

ภาคผนวก จ

ใบรับรองเอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0496	3-Jul-22	3-Jan-23	6
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	16-Dec-21	16-Dec-22	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, S	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, S	-	-	-	-
Stack (CEMs)	Flow Rate	Analyzer , System calibration, S	-	-	-	-
Ambient	Total Suspended Particulate	High Volume	BKK_FS1059	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0364	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0359	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0373	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0375	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1063	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0386	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0382	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1061	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1088	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0800	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0782	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0741	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1070	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1087	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1091	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0781	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0740	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1069	1-Jul-22	1-Jan-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0435	26-Jan-22	27-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0887	30-May-22	28-Nov-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0436	6-Jan-22	7-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0975	26-Jan-22	27-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0888	30-May-22	28-Nov-23	18
Ambient	Temperature	Temperatue Sensor	RYG_FS0435	26-Jan-22	27-Jul-23	18
Ambient	Temperature	Temperatue Sensor	BKK_FS0887	30-May-22	28-Nov-23	18
Ambient	Temperature	Temperatue Sensor	RYG_FS0436	6-Jan-22	7-Jul-23	18
Ambient	Temperature	Temperatue Sensor	BKK_FS0975	26-Jan-22	27-Jul-23	18
Ambient	Temperature	Temperatue Sensor	BKK_FS0888	30-May-22	28-Nov-23	18
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	14-Jan-22	14-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0877	25-Oct-22	25-Oct-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0930	12-Jan-22	12-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0110	14-Dec-21	14-Dec-22	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	14-Jan-22	14-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0032	15-Aug-22	15-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0098	15-Aug-22	15-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0101	20-Jun-22	20-Jun-23	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	14-Jan-22	14-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0107	2-Nov-22	2-Nov-23	12
Noise	Leq 5 min	Sound Calibrator	BKK_FS0632	14-Jan-22	14-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0877	25-Oct-22	25-Oct-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0930	12-Jan-22	12-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0110	14-Dec-21	14-Dec-22	12
Noise	Leq 5 min	Sound Calibrator	BKK_FS0632	14-Jan-22	14-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0032	15-Aug-22	15-Aug-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0098	15-Aug-22	15-Aug-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0101	20-Jun-22	20-Jun-23	12



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0680	15-Feb-22	15-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0673	1-Oct-21	1-Oct-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0661	13-Dec-21	13-Dec-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0682	1-Oct-21	1-Oct-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0682	21-Nov-22	21-Nov-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0672	17-Mar-22	17-Mar-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0678	15-Feb-22	15-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0679	28-Sep-22	28-Sep-23	12
Illuminance	Illuminance	Lux Meter	BKK_FS0606	15-Feb-22	15-Feb-23	12
Water Lab	Temperature	Digital Thermometer Wite Senc	BKK_LG0031	23-Dec-21	23-Dec-22	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0072	12-Sep-22	12-Mar-24	18
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	31-Jan-22	1-Aug-23	18
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0273	22-Jul-21	20-Jan-23	18
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Water Lab	Total Dissolved Solids 180°C	Oven	BKK_EN0273	22-Jul-21	20-Jan-23	18
Water Lab	BOD	DO Meter	BKK_EN0017	24-May-22	24-Nov-23	18
Water Lab	BOD	Incubator	BKK_EN0005	4-Oct-21	4-Apr-23	18
Water Lab	Residual Free Chlorine	Chlorine Meter	BKK_LG0043	25-May-22	25-May-23	12
Water Lab	Dissolved Oxygen	Burette	BKK_EN0171	30-Aug-22	1-Mar-24	18
Water Lab	Dissolved Oxygen	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Calcium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Water Lab	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Water Lab	Magnesium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Magnesium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Water Lab	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	SAR	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	SAR	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	SAR	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Total Trihalomethane	Gas Chromatography (MSD)	BKK_EN0059	21-Jun-22	21-Dec-23	18
Water Lab	Conductivity	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Water Lab	Arsenic	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Barium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Barium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Barium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Trivalent Chromium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Trivalent Chromium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Lead	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nickel	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Nickel	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Selenium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Iron	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Iron	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Iron	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Zinc	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Zinc	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Organochlorine Pesticide	GC MSMS	BKK_EN0284	23-Nov-21	22-May-23	18
Water Lab	Color	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	COD	Hot Block	BKK_EN0222	21-Mar-22	21-Mar-23	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Cyanide	Discrete analyzer	BKK_EN0037	30-Jun-22	30-Jun-23	12
Water Lab	Cyanide	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Formaldehyde	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Formaldehyde	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Phenol	Discrete analyzer	BKK_EN0037	30-Jun-22	30-Jun-23	12
Water Lab	Phenol	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Fluoride	Ion Chromatography	BKK_EN0069	12-Jan-22	12-Jan-23	12
Water Lab	Anionic Surfactant	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Anionic Surfactant	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Copper	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Copper	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Copper	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Sulfide	Burette	BKK_EN0171	30-Aug-22	1-Mar-24	18
Water Lab	Sulfide	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Total Kjeldahl Nitrogen	Digestion Unit	BKK_EN0141	4-Aug-21	2-Feb-23	18
Water Lab	Total Kjeldahl Nitrogen	Discrete analyzer	BKK_EN0037	30-Jun-22	30-Jun-23	12
Water Lab	Conductivity (On site)	Conductivity meter	BKK_LG0035	10-Feb-22	10-Feb-23	12
Sludge	Salinity	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Sludge	pH aqueous phase 50% (w/v)	pH meter	BKK_EN0072	12-Sep-22	12-Mar-24	18
Sludge	Conductivity aqueous phase 20% (w/v)	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Sludge	Residual Chlorine	Chlorine Meter	BKK_LG0042	28-Jan-22	28-Jan-23	12
Sludge	Total Trihalomethane	Gas Chromatography (MSD)	BKK_EN0059	21-Jun-22	21-Dec-23	18
Sludge	Calcium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Calcium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Sodium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Sodium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Manganese	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 3 Jul 22
Next Cal. Date : 3 Jan 23

Barometric Pressure (mm.Hg) : 753
Relative Humidity (%) : 55.0
Temperature : 34.0

Console Control Meter Data

Calibration No. : C-030722-BKK_FS0496
Dry Gas Meter No. : BKK_FS0496
Serial No. : 1412087
Model No. : XC-572-V

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID.: BKK_FS0629
Serial No. : 1607009
Correction Factor (Yr) : 1.0060
Next Calibration Date : 7 Oct 22

ΔH (mm.H ₂ O)	\ominus Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter Correction	Orifice Calibration
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Tm (°C)	Factor (Y)	Factor $\Delta H@$
		Final	Initial	Total		Final	Initial	Total					
15	11.38	150.00	0.00	150.00	40.0	328008.0	327861.0	147.00	40.0	40.0	40.0	1.0250	41.3065
25	9.04	150.00	0.00	150.00	40.0	327344.4	327202.0	142.40	40.0	40.0	40.0	1.0571	43.4429
50	6.23	150.00	0.00	150.00	40.0	327528.2	327380.0	148.20	40.0	40.0	40.0	1.0133	41.2656
80	5.03	150.00	0.00	150.00	40.0	327685.0	327536.0	149.00	40.0	40.0	40.0	1.0049	43.0396
120	4.08	150.00	0.00	150.00	40.0	327849.0	327701.0	148.00	40.0	40.0	40.0	1.0078	42.4760
											Avg.	1.0216	42.3061

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

$\Delta H@$: 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:

Vanich P.

