35:07 PM	Audit	AceClosed	Session	None
June 25, 2025 6:35:57 PM	Audit	AceRestarted	Session	Host Name: 5CG1115HKC, Drive Serial Number: C2031778
June 25, 2025 6:35:59 PM	Audit	SessionReloaded	Session	None
June 25, 2025 6:36:12 PM	start	Qualification	Session	OQ
June 25, 2025 6:36:13 PM	start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 25, 2025 6:39:41 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : C:\Users\imsongth\Downloads\OQ data\OQ data\OQ_SN_F2_002.D
June 25, 2025 6:42:57 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 3
June 25, 2025 6:43:11 PM	End	Qualification	Session	OQ
June 25, 2025 6:43:11 PM	start	Reporting	Session	None
June 25, 2025 8:04:02 PM	Audit	Reporting	Session	Report Generated : Certificate
June 25, 2025 8:32:04 PM	Audit	Reporting	Session	Report Generated : Report

DKSH

Certificate of Calibration

Equipment:	pH METER	Certificate No.:	C07250317
Manufacturer:	SI Analytics	Job No.:	WO-00076560
Model:	TitroLine 7000	Issued Date:	30 June 2025
Serial No.:	10013826	Due Date:	30 June 2026
ID No.:	BKK_EN0373	Page:	1 of 3
Condition of the item:	Normal		

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

REVIEW BY Jinda K
APPROVED BY Siriluk P
NEXT CAL. DATE 30/06/26

Environment Condition:

Temperature	22.3	°C	±	0.1	°C
Relative Humidity	56.3	%	±	0.4	%

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd.(Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By: Mr.Pongpisut Suebchantha
Calibration Date: 30 June 2025
The Method Used: In house method, CAL-WI-58, base on ASTM E 70-07
Traceability: This certificate is traceable to SI Units, Sample Test is assured through primary meaurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 1100242, 1100244, 1034231 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20240602EA

(Mr. Pongpisut Suebchantha)
Person in charge

(Miss Kaewkan Suradech)
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 Evaluation of measurement data - Guide to the expression of uncertainty in measurement (JCGM 100).

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.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Calibration Results:

pH Scale

Input	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
(mV)	(mV)	Error (mV)	(pH)		
414.12	413.9	-0.22	0.000	0.065	2.00
354.96	354.8	-0.16	1.000	0.065	2.00
295.8	295.7	-0.10	2.001	0.065	2.00
236.64	236.6	-0.04	3.001	0.065	2.00
177.48	177.4	-0.08	4.000	0.065	2.00
118.32	118.3	-0.02	5.000	0.065	2.00
59.16	59.1	-0.06	6.000	0.065	2.00
0	0.0	0.00	7.000	0.065	2.00
-59.16	-59.1	0.06	8.000	0.065	2.00
-118.32	-118.3	0.02	9.000	0.065	2.00
-177.48	-177.4	0.08	10.000	0.065	2.00
-236.64	-236.5	0.14	11.000	0.065	2.00
-295.8	-295.6	0.20	12.000	0.065	2.00
-354.96	-354.8	0.16	13.000	0.065	2.00
-414.12	-413.9	0.22	14.000	0.065	2.00

Sample Test Results

Manufacturer: Thermo Scientific **Model:** 8157BNUMD **Electrode Serial No.:** BW1-13563

The three-point calibration using three standard buffer solutions; pH 4.007 , pH 6.988 and pH 10.010

- During calibraton, display of pH meter can be adjust to reading; pH 4.007 , pH 6.988 and pH 10.010

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.007	3.999	-0.008	0.0086	2.28
6.988	6.993	0.005	0.0085	2.00
10.010	10.013	0.003	0.013	2.00

Practical slope and zero point*

The three-point calibration using three standard buffer solutions; pH 4.007 , pH 6.988 and pH 10.010

- During calibraton, display of pH meter can be adjust to reading; pH 4.007 , pH 6.988 and pH 10.010

The practical slope of the pH electrode; 57.73 (mV/pH), 97.58%

The zero point of the pH electrode; 6.41 (pH)

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

The End of Certificate

DKSH

Checklist for pH Meter

Worksheet number: WO-00076560

Instrument type: pH METER Model: TitroLine 7000 S/N: 10013826

Check (receive) 30 Jun 2025 Normal	Defective	Checklist	Check (send) 30 Jun 2025 Normal	Defective	Note
☑	☐	1. Integrity of the tools	☑	☐	
☑	☐	2. Cleanliness of tools	☑	☐	
☑	☐	3. On-Off Swicth	☑	☐	
☑	☐	4. Keypad	☑	☐	
☑	☐	5. Display, Screen Contrast	☑	☐	
☑	☐	6. Electrode and Connection Cable	☑	☐	
☑	☐	7. Electrode (Level KCl)	☑	☐	
☑	☐	8. Electrode (Dust Protection Hood)	☑	☐	
☑	☐	9. Stand	☑	☐	