(Mr. Vanich Phanpipit)
Field Scientist(3)

Approved by:

S. P.

(Mr.Samart Roo-ngan)

Specialist (1)



Stopwatch Calibration Test Report

Calibration Date : 3 Jul 22 Next Cal. Date : 3 Jan 23
Barometric Pressure (mmHg) : 756 Temperature (°C) : 31.0
Relative Humidity (%) : 62.0

Reference Stopwatch Data

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

Console Control Meter Data

Dry Gas Meter No. : BKK_FS0496
Model : XC-572-V
Serial No. : 1462087

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:10	5:00	10	0.00017
2	5:00:11	5:00	11	0.00018
3	5:00:12	5:00	12	0.00020
4	5:00:11	5:00	11	0.00018
5	5:00:10	5:00	10	0.00017
6	5:00:10	5:00	10	0.00017
7	5:00:08	5:00	8	0.00013
8	5:00:10	5:00	10	0.00017
9	5:00:12	5:00	12	0.00020
10	5:00:11	5:00	11	0.00018
			Average	0.00018
			SD	0.00002

Calibrate by :

Mr. Prasert Surakhan

Field Scientist (3)

Approved by :

Mr. Samart Roo-ngan

Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jul 22	Ambient Temperature (°C) :	31
Calibration sheet No. :	C-030722-BKK_FS0497	Relative Humidity (%) :	62
Digital Temperature ID	BKK_FS0497	Reference Temperature ID :	BKK_FS0609
Serial No. :	1412087	Serial No. :	7688004
Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	25	0	
	50	50	0	
	100	100	0	
	150	150	0	
	200	199	-1	
	250	249	-1	
	300	299	-1	
	500	499	-1	
	1000	999	-1	
	1200	1199	-1	
Probe	100	100	0	
	125	125	0	
	150	150	0	
Oven	100	100	0	
	125	125	0	
	150	151	1	
Filter	100	100	0	
	125	125	0	
	150	150	0	
Exit	0	1	1	
	10	11	1	
	20	21	1	
Meter	0	1	1	
	25	26	1	
	50	51	1	
AUX	0	0	0	
	25	25	0	
	50	50	0	

Calibrated by : _____

(Mr. Prasert Surakan)

Field Scientist (3)

Approved by : _____

(Mr. Samart Roo-ngan)

Specialist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0500

Calibration Date : 3 Jul 22

Lab test duct Number : 258-1-13-01

Standard Pitot ID : BKK_FS0441

Calibration Sheet No. : C-030722-BKK_FS0500

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

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

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

Calibrated by : _____

(Mr. Prasert Surakhan)

Field Scientist (3)

Approved by : _____

(Mr.Samart Roo-ngan)

Field Specialist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0501 Calibration Date : 3 Jul 22
 Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK_FS0441
 Calibration Sheet No. : C-030722-BKK_FS0501 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

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

$$\text{Average deviation}(A \text{ or } B) = \frac{\sum_{i=1}^3 [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by : _____

(Mr. Prasert Surakhan)

Field Scientist (3)

Approved by : _____

(Mr.Samart Roo-ngan)

Field Specialist (1)



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	3 Jul 22	Nozzle Set ID. :	BKK_FS0502
Calibration Sheet No. :	C-030722-228-2-32-07	Vernier Caliper ID. :	BKK_FS0626

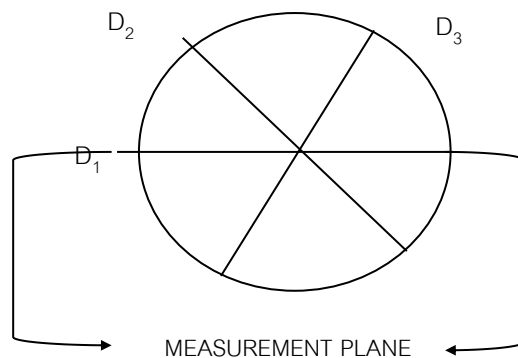
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270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

Where :

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

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

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



Calibrated by : _____

(Mr. Prasert Surakhan)

Field Scientist (3)

Approved by : _____

Mr. Samart Roo-ngan

Field Specialist (1)



Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/21161

Certificate No.:	PTC/07/21161	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	38304165
Model:	SECURA224-1S	ID No:	BKK_EN0309
Type of Balance:	Single interval		



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

Environment Condition: Temperature 23.8 °C \pm 0.4 °C
Humidity 58.1 %RH \pm 0.7 %RH
Air density 1.18 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40, Phatthanakarn Rd.,
Khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.



The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: December 16, 2021

Calibration Date: December 16, 2021

Issued Date: December 20, 2021

Calibration By: Mr. Keattisak Kerdto



PENTA CALIBRATION CO., LTD.

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Mr. Keattisak Kerdto)

Laboratory Manager

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 recognised national standard laboratories.

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

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/21161

Certificate No.: PTC/07/21161

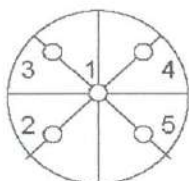
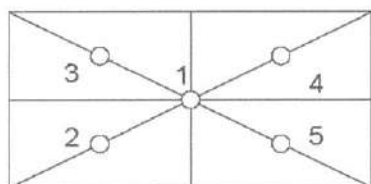
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Internal Calibration

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	0.0000	-0.0001	-0.0001
Maximum deviation:			0.0001	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
200	0.00004

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00013	2.37
0.01	0.01000	0.0100	0.0000	0.00028	2.00
0.1	0.10000	0.1000	0.0000	0.00015	2.12
1	1.00000	1.0000	0.0000	0.00014	2.18
2	2.00000	2.0000	0.0000	0.00014	2.20
5	5.00001	5.0000	0.0000	0.00014	2.20
10	10.00000	10.0000	0.0000	0.00014	2.20
20	20.00003	20.0000	0.0000	0.00014	2.18
50	50.00004	50.0000	0.0000	0.00015	2.11
100	100.00004	100.0000	0.0000	0.00018	2.05
200	200.00011	200.0000	0.0001	0.00025	2.00

Note: Weight of adjust - (g)

The End of Certificate



Lot No. 22119258-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co., Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ 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	0.01	0.04
Low-Level Gas	8.02	8.03	8.01	0.08
Span Gas	16.02	16.01	16.05	0.16

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	54.64	54.59	54.61	0.02
Span Gas	81.85	81.85	81.81	0.04

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	54.34	54.33	54.30	0.03
Span Gas	79.92	79.92	79.90	0.02

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



Lot No. 22119258-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co., Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.02	0.08	0.08
Upscale Gas	16.01	16.06	0.20	16.08	0.28	0.08

NO_x ANALYZER

Cylinder Conc. (ppm) : 81.85 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	0.02	0.02	0.02	0.02	0.00
Upscale Gas	81.85	81.79	0.06	81.72	0.13	0.07

SO₂ ANALYZER

Cylinder Conc. (ppm) : 79.92 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	79.92	79.75	0.17	79.69	0.23	0.06

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	1
Date	18 Nov 22	Location	HRSG 11
Start Time	13:35	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	13:55
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:35	13.92	4.21	18.26	0.06	-	
13:36	13.99	4.17	19.04	0.07	-	
13:37	13.99	4.22	19.81	0.08	-	
13:38	13.97	4.18	21.51	0.13	-	
13:39	14.02	4.15	22.82	0.07	-	
13:40	14.02	4.17	22.85	0.08	-	
13:41	14.02	4.19	22.61	0.07	-	
13:42	14.02	4.17	22.54	0.05	-	
13:43	14.02	4.21	22.47	0.06	-	
13:44	14.02	4.18	22.48	0.06	-	
13:45	14.02	4.20	22.60	0.05	-	
13:46	14.02	4.17	22.74	0.06	-	
13:47	14.01	4.18	22.75	0.06	-	
13:48	14.01	4.17	22.81	0.06	-	
13:49	14.01	4.21	22.77	0.06	-	
13:50	14.01	4.21	22.82	0.07	-	
13:51	14.01	4.18	22.89	0.06	-	
13:52	14.00	4.18	22.99	0.06	-	
13:53	14.00	4.15	23.03	0.06	-	
13:54	14.01	4.18	22.95	0.07	-	
13:55	14.01	4.20	22.90	0.07	-	
Average	14.00	4.18	22.17	0.07	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	2
Date	18 Nov 22	Location	HRSG 11
Start Time	13:56	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	14:16
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:56	14.00	4.18	22.91	0.07	-	
13:57	14.00	4.18	22.98	0.06	-	
13:58	14.01	4.14	22.98	0.06	-	
13:59	14.00	4.16	22.90	0.07	-	
14:00	14.00	4.18	22.89	0.06	-	
14:01	14.00	4.18	22.90	0.07	-	
14:02	13.99	4.18	22.88	0.07	-	
14:03	13.99	4.16	22.90	0.07	-	
14:04	14.01	4.20	22.90	0.07	-	
14:05	14.00	4.18	22.94	0.06	-	
14:06	14.00	4.17	23.02	0.06	-	
14:07	14.01	4.17	22.99	0.06	-	
14:08	14.00	4.17	22.91	0.07	-	
14:09	14.00	4.20	22.90	0.07	-	
14:10	14.01	4.21	22.90	0.07	-	
14:11	14.00	4.20	22.86	0.07	-	
14:12	14.01	4.19	22.84	0.05	-	
14:13	14.01	4.20	22.78	0.04	-	
14:14	14.00	4.19	22.81	0.06	-	
14:15	13.99	4.22	22.96	0.05	-	
14:16	13.99	4.19	23.12	0.06	-	
Average	14.00	4.18	22.92	0.06	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	3
Date	18 Nov 22	Location	HRSG 11
Start Time	14:17	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	14:37
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:17	13.99	4.19	23.15	0.05	-	
14:18	13.98	4.19	23.16	0.06	-	
14:19	13.99	4.16	23.26	0.06	-	
14:20	14.00	4.20	23.27	0.06	-	
14:21	13.99	4.20	23.14	0.05	-	
14:22	14.00	4.19	23.15	0.05	-	
14:23	14.00	4.19	23.20	0.05	-	
14:24	14.01	4.15	23.16	0.05	-	
14:25	14.00	4.20	23.15	0.05	-	
14:26	14.00	4.18	23.14	0.05	-	
14:27	14.00	4.19	23.23	0.05	-	
14:28	14.01	4.22	23.14	0.05	-	
14:29	14.01	4.16	23.05	0.05	-	
14:30	14.02	4.18	22.96	0.05	-	
14:31	13.99	4.21	23.05	0.06	-	
14:32	14.00	4.18	23.19	0.06	-	
14:33	14.01	4.16	23.29	0.05	-	
14:34	14.02	4.19	23.07	0.06	-	
14:35	14.01	4.19	22.96	0.06	-	
14:36	14.02	4.16	22.96	0.06	-	
14:37	14.01	4.19	23.07	0.06	-	
Average	14.00	4.18	23.13	0.05	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



Lot No. 22119259-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ 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	8.02	8.02	8.04	0.08
Span Gas	16.02	16.03	16.06	0.12

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	0.01	0.01
Low-Level Gas	54.64	54.63	54.60	0.03
Span Gas	81.85	81.82	81.76	0.06

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	54.34	54.30	54.27	0.03
Span Gas	79.92	79.90	79.88	0.02

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



Lot No. 22119259-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.01	0.04	0.00	0.00	0.04
Upscale Gas	16.03	16.09	0.24	16.11	0.32	0.08

NO_x ANALYZER

Cylinder Conc. (ppm) : 81.85 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	0.01	0.01	0.02	0.02	0.01
Upscale Gas	81.82	81.78	0.04	81.80	0.02	0.02

SO₂ ANALYZER

Cylinder Conc. (ppm) : 79.92 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	79.90	79.83	0.07	79.78	0.12	0.05

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	1
Date	17 Nov 22	Location	HRSG 12
Start Time	15:00	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	15:20
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:00	13.98	4.19	16.46	0.05	-	
15:01	13.97	4.14	16.64	0.05	-	
15:02	13.97	4.17	16.76	0.05	-	
15:03	13.98	4.14	16.82	0.05	-	
15:04	13.99	4.16	16.81	0.06	-	
15:05	13.97	4.14	16.84	0.06	-	
15:06	13.99	4.13	16.89	0.06	-	
15:07	13.98	4.17	16.91	0.03	-	
15:08	13.99	4.17	16.90	0.03	-	
15:09	13.99	4.18	16.95	0.03	-	
15:10	14.00	4.14	16.93	0.03	-	
15:11	13.98	4.17	16.75	0.03	-	
15:12	13.97	4.17	16.50	0.02	-	
15:13	13.96	4.15	16.36	0.02	-	
15:14	13.95	4.18	16.38	0.02	-	
15:15	13.94	4.19	16.44	0.02	-	
15:16	13.97	4.17	16.44	0.02	-	
15:17	13.98	4.20	16.32	0.01	-	
15:18	13.96	4.17	16.16	0.01	-	
15:19	13.95	4.19	16.09	0.02	-	
15:20	13.97	4.17	16.11	0.02	-	
Average	13.97	4.16	16.59	0.03	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	2
Date	17 Nov 22	Location	HRSG 12
Start Time	15:21	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	15:41
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:21	13.98	4.18	16.17	0.02	-	
15:22	13.98	4.15	16.22	0.01	-	
15:23	13.98	4.19	16.29	0.02	-	
15:24	13.98	4.19	16.34	0.01	-	
15:25	13.97	4.18	16.40	0.01	-	
15:26	13.96	4.18	16.45	0.02	-	
15:27	13.96	4.15	16.52	0.02	-	
15:28	13.96	4.16	16.52	0.01	-	
15:29	13.97	4.18	16.54	0.01	-	
15:30	13.99	4.17	16.38	0.01	-	
15:31	13.98	4.18	16.30	0.01	-	
15:32	13.97	4.16	16.33	0.01	-	
15:33	13.97	4.14	16.53	0.01	-	
15:34	13.98	4.16	16.60	0.01	-	
15:35	13.99	4.16	16.55	0.02	-	
15:36	13.97	4.19	16.57	0.01	-	
15:37	13.97	4.15	16.69	0.01	-	
15:38	13.98	4.15	16.69	0.01	-	
15:39	13.98	4.16	16.62	0.02	-	
15:40	13.96	4.11	16.58	0.01	-	
15:41	13.98	4.15	16.63	0.01	-	
Average	13.97	4.16	16.47	0.01	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	3
Date	17 Nov 22	Location	HRSG 12
Start Time	15:42	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	16:02
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:42	13.98	4.16	16.63	0.02	-	
15:43	13.98	4.17	16.61	0.02	-	
15:44	13.98	4.19	16.60	0.03	-	
15:45	13.98	4.15	16.53	0.03	-	
15:46	13.96	4.18	16.59	0.02	-	
15:47	13.97	4.15	16.64	0.02	-	
15:48	13.97	4.16	16.66	0.02	-	
15:49	13.97	4.14	16.68	0.02	-	
15:50	13.98	4.13	16.66	0.02	-	
15:51	13.99	4.18	16.54	0.02	-	
15:52	13.98	4.14	16.43	0.03	-	
15:53	13.98	4.15	16.46	0.02	-	
15:54	13.98	4.18	16.49	0.02	-	
15:55	13.96	4.18	16.45	0.03	-	
15:56	13.96	4.14	16.55	0.02	-	
15:57	13.96	4.19	16.66	0.03	-	
15:58	13.97	4.15	16.68	0.03	-	
15:59	13.99	4.15	16.64	0.03	-	
16:00	14.00	4.15	16.63	0.02	-	
16:01	13.98	4.13	16.67	0.03	-	
16:02	13.98	4.15	16.69	0.04	-	
Average	13.98	4.16	16.59	0.02	-	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