Recommend :

Mr.Pongpisut Suebchantha

Service Engineer

DKSH

Certificate of Calibration

Equipment : Digital Thermometer with Probe
Manufacturer: SI Analytics
Model: TitroLine 7000
Serial No.: 10013826
ID No.: BKK_EN0373
Condition of the item: Normal

Certificate No. : C15250720
Job No. : WO-00076560
Issued Date : 1 July 2025
Due Date: 30 June 2026
Page: 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition : Temperature: 30 °C ± 10 °C
Humidity: 55 %RH ± 25 %RH
Voltage: 220 VAC ± 10 %

Calibration Place : ALS Laboratory Group (Thailand) Co., Ltd.(Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By : Ms. Kaewkan Suradech
Calibration Date : 30 June 2025
The Method used : In house method, CAL-WI-69, by comparison with standard thermometer
Traceability : This certificate is traceable to the International System of Unit maintained by: Quality Reborn Co.,Ltd. (QR)

(Miss Kaewkan Suradech)
Person in charge

(Mr. Tweewong Thaithiang)
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 Evaluation of measurement data - Guide to the expression of uncertainty in measurement (JCGM 100).
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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Certificate No.: C15250720
Page: 2 of 2

Reference standard equipment:

Equipment	Certificate no	Cal. date	Next Cal. date
Digital Thermometer with Probe	QR24-2043	21 August 2024	21 August 2025

Calibration Results:

Without Adjustment

Sensor Type: RTD Electrode Serial No.: BW1-13563 Channel: -

Diameter (mm): 12 Length (mm): 120 Immersion (mm): 120

Calibrate Point.(°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Uncertainty (± °C)
25.0	24.994	24.9	0.094	0.20

The End of Certificate

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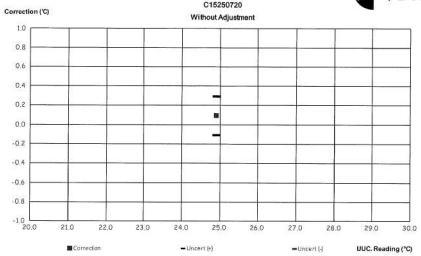

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ใบตรวจสอบสภาพเครื่องมือวัดอุณหภูมิ
(Digital Thermometer Checklist)

Equipment : Digital Thermometer with Probe Certificate No. : C15250720

Serial No. : 10013826 Model : TitroLine 7000

Check Date 30-Jun-2025 Normal	Defective	รายการตรวจเช็ค (Description)	Check before delivery 30-Jun-2025 Normal	Defective	หมายเหตุ (Remark)
		General			
☑	☐	1. สายไฟ (Electric wire)	☑	☐	
☑	☐	2. Adaptor / Power supply 220 / 110 VAC	☑	☐	
☑	☐	3. การทำงาน (On/Off Switch)	☑	☐	
☑	☐	4. การทำงาน (Selector Key)	☑	☐	
☑	☐	5. หน้าจอแสดงผล (Display)	☑	☐	
☐	☐	6. แบตเตอรี่ (Battery)	☐	☐	ไม่มี
☑	☐	7. สภาพตัวเครื่อง (Equipment Body)	☑	☐	
☑	☐	8. หัววัดซีนเซอร์ (Sensor (In / Ex)	☑	☐	

Note :

Ms. Kaewkan Suradech

Service Engineer

DKSH

Certificate of Calibration

Equipment: CONDUCTIVITY METER
Manufacturer: Thermo Scientific
Model: ORION STAR A215
Serial No.: X58031
ID No.: BKK_EN0373
Condition of the item: Normal

Certificate No.: C24250156
Job No.: WO-00076560
Issued Date: 30 June 2025
Due Date: 30 June 2026
Page: 1 of 2

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition: Temperature 22.5 °C ± 0.1 °C
Relative Humidity 56.2 % ± 0.4 %

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd.(Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By: Mr. Pongpisut Suebchantha
Calibration Date: 30 June 2025
The Method Used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14
Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 1066607, 1066608, 1066609

(Mr. Pongpisut Suebchantha)
Person in charge

(Miss Kaewkan Suradech)
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 Evaluation of measurement data - Guide to the expression of uncertainty in measurement (JCGM 100).
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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Certificate No.: C24250156 Page: 2 of 2

Calibration Results:

Manufacturer: Thermo Scientific **Model :** ORION 013005MD **Electrode Serial No.:** YV1-18416

Before Adjustment

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
84.003 µS/cm	91.88 µS/cm	-7.877 µS/cm	2.00	0.68 µS/cm
1413.1 µS/cm	1445 µS/cm	-31.9 µS/cm	2.00	11 µS/cm
12.881 mS/cm	13.06 mS/cm	-0.179 mS/cm	2.00	0.098 mS/cm

After Adjustment ; at 84.003 µS/cm, 1413.1 µS/cm, 12.880 mS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
84.003 µS/cm	84.14 µS/cm	-0.137 µS/cm	2.00	0.68 µS/cm
1413.1 µS/cm	1413 µS/cm	0.1 µS/cm	2.00	11 µS/cm
12.881 mS/cm	12.89 mS/cm	-0.009 mS/cm	2.00	0.098 mS/cm

The End of Certificate

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพระโขนง เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

Checklist for Conductivity Meter

Worksheet number: WO-00076560

Instrument type: Conductivity Meter Model: ORION STAR A215 S/N: X58031

Check (receive) 30 Jun 2025 Normal	Defective	Checklist	Check (send) 30 Jun 2025 Normal	Defective	Note
☑	☐	1. Integrity of the tools	☑	☐	
☑	☐	2. Cleanliness of tools	☑	☐	
☑	☐	3. On-Off Swicth	☑	☐	
☑	☐	4. Keypad	☑	☐	*
☑	☐	5. Display, Screen Contrast	☑	☐	
☑	☐	6. Electrode and Connection Cable	☑	☐	
☐	☐	7. Electrode (Dust Protection Hood)	☐	☐	
☑	☐	8. Stand	☑	☐	

Recommend : * ปุ่มกดเลื่อน ขึ้น-ลง,ซ้าย-ขวา กดยาก

Mr. Pongpisut Suebchantha
Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพระโขนง เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

Certificate of Calibration

Equipment : Digital Thermometer with Probe
Manufacturer: Thermo Scientific
Model: ORION STAR A215
Serial No.: X58031
ID No.: BKK_EN0373
Condition of the item: Normal

Certificate No. : C15250721
Job No. : WO-00076560
Issued Date : 1 July 2025
Due Date: 30 June 2026
Page: 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition : Temperature: 30 °C ± 10 °C
Humidity: 55 %RH ± 25 %RH
Voltage: 220 VAC ± 10 %

Calibration Place : ALS Laboratory Group (Thailand) Co., Ltd.(Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By : Ms. Kaewkan Suradech
Calibration Date : 30 June 2025
The Method used : In house method, CAL-WI-69, by comparison with standard thermometer
Traceability : This certificate is traceable to the International System of Unit maintained by: Quality Reborn Co.,Ltd. (QR)

(Miss Kaewkan Suradech)
Person in charge

(Mr. Tweewong Thaithiang)
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 Evaluation of measurement data - Guide to the expression of uncertainty in measurement (JCGM 100).
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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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Certificate No.: C15250721
Page: 2 of 2

Reference standard equipment:

Equipment	Certificate no	Cal. date	Next Cal. date
Digital Thermometer with Probe	QR24-2043	21 August 2024	21 August 2025

Calibration Results:
Without Adjustment
Sensor Type: RTD Electrode Serial No.: YV1-18416 Channel: -
Diameter (mm): 15 Length (mm): 120 Immersion (mm): 120

Calibrate Point.(°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Uncertainty (± °C)
25.0	24.994	25.0	-0.006	0.20

The End of Certificate

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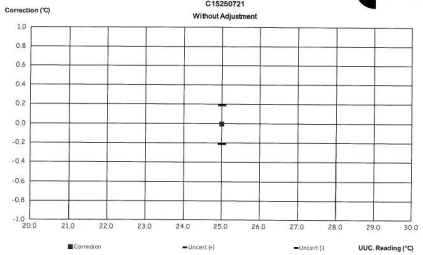

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ใบตรวจสอบสภาพเครื่องมือวัดอุณหภูมิ
(Digital Thermometer Checklist)

Equipment : Digital Thermometer with Probe Certificate No. : C15250721
Serial No. : X58031 Model : ORION STAR A215