Lot No. 22119271-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ 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	0.01	0.04
Low-Level Gas	8.02	8.03	8.01	0.08
Span Gas	16.02	16.01	16.05	0.16

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	54.64	54.59	54.61	0.02
Span Gas	81.85	81.85	81.81	0.04

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	54.34	54.33	54.30	0.03
Span Gas	79.92	79.92	79.90	0.02

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group



Lot No. 22119271-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.02	0.08	0.08
Upscale Gas	16.01	16.06	0.20	16.08	0.28	0.08

NO_x ANALYZER

Cylinder Conc. (ppm) : 81.85 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	0.02	0.02	0.02	0.02	0.00
Upscale Gas	81.85	81.79	0.06	81.72	0.13	0.07

SO₂ ANALYZER

Cylinder Conc. (ppm) : 79.92 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	79.92	79.75	0.17	79.69	0.23	0.06

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group



CEMs Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 18 Nov 22
Location HRSG 11

Run No: 1

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	13:35	0.00	20.67	-	14.15	42.92
18 Nov 22	13:36	0.00	20.69	-	14.16	42.91
18 Nov 22	13:37	0.00	20.76	-	14.16	42.93
18 Nov 22	13:38	0.00	20.76	-	14.16	42.94
18 Nov 22	13:39	0.00	20.77	-	14.15	43.02
18 Nov 22	13:40	0.00	20.99	-	14.15	43.07
18 Nov 22	13:41	0.00	21.06	-	14.15	43.09
18 Nov 22	13:42	0.00	21.03	-	14.15	43.13
18 Nov 22	13:43	0.00	21.06	-	14.14	43.12
18 Nov 22	13:44	0.00	21.10	-	14.15	43.18
18 Nov 22	13:45	0.00	21.00	-	14.15	43.27
18 Nov 22	13:46	0.00	21.07	-	14.14	43.24
18 Nov 22	13:47	0.00	21.16	-	14.13	43.32
18 Nov 22	13:48	0.00	21.39	-	14.13	43.23
18 Nov 22	13:49	0.00	21.27	-	14.14	43.27
18 Nov 22	13:50	0.00	21.04	-	14.14	43.29
18 Nov 22	13:51	0.00	21.08	-	14.13	43.31
18 Nov 22	13:52	0.00	21.15	-	14.12	43.26
18 Nov 22	13:53	0.00	21.67	-	14.13	43.29
18 Nov 22	13:54	0.00	21.10	-	14.14	43.36
18 Nov 22	13:55	0.00	21.41	-	14.13	43.40
Max		0.00	21.67	-	14.16	43.40
Avg		0.00	21.06	-	14.14	43.17

Run No: 2

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	13:56	0.00	21.40	-	14.13	43.44
18 Nov 22	13:57	0.01	21.54	-	14.13	43.44
18 Nov 22	13:58	0.00	21.57	-	14.12	43.40
18 Nov 22	13:59	0.00	21.57	-	14.13	43.36
18 Nov 22	14:00	0.00	21.54	-	14.13	43.36
18 Nov 22	14:01	0.00	21.87	-	14.12	43.27
18 Nov 22	14:02	0.00	21.68	-	14.14	43.24
18 Nov 22	14:03	0.00	21.58	-	14.14	43.24
18 Nov 22	14:04	0.05	21.65	-	14.14	43.16
18 Nov 22	14:05	0.09	21.73	-	14.14	43.15
18 Nov 22	14:06	0.09	21.75	-	14.13	43.11
18 Nov 22	14:07	0.02	21.73	-	14.13	43.16
18 Nov 22	14:08	0.00	21.67	-	14.14	43.41
18 Nov 22	14:09	0.00	21.74	-	14.13	43.49
18 Nov 22	14:10	0.00	21.90	-	14.12	43.55
18 Nov 22	14:11	0.00	22.11	-	14.11	43.52
18 Nov 22	14:12	0.00	21.97	-	14.12	43.49
18 Nov 22	14:13	0.00	22.16	-	14.11	43.46
18 Nov 22	14:14	0.00	22.37	-	14.11	43.32
18 Nov 22	14:15	0.03	22.32	-	14.13	43.32
18 Nov 22	14:16	0.11	22.09	-	14.13	43.28
Max		0.11	22.37	-	14.14	43.55
Avg		0.02	21.81	-	14.13	43.34

Run No: 3

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	14:17	0.13	22.15	-	14.13	43.24
18 Nov 22	14:18	0.15	22.18	-	14.13	43.25
18 Nov 22	14:19	0.03	22.19	-	14.14	43.25
18 Nov 22	14:20	0.00	22.12	-	14.13	43.24
18 Nov 22	14:21	0.00	22.15	-	14.13	43.25
18 Nov 22	14:22	0.00	22.24	-	14.12	43.06
18 Nov 22	14:23	0.00	22.08	-	14.14	43.10
18 Nov 22	14:24	0.00	21.97	-	14.14	43.13
18 Nov 22	14:25	0.00	22.11	-	14.15	43.18
18 Nov 22	14:26	0.00	22.19	-	14.14	43.20
18 Nov 22	14:27	0.06	22.47	-	14.12	43.07
18 Nov 22	14:28	0.13	22.16	-	14.13	43.01
18 Nov 22	14:29	0.16	22.03	-	14.15	43.05
18 Nov 22	14:30	0.14	22.02	-	14.14	43.11
18 Nov 22	14:31	0.03	22.16	-	14.14	43.19
18 Nov 22	14:32	0.00	22.10	-	14.14	43.30
18 Nov 22	14:33	0.00	22.39	-	14.12	43.25
18 Nov 22	14:34	0.00	22.57	-	14.14	43.27
18 Nov 22	14:35	0.00	22.23	-	14.13	43.29
18 Nov 22	14:36	0.00	22.53	-	14.13	43.22
18 Nov 22	14:37	0.00	22.49	-	14.14	43.16
Max		0.16	22.57	-	14.15	43.30
Avg		0.04	22.22	-	14.13	43.18

Run No: 4

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	14:38	0.00	22.80	-	14.13	43.00
18 Nov 22	14:39	0.09	22.61	-	14.15	43.00
18 Nov 22	14:40	0.18	22.33	-	14.16	43.14
18 Nov 22	14:41	0.15	22.45	-	14.15	43.20
18 Nov 22	14:42	0.17	22.55	-	14.15	43.29
18 Nov 22	14:43	0.04	22.56	-	14.14	43.32
18 Nov 22	14:44	0.00	22.51	-	14.14	43.34
18 Nov 22	14:45	0.00	22.37	-	14.14	43.40
18 Nov 22	14:46	0.00	22.71	-	14.13	43.37
18 Nov 22	14:47	0.00	22.50	-	14.13	43.40
18 Nov 22	14:48	0.00	22.68	-	14.12	43.31
18 Nov 22	14:49	0.00	22.67	-	14.14	43.26
18 Nov 22	14:50	0.01	22.36	-	14.14	43.28
18 Nov 22	14:51	0.09	22.63	-	14.13	43.24
18 Nov 22	14:52	0.16	22.50	-	14.14	43.22
18 Nov 22	14:53	0.19	22.14	-	14.14	43.31
18 Nov 22	14:54	0.21	22.31	-	14.13	43.35
18 Nov 22	14:55	0.13	22.40	-	14.13	43.38
18 Nov 22	14:56	0.00	22.36	-	14.12	43.37
18 Nov 22	14:57	0.00	22.27	-	14.13	43.40
18 Nov 22	14:58	0.00	22.38	-	14.12	43.37
Max		0.21	22.80	-	14.16	43.40
Avg		0.07	22.48	-	14.14	43.28

Run No: 5

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	14:59	0.00	22.32	-	14.13	43.33
18 Nov 22	15:00	0.00	22.32	-	14.14	43.46
18 Nov 22	15:01	0.00	22.57	-	14.12	43.43
18 Nov 22	15:02	0.00	22.76	-	14.13	43.37
18 Nov 22	15:03	0.05	22.72	-	14.12	43.28
18 Nov 22	15:04	0.14	22.41	-	14.14	43.34
18 Nov 22	15:05	0.17	22.35	-	14.13	43.36
18 Nov 22	15:06	0.24	22.67	-	14.12	43.31
18 Nov 22	15:07	0.22	22.58	-	14.13	43.27
18 Nov 22	15:08	0.09	22.52	-	14.13	43.24
18 Nov 22	15:09	0.00	22.57	-	14.12	43.08
18 Nov 22	15:10	0.00	22.50	-	14.13	43.05
18 Nov 22	15:11	0.00	22.32	-	14.13	42.89
18 Nov 22	15:12	0.00	22.18	-	14.13	42.90
18 Nov 22	15:13	0.00	21.32	-	14.13	43.18
18 Nov 22	15:14	0.00	21.25	-	14.12	43.42
18 Nov 22	15:15	0.01	21.56	-	14.11	43.52
18 Nov 22	15:16	0.12	21.59	-	14.09	43.47
18 Nov 22	15:17	0.18	21.66	-	14.11	43.52
18 Nov 22	15:18	0.24	21.65	-	14.11	43.55
18 Nov 22	15:19	0.23	21.66	-	14.12	43.68
Max		0.24	22.76	-	14.14	43.68
Avg		0.08	22.17	-	14.12	43.32

Run No: 6

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	15:20	0.17	21.85	-	14.11	43.75
18 Nov 22	15:21	0.02	22.13	-	14.10	43.46
18 Nov 22	15:22	0.00	21.70	-	14.11	43.99
18 Nov 22	15:23	0.00	22.45	-	14.08	43.78
18 Nov 22	15:24	0.00	21.98	-	14.09	43.63
18 Nov 22	15:25	0.00	22.15	-	14.11	43.66
18 Nov 22	15:26	0.00	21.88	-	14.12	43.80
18 Nov 22	15:27	0.00	22.27	-	14.09	43.76
18 Nov 22	15:28	0.00	22.16	-	14.11	43.87
18 Nov 22	15:29	0.05	21.91	-	14.11	43.96
18 Nov 22	15:30	0.15	22.07	-	14.09	43.99
18 Nov 22	15:31	0.23	21.78	-	14.10	44.10
18 Nov 22	15:32	0.27	22.14	-	14.08	44.05
18 Nov 22	15:33	0.26	22.32	-	14.07	43.97
18 Nov 22	15:34	0.11	21.75	-	14.10	44.05
18 Nov 22	15:35	0.01	21.66	-	14.10	44.01
18 Nov 22	15:36	0.00	21.45	-	14.11	43.99
18 Nov 22	15:37	0.00	21.43	-	14.12	43.98
18 Nov 22	15:38	0.00	21.32	-	14.12	44.14
18 Nov 22	15:39	0.00	21.65	-	14.11	44.05
18 Nov 22	15:40	0.00	21.78	-	14.12	44.04
Max		0.27	22.45	-	14.12	44.14
Avg		0.06	21.90	-	14.10	43.91



CEMs Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 18 Nov 22
Location HRSG 11

Run No: 7 Time Base : 21 min

Run No: 8 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	15:41	0.00	21.77	-	14.13	43.97
18 Nov 22	15:42	0.01	21.71	-	14.15	44.01
18 Nov 22	15:43	0.10	21.62	-	14.15	44.03
18 Nov 22	15:44	0.19	21.58	-	14.15	43.99
18 Nov 22	15:45	0.28	21.61	-	14.15	43.99
18 Nov 22	15:46	0.33	21.85	-	14.15	43.99
18 Nov 22	15:47	0.33	21.91	-	14.14	44.07
18 Nov 22	15:48	0.23	22.03	-	14.13	44.00
18 Nov 22	15:49	0.05	21.44	-	14.15	44.01
18 Nov 22	15:50	0.00	21.00	-	14.15	43.95
18 Nov 22	15:51	0.00	21.03	-	14.15	44.00
18 Nov 22	15:52	0.00	21.27	-	14.15	43.99
18 Nov 22	15:53	0.00	21.30	-	14.15	44.00
18 Nov 22	15:54	0.00	21.28	-	14.16	44.06
18 Nov 22	15:55	0.00	21.37	-	14.15	44.03
18 Nov 22	15:56	0.00	21.33	-	14.15	44.05
18 Nov 22	15:57	0.02	21.33	-	14.15	43.98
18 Nov 22	15:58	0.11	21.12	-	14.15	43.95
18 Nov 22	15:59	0.22	21.15	-	14.15	44.01
18 Nov 22	16:00	0.27	21.27	-	14.15	43.88
18 Nov 22	16:01	0.33	21.26	-	14.14	43.84
Max		0.33	22.03	-	14.16	44.07
Avg		0.12	21.44	-	14.15	43.99

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	16:02	0.32	21.37	-	14.15	43.96
18 Nov 22	16:03	0.23	21.48	-	14.15	43.89
18 Nov 22	16:04	0.03	21.61	-	14.15	43.89
18 Nov 22	16:05	0.00	21.52	-	14.15	43.86
18 Nov 22	16:06	0.00	21.49	-	14.16	43.91
18 Nov 22	16:07	0.00	21.41	-	14.16	43.87
18 Nov 22	16:08	0.00	21.60	-	14.16	43.80
18 Nov 22	16:09	0.00	21.51	-	14.16	43.95
18 Nov 22	16:10	0.00	21.75	-	14.17	43.95
18 Nov 22	16:11	0.01	21.71	-	14.17	43.96
18 Nov 22	16:12	0.03	21.87	-	14.17	43.97
18 Nov 22	16:13	0.13	21.66	-	14.17	43.90
18 Nov 22	16:14	0.22	21.65	-	14.17	43.90
18 Nov 22	16:15	0.31	21.74	-	14.16	43.90
18 Nov 22	16:16	0.39	21.74	-	14.16	43.90
18 Nov 22	16:17	0.39	21.69	-	14.17	43.89
18 Nov 22	16:18	0.32	21.75	-	14.17	43.83
18 Nov 22	16:19	0.13	21.67	-	14.17	43.88
18 Nov 22	16:20	0.02	21.86	-	14.17	43.90
18 Nov 22	16:21	0.01	21.98	-	14.17	43.90
18 Nov 22	16:22	0.01	22.18	-	14.17	43.96
Max		0.39	22.18	-	14.17	43.97
Avg		0.12	21.68	-	14.16	43.90