Check Date 30-Jun-2025 Normal	Defective	รายการตรวจเช็ค (Description)	Check before delivery 30-Jun-2025 Normal	Defective	หมายเหตุ (Remark)
		General			
☑	☐	1. สายไฟ (Electric wire)	☑	☐	
☑	☐	2. Adaptor / Power supply 220 / 110 VAC	☑	☐	
☑	☐	3. การทำงาน (On/Off Switch)	☑	☐	
☑	☐	4. การทำงาน (Selector Key)	☑	☐	
☑	☐	5. หน้าจอแสดงผล (Display)	☑	☐	
☐	☐	6. แบตเตอรี่ (Battery)	☐	☐	ไม่มี
☑	☐	7. สภาพตัวเครื่อง (Equipment Body)	☑	☐	
☑	☐	8. หัววัดเซ็นเซอร์ (Sensor (In / Ex)	☑	☐	

Note :

Ms. Kaewkan Suradech
Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
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2533 ถนนสุขุมวิท แขวงพระโขนง เขตพระโขนง กรุงเทพมหานคร 10260
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Certificate of Calibration

Equipment: Automatic Titrator
Manufacturer: SI Analytics
Model: TitroLine 7000
Serial No.: 10013826
ID No.: BKK_EN0373
Type of Titration : Motor - driven
Condition of the item: Normal

Certificate No.: C32250030
Job No.: WO-00076560
Issued Date: 30 June 2025
Due Date: 30 June 2026
Page: 1 of 3

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition: Temperature 22 °C ± 0.4 °C
Relative Humidity 56 % ± 1.4 %
Atmospheric Pressure 1009 mbar ± 0.4 mbar

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By: Mr. Atachai Ngamchanat
Calibration Date: 30 June 2025
The Method Used: In house method, CAL-WI-57, base on ISO 8655:2002
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited. Certificate No. C01243206

(Mr. Atachai Ngamchanat)
Person in charge

(Miss Kaewkan Suradech)
Authorized signatory

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Certificate No.: C32250030 Page: 2 of 2

Calibration Results:
Nominal Volume 20 ml
Manufacturer: SI Analytics Burettes Model : TZ 3920 Serial No., Nr : 007734
Exchange Unit Model : WA-20 Exchange Unit Serial No. : 10045524 Nominal Vol.: 20 ml

Piston burettes of volumetric apparatus for automatic titrator

Volume (%)	Volume (ml)	Measurement Volume (V_{20}) (ml)	Systematic error (trueness) es (%)	es (µl)	Random error (precision) CV (%)	S_r (µl)	Measurement Uncertainty (µl)	k
10%	2.0000	1.9997	-0.002	-0.3	0.004	0.7	0.73	2.04
50%	10.0000	10.0076	0.038	7.6	0.003	0.7	1.0	2.00
100%	20.0000	20.0026	0.013	2.6	0.003	0.6	1.5	2.00

ISO 8655-3:2002(E) Table 1 - Maximum permissible errors for motor-driven piston burettes

Nominal volume ml	Maximum permissible systematic error ± %	± µl [a]	Maximum permissible random error ± % [b]	± µl [c]
≤1	0.6	6	0.1	1
2	0.5	10	0.1	2
5	0.3	15	0.1	5
10	0.2	20	0.07	7
20	0.2	40	0.07	14
25	0.2	50	0.07	17.5
50	0.2	100	0.05	25
100	0.2	200	0.03	30

a Expressed as the deviation of the mean of tenfold measurement from the nominal volume or from the selected volume (see ISO 8655-6:2002, 8.4)

b Expressed as the coefficient of variation of a tenfold measurement (see ISO 8655-6:2002, 8.5)

c Expressed as the repeatability standard deviation of a tenfold measurement (see ISO 8655-6:2002, 8.5)

The End of Certificate

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DKSH Technology Limited
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Checklist for Automatic Titrator

Worksheet number: WO-00076560

Instrument type: Automatic Titrator Model: TitroLine 7000 S/N: 10013826

Check (receive) 30 Jun 2025 Normal	Defective	Checklist	Check (send) 30 Jun 2025 Normal	Defective	Note
☑	☐	1. Integrity of the tools	☑	☐	
☑	☐	2. Cleanliness of tools	☑	☐	
☑	☐	3. On-Off Swicth	☑	☐	
☑	☐	4. Keypad	☑	☐	
☑	☐	5. Display, Screen Contrast	☑	☐	
☑	☐	6. Piston Burettes	☑	☐	
☑	☐	7. Function Rinsing and Dosing	☑	☐	
☑	☐	8. Dosing silicone tube and Accessories	☑	☐	

Recommend :

Mr. Atachai Ngamchanat

Service Engineer

Certificate of Calibration

Equipment: Automatic Titrator
Manufacturer: SI Analytics
Model: TitroLine 7000
Serial No.: 10013826
ID No.: BKK_EN0373
Type of Titration : Motor - driven
Condition of the item: Normal

Certificate No.: C32250031
Job No.: WO-00076560
Issued Date: 30 June 2025
Due Date: 30 June 2026
Page: 1 of 3

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition:
Temperature 22 °C ± 0.2 °C
Relative Humidity 56 % ± 1.9 %
Atmospheric Pressure 1009 mbar ± 0.2 mbar

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Wet Chemistry Lab 2)
104 Soi Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By: Mr. Atachai Ngamchanat
Calibration Date: 30 June 2025
The Method Used: In house method, CAL-WI-57, base on ISO 8655:2002
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited. Certificate No. C01243206

(Mr. Atachai Ngamchanat)
Person in charge

(Miss Kaewkan Suradech)
Authorized signatory

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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.