Run No: 9 Time Base : 21 min

Run No: 10 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	16:23	0.02	22.03	-	14.17	43.93
18 Nov 22	16:24	0.02	21.51	-	14.18	43.90
18 Nov 22	16:25	0.01	21.63	-	14.16	43.90
18 Nov 22	16:26	0.02	21.58	-	14.16	43.97
18 Nov 22	16:27	0.03	21.68	-	14.15	43.91
18 Nov 22	16:28	0.10	21.75	-	14.15	43.89
18 Nov 22	16:29	0.23	21.75	-	14.15	43.87
18 Nov 22	16:30	0.31	21.50	-	14.15	43.94
18 Nov 22	16:31	0.36	21.58	-	14.16	43.98
18 Nov 22	16:32	0.37	21.73	-	14.15	43.93
18 Nov 22	16:33	0.36	21.80	-	14.15	43.88
18 Nov 22	16:34	0.17	21.84	-	14.15	43.91
18 Nov 22	16:35	0.03	21.91	-	14.15	43.92
18 Nov 22	16:36	0.01	21.92	-	14.16	43.87
18 Nov 22	16:37	0.01	22.06	-	14.15	43.87
18 Nov 22	16:38	0.00	21.98	-	14.16	43.86
18 Nov 22	16:39	0.00	21.81	-	14.16	43.87
18 Nov 22	16:40	0.01	21.84	-	14.15	43.86
18 Nov 22	16:41	0.00	21.99	-	14.15	43.88
18 Nov 22	16:42	0.01	21.95	-	14.16	43.85
18 Nov 22	16:43	0.04	21.91	-	14.16	43.86
Max		0.37	22.06	-	14.18	43.98
Avg		0.10	21.80	-	14.16	43.90

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	16:44	0.17	21.95	-	14.16	43.84
18 Nov 22	16:45	0.28	21.84	-	14.17	43.85
18 Nov 22	16:46	0.34	21.93	-	14.16	43.79
18 Nov 22	16:47	0.38	21.73	-	14.16	43.79
18 Nov 22	16:48	0.40	21.96	-	14.16	43.74
18 Nov 22	16:49	0.29	21.81	-	14.16	43.69
18 Nov 22	16:50	0.10	21.60	-	14.16	43.72
18 Nov 22	16:51	0.02	21.66	-	14.16	43.64
18 Nov 22	16:52	0.01	21.73	-	14.15	43.71
18 Nov 22	16:53	0.01	21.66	-	14.15	43.71
18 Nov 22	16:54	0.00	21.55	-	14.15	43.68
18 Nov 22	16:55	0.02	21.48	-	14.15	43.71
18 Nov 22	16:56	0.12	21.62	-	14.15	43.76
18 Nov 22	16:57	0.23	21.53	-	14.15	43.72
18 Nov 22	16:58	0.32	21.69	-	14.15	43.69
18 Nov 22	16:59	0.37	21.53	-	14.15	43.70
18 Nov 22	17:00	0.36	21.49	-	14.15	43.59
18 Nov 22	17:01	0.33	21.57	-	14.15	43.51
18 Nov 22	17:02	0.11	21.45	-	14.15	43.52
18 Nov 22	17:03	0.01	21.50	-	14.14	43.50
18 Nov 22	17:04	0.00	21.34	-	14.13	43.33
Max		0.40	21.96	-	14.17	43.85
Avg		0.18	21.65	-	14.15	43.68

Run No: 11 Time Base : 21 min

Run No: 12 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	17:05	0.00	21.21	-	14.13	43.34
18 Nov 22	17:06	0.00	21.11	-	14.13	43.14
18 Nov 22	17:07	0.03	20.95	-	14.12	43.38
18 Nov 22	17:08	0.15	20.98	-	14.12	43.29
18 Nov 22	17:09	0.27	21.09	-	14.12	43.24
18 Nov 22	17:10	0.33	20.87	-	14.13	43.32
18 Nov 22	17:11	0.34	20.90	-	14.12	43.22
18 Nov 22	17:12	0.34	21.11	-	14.12	43.26
18 Nov 22	17:13	0.14	21.00	-	14.13	43.25
18 Nov 22	17:14	0.00	21.07	-	14.11	43.12
18 Nov 22	17:15	0.00	20.99	-	14.12	43.16
18 Nov 22	17:16	0.00	20.94	-	14.12	43.19
18 Nov 22	17:17	0.00	21.12	-	14.11	43.18
18 Nov 22	17:18	0.00	20.94	-	14.12	43.14
18 Nov 22	17:19	0.00	20.89	-	14.12	43.12
18 Nov 22	17:20	0.00	20.79	-	14.11	43.11
18 Nov 22	17:21	0.00	20.55	-	14.11	43.08
18 Nov 22	17:22	0.00	20.54	-	14.10	43.13
18 Nov 22	17:23	0.00	20.53	-	14.11	43.15
18 Nov 22	17:24	0.07	20.41	-	14.11	43.15
18 Nov 22	17:25	0.17	20.38	-	14.10	43.10
Max		0.34	21.21	-	14.13	43.38
Avg		0.09	20.87	-	14.12	43.19

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
18 Nov 22	17:26	0.29	20.54	-	14.10	43.01
18 Nov 22	17:27	0.36	20.33	-	14.09	43.05
18 Nov 22	17:28	0.40	20.17	-	14.09	43.03
18 Nov 22	17:29	0.42	20.47	-	14.09	43.02
18 Nov 22	17:30	0.30	20.23	-	14.08	43.07
18 Nov 22	17:31	0.11	20.20	-	14.08	43.01
18 Nov 22	17:32	0.03	20.23	-	14.07	42.99
18 Nov 22	17:33	0.02	20.15	-	14.07	42.98
18 Nov 22	17:34	0.03	20.24	-	14.07	42.99
18 Nov 22	17:35	0.02	19.94	-	14.08	42.99
18 Nov 22	17:36	0.02	19.79	-	14.08	43.02
18 Nov 22	17:37	0.05	19.89	-	14.07	43.23
18 Nov 22	17:38	0.04	20.07	-	14.07	43.16
18 Nov 22	17:39	0.05	20.02	-	14.07	43.14
18 Nov 22	17:40	0.06	19.96	-	14.07	43.18
18 Nov 22	17:41	0.17	20.04	-	14.07	43.17
18 Nov 22	17:42	0.29	20.08	-	14.08	43.22
18 Nov 22	17:43	0.37	19.98	-	14.08	43.27
18 Nov 22	17:44	0.42	20.09	-	14.08	43.29
18 Nov 22	17:45	0.44	20.27	-	14.07	43.28
18 Nov 22	17:46	0.39	20.36	-	14.08	43.24
Max		0.44	20.54	-	14.10	43.29
Avg		0.20	20.15	-	14.08	43.11



Reference Method Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 18 Nov 22
Location HRSG 11

Run No: 1

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	13:35	0.06	18.26	-	13.92	-
18 Nov 22	13:36	0.07	19.04	-	13.99	-
18 Nov 22	13:37	0.08	19.81	-	13.99	-
18 Nov 22	13:38	0.13	21.51	-	13.97	-
18 Nov 22	13:39	0.07	22.82	-	14.02	-
18 Nov 22	13:40	0.08	22.85	-	14.02	-
18 Nov 22	13:41	0.07	22.61	-	14.02	-
18 Nov 22	13:42	0.05	22.54	-	14.02	-
18 Nov 22	13:43	0.06	22.47	-	14.02	-
18 Nov 22	13:44	0.06	22.48	-	14.02	-
18 Nov 22	13:45	0.05	22.60	-	14.02	-
18 Nov 22	13:46	0.06	22.74	-	14.02	-
18 Nov 22	13:47	0.06	22.75	-	14.01	-
18 Nov 22	13:48	0.06	22.81	-	14.01	-
18 Nov 22	13:49	0.06	22.77	-	14.01	-
18 Nov 22	13:50	0.07	22.82	-	14.01	-
18 Nov 22	13:51	0.06	22.89	-	14.01	-
18 Nov 22	13:52	0.06	22.99	-	14.00	-
18 Nov 22	13:53	0.06	23.03	-	14.00	-
18 Nov 22	13:54	0.07	22.95	-	14.01	-
18 Nov 22	13:55	0.07	22.90	-	14.01	-
Max		0.13	23.03	-	14.02	-
Avg		0.07	22.17	-	14.00	-

Run No: 2

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	13:56	0.07	22.91	-	14.00	-
18 Nov 22	13:57	0.06	22.98	-	14.00	-
18 Nov 22	13:58	0.06	22.98	-	14.01	-
18 Nov 22	13:59	0.07	22.90	-	14.00	-
18 Nov 22	14:00	0.06	22.89	-	14.00	-
18 Nov 22	14:01	0.07	22.90	-	14.00	-
18 Nov 22	14:02	0.07	22.88	-	13.99	-
18 Nov 22	14:03	0.07	22.90	-	13.99	-
18 Nov 22	14:04	0.07	22.90	-	14.01	-
18 Nov 22	14:05	0.06	22.94	-	14.00	-
18 Nov 22	14:06	0.06	23.02	-	14.00	-
18 Nov 22	14:07	0.06	22.99	-	14.01	-
18 Nov 22	14:08	0.07	22.91	-	14.00	-
18 Nov 22	14:09	0.07	22.90	-	14.00	-
18 Nov 22	14:10	0.07	22.90	-	14.01	-
18 Nov 22	14:11	0.07	22.86	-	14.00	-
18 Nov 22	14:12	0.05	22.84	-	14.01	-
18 Nov 22	14:13	0.04	22.78	-	14.01	-
18 Nov 22	14:14	0.06	22.81	-	14.00	-
18 Nov 22	14:15	0.05	22.96	-	13.99	-
18 Nov 22	14:16	0.06	23.12	-	13.99	-
Max		0.07	23.12	-	14.01	-
Avg		0.06	22.92	-	14.00	-

Run No: 3

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	14:17	0.05	23.15	-	13.99	-
18 Nov 22	14:18	0.06	23.16	-	13.98	-
18 Nov 22	14:19	0.06	23.26	-	13.99	-
18 Nov 22	14:20	0.06	23.27	-	14.00	-
18 Nov 22	14:21	0.05	23.14	-	13.99	-
18 Nov 22	14:22	0.05	23.15	-	14.00	-
18 Nov 22	14:23	0.05	23.20	-	14.00	-
18 Nov 22	14:24	0.05	23.16	-	14.01	-
18 Nov 22	14:25	0.05	23.15	-	14.00	-
18 Nov 22	14:26	0.05	23.14	-	14.00	-
18 Nov 22	14:27	0.05	23.23	-	14.00	-
18 Nov 22	14:28	0.05	23.14	-	14.01	-
18 Nov 22	14:29	0.05	23.05	-	14.01	-
18 Nov 22	14:30	0.05	22.96	-	14.02	-
18 Nov 22	14:31	0.06	23.05	-	13.99	-
18 Nov 22	14:32	0.06	23.19	-	14.00	-
18 Nov 22	14:33	0.05	23.29	-	14.01	-
18 Nov 22	14:34	0.06	23.07	-	14.02	-
18 Nov 22	14:35	0.06	22.96	-	14.01	-
18 Nov 22	14:36	0.06	22.96	-	14.02	-
18 Nov 22	14:37	0.06	23.07	-	14.01	-
Max		0.06	23.29	-	14.02	-
Avg		0.05	23.13	-	14.00	-

Run No: 4

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	14:38	0.06	23.17	-	14.00	-
18 Nov 22	14:39	0.06	23.22	-	14.01	-
18 Nov 22	14:40	0.06	23.29	-	14.00	-
18 Nov 22	14:41	0.06	23.36	-	14.00	-
18 Nov 22	14:42	0.07	23.51	-	14.00	-
18 Nov 22	14:43	0.06	23.49	-	14.00	-
18 Nov 22	14:44	0.06	23.35	-	14.01	-
18 Nov 22	14:45	0.06	23.24	-	14.02	-
18 Nov 22	14:46	0.07	23.23	-	14.01	-
18 Nov 22	14:47	0.07	23.32	-	14.01	-
18 Nov 22	14:48	0.07	23.36	-	14.00	-
18 Nov 22	14:49	0.07	23.30	-	14.00	-
18 Nov 22	14:50	0.07	23.29	-	14.00	-
18 Nov 22	14:51	0.07	23.30	-	14.00	-
18 Nov 22	14:52	0.08	23.45	-	13.99	-
18 Nov 22	14:53	0.07	23.50	-	13.99	-
18 Nov 22	14:54	0.08	23.48	-	14.01	-
18 Nov 22	14:55	0.07	23.37	-	14.00	-
18 Nov 22	14:56	0.09	23.34	-	13.99	-
18 Nov 22	14:57	0.09	23.32	-	14.00	-
18 Nov 22	14:58	0.08	23.16	-	14.00	-
Max		0.09	23.51	-	14.02	-
Avg		0.07	23.34	-	14.00	-

Run No: 5

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	14:59	0.09	23.11	-	14.00	-
18 Nov 22	15:00	0.08	23.21	-	14.00	-
18 Nov 22	15:01	0.09	23.25	-	14.00	-
18 Nov 22	15:02	0.09	23.18	-	14.00	-
18 Nov 22	15:03	0.08	23.18	-	13.99	-
18 Nov 22	15:04	0.08	23.22	-	14.00	-
18 Nov 22	15:05	0.09	23.23	-	14.00	-
18 Nov 22	15:06	0.09	23.33	-	14.00	-
18 Nov 22	15:07	0.09	23.57	-	14.00	-
18 Nov 22	15:08	0.09	23.58	-	14.01	-
18 Nov 22	15:09	0.10	23.37	-	14.01	-
18 Nov 22	15:10	0.10	23.26	-	14.00	-
18 Nov 22	15:11	0.10	23.32	-	13.99	-
18 Nov 22	15:12	0.07	23.37	-	14.00	-
18 Nov 22	15:13	0.07	23.36	-	14.00	-
18 Nov 22	15:14	0.07	23.30	-	14.00	-
18 Nov 22	15:15	0.08	23.27	-	14.01	-
18 Nov 22	15:16	0.07	23.25	-	14.00	-
18 Nov 22	15:17	0.08	22.97	-	14.00	-
18 Nov 22	15:18	0.07	22.46	-	14.00	-
18 Nov 22	15:19	0.08	22.13	-	13.99	-
Max		0.10	23.58	-	14.01	-
Avg		0.08	23.19	-	14.00	-