Calibration Results:
Nominal Volume 20 ml
Manufacturer: SI Analytics Burettes Model : TZ 3920 Serial No., Nr : 007773
Exchange Unit Model : WA-20 Exchange Unit Serial No. : 10045489 Nominal Vol.: 20 ml

Piston burettes of volumetric apparatus for automatic titrator

Volume (%)	Volume (ml)	Measurement Volume (V_{20}) (ml)	Systematic error (trueness) es (%)	es (µl)	Random error (precision) CV (%)	S_r (µl)	Measurement Uncertainty (µl)	k
10%	2.0000	2.0009	0.004	0.9	0.004	0.7	0.73	2.04
50%	10.0000	10.0050	0.025	5.0	0.002	0.4	0.90	2.00
100%	20.0000	20.0054	0.027	5.4	0.003	0.5	1.5	2.00

ISO 8655-3:2002(E) Table 1 - Maximum permissible errors for motor-driven piston burettes

Nominal volume	Maximum permissible systematic error		Maximum permissible random error	
ml	± %	± µl [a]	± % [b]	± µl [c]
≤1	0.6	6	0.1	1
2	0.5	10	0.1	2
5	0.3	15	0.1	5
10	0.2	20	0.07	7
20	0.2	40	0.07	14
25	0.2	50	0.07	17.5
50	0.2	100	0.05	25
100	0.2	200	0.03	30

a Expressed as the deviation of the mean of tenfold measurement from the nominal volume or from the selected volume (see ISO 8655-6:2002, 8.4)

b Expressed as the coefficient of variation of a tenfold measurement (see ISO 8655-6:2002, 8.5)

c Expressed as the repeatability standard deviation of a tenfold measurement (see ISO 8655-6:2002, 8.5)

The End of Certificate

Checklist for Automatic Titrator

Worksheet number: WO-00076560

Instrument type: Automatic Titrator Model: TitroLine 7000 S/N: 10013826

Check (receive) 30 Jun 2025 Normal	Defective	Checklist	Check (send) 30 Jun 2025 Normal	Defective	Note
☑	☐	1. Integrity of the tools	☑	☐	
☑	☐	2. Cleanliness of tools	☑	☐	
☑	☐	3. On-Off Swicth	☑	☐	
☑	☐	4. Keypad	☑	☐	
☑	☐	5. Display, Screen Contrast	☑	☐	
☑	☐	6. Piston Burettes	☑	☐	
☑	☐	7. Function Rinsing and Dosing	☑	☐	
☑	☐	8. Dosing silicone tube and Accessories	☑	☐	

Recommend :

Mr. Atachai Ngamchanat

Service Engineer

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

Certificate of Calibration

Cert.No.: 25CH690
Page.: 1 of 2

Equipment : Conductivity Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S3
Serial No. : C307698815
ID No. : BKK_LG0072
Condition As-Received: Used Item
Received Date : 12 June 2025
Calibration Date : 13 June 2025
Reference : 2506-0355DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand

REVIEW BY Chayathron P.
APPROVED BY Warakorn P.
NEXT CAL DATE 13/06/26

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In -house method :
- CP-CH6 by direct measurement with reference material (RM)

Calibrated by : Warakorn Lerngagtrakul

Approved by :
Approved Signatory

( ) Chakrit Waewwanjua
( ) Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 16 June 2025

The Uncertainties are for a confidence probability of approximately 95%

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Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	241995	09 Sep 2025

- This measurement result is traceable to SI throught Technology Promotion Association (Thailand - Japan)

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

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413 µS/cm	Thermo Scientific	174/03	26 Apr 2027

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) °C

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

Calibration results
Function : Conductivity Measurement
(*) After Adjustment at 1413 µS/cm
Conductivity Electrode Serial No.: 5822439456

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor *k*
1413 µS/cm	1378 µS/cm	1414 µS/cm	15 µS/cm	2.00

Remark : **- UUC* = Unit Under Calibration**
- Cell constant = 0.568 cm^{-1}

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-