Run No: 6

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	15:20	0.08	22.19	-	13.97	-
18 Nov 22	15:21	0.08	22.35	-	13.96	-
18 Nov 22	15:22	0.08	22.46	-	13.97	-
18 Nov 22	15:23	0.08	22.47	-	13.98	-
18 Nov 22	15:24	0.08	22.52	-	13.98	-
18 Nov 22	15:25	0.09	22.68	-	13.97	-
18 Nov 22	15:26	0.08	22.80	-	13.97	-
18 Nov 22	15:27	0.09	22.87	-	13.95	-
18 Nov 22	15:28	0.08	22.88	-	13.94	-
18 Nov 22	15:29	0.09	22.97	-	13.96	-
18 Nov 22	15:30	0.09	22.82	-	13.98	-
18 Nov 22	15:31	0.09	22.79	-	13.97	-
18 Nov 22	15:32	0.09	22.83	-	13.96	-
18 Nov 22	15:33	0.09	22.86	-	13.98	-
18 Nov 22	15:34	0.09	22.81	-	13.97	-
18 Nov 22	15:35	0.09	22.75	-	13.96	-
18 Nov 22	15:36	0.09	22.76	-	13.95	-
18 Nov 22	15:37	0.09	22.85	-	13.94	-
18 Nov 22	15:38	0.09	22.97	-	13.95	-
18 Nov 22	15:39	0.10	22.86	-	13.97	-
18 Nov 22	15:40	0.09	22.56	-	13.97	-
Max		0.10	22.97	-	13.98	-
Avg		0.09	22.72	-	13.96	-



Reference Method Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 18 Nov 22
Location HRSG 11

Run No: 7

Time Base : 21 min

Run No: 8

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	15:41	0.09	22.36	-	13.98	-
18 Nov 22	15:42	0.06	22.22	-	13.99	-
18 Nov 22	15:43	0.06	22.28	-	13.98	-
18 Nov 22	15:44	0.07	22.45	-	13.99	-
18 Nov 22	15:45	0.07	22.62	-	13.99	-
18 Nov 22	15:46	0.06	22.61	-	14.01	-
18 Nov 22	15:47	0.06	22.52	-	14.02	-
18 Nov 22	15:48	0.06	22.49	-	14.02	-
18 Nov 22	15:49	0.06	22.46	-	14.02	-
18 Nov 22	15:50	0.07	22.51	-	14.02	-
18 Nov 22	15:51	0.06	22.55	-	14.02	-
18 Nov 22	15:52	0.07	22.70	-	14.00	-
18 Nov 22	15:53	0.06	22.74	-	14.01	-
18 Nov 22	15:54	0.06	22.53	-	14.02	-
18 Nov 22	15:55	0.07	22.13	-	14.02	-
18 Nov 22	15:56	0.06	22.08	-	14.02	-
18 Nov 22	15:57	0.07	22.13	-	14.02	-
18 Nov 22	15:58	0.06	22.17	-	14.02	-
18 Nov 22	15:59	0.06	22.24	-	14.02	-
18 Nov 22	16:00	0.07	22.27	-	14.02	-
18 Nov 22	16:01	0.06	22.23	-	14.02	-
Max		0.09	22.74	-	14.02	-
Avg		0.06	22.40	-	14.01	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	16:02	0.07	22.14	-	14.02	-
18 Nov 22	16:03	0.06	22.13	-	14.02	-
18 Nov 22	16:04	0.06	22.12	-	14.01	-
18 Nov 22	16:05	0.06	22.08	-	14.01	-
18 Nov 22	16:06	0.06	22.04	-	14.01	-
18 Nov 22	16:07	0.07	22.10	-	14.02	-
18 Nov 22	16:08	0.06	22.27	-	14.01	-
18 Nov 22	16:09	0.05	22.37	-	14.02	-
18 Nov 22	16:10	0.06	22.38	-	14.02	-
18 Nov 22	16:11	0.06	22.36	-	14.02	-
18 Nov 22	16:12	0.05	22.40	-	14.02	-
18 Nov 22	16:13	0.05	22.42	-	14.02	-
18 Nov 22	16:14	0.05	22.45	-	14.02	-
18 Nov 22	16:15	0.05	22.55	-	14.03	-
18 Nov 22	16:16	0.05	22.59	-	14.02	-
18 Nov 22	16:17	0.04	22.60	-	14.03	-
18 Nov 22	16:18	0.05	22.58	-	14.03	-
18 Nov 22	16:19	0.05	22.54	-	14.03	-
18 Nov 22	16:20	0.05	22.52	-	14.02	-
18 Nov 22	16:21	0.05	22.59	-	14.02	-
18 Nov 22	16:22	0.05	22.61	-	14.03	-
Max		0.07	22.61	-	14.03	-
Avg		0.05	22.37	-	14.02	-

Run No: 9

Time Base : 21 min

Run No: 10

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	16:23	0.05	22.60	-	14.03	-
18 Nov 22	16:24	0.05	22.61	-	14.03	-
18 Nov 22	16:25	0.05	22.74	-	14.03	-
18 Nov 22	16:26	0.05	22.92	-	14.03	-
18 Nov 22	16:27	0.05	23.02	-	14.02	-
18 Nov 22	16:28	0.05	22.83	-	14.03	-
18 Nov 22	16:29	0.05	22.61	-	14.02	-
18 Nov 22	16:30	0.05	22.48	-	14.02	-
18 Nov 22	16:31	0.05	22.53	-	14.02	-
18 Nov 22	16:32	0.05	22.51	-	14.02	-
18 Nov 22	16:33	0.05	22.48	-	14.01	-
18 Nov 22	16:34	0.04	22.52	-	14.01	-
18 Nov 22	16:35	0.05	22.54	-	14.01	-
18 Nov 22	16:36	0.04	22.56	-	14.01	-
18 Nov 22	16:37	0.04	22.65	-	14.01	-
18 Nov 22	16:38	0.05	22.68	-	14.01	-
18 Nov 22	16:39	0.05	22.68	-	14.01	-
18 Nov 22	16:40	0.05	22.79	-	14.02	-
18 Nov 22	16:41	0.04	22.79	-	14.02	-
18 Nov 22	16:42	0.05	22.87	-	14.01	-
18 Nov 22	16:43	0.05	22.84	-	14.02	-
Max		0.05	23.02	-	14.03	-
Avg		0.05	22.68	-	14.02	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	16:44	0.05	22.76	-	14.02	-
18 Nov 22	16:45	0.05	22.72	-	14.01	-
18 Nov 22	16:46	0.05	22.78	-	14.02	-
18 Nov 22	16:47	0.05	22.83	-	14.02	-
18 Nov 22	16:48	0.04	22.81	-	14.02	-
18 Nov 22	16:49	0.05	22.84	-	14.02	-
18 Nov 22	16:50	0.05	22.83	-	14.02	-
18 Nov 22	16:51	0.05	22.81	-	14.02	-
18 Nov 22	16:52	0.05	22.76	-	14.02	-
18 Nov 22	16:53	0.05	22.73	-	14.02	-
18 Nov 22	16:54	0.05	22.74	-	14.02	-
18 Nov 22	16:55	0.04	22.68	-	14.02	-
18 Nov 22	16:56	0.05	22.67	-	14.02	-
18 Nov 22	16:57	0.05	22.67	-	14.02	-
18 Nov 22	16:58	0.05	22.72	-	14.02	-
18 Nov 22	16:59	0.05	22.62	-	14.01	-
18 Nov 22	17:00	0.05	22.51	-	14.01	-
18 Nov 22	17:01	0.05	22.48	-	14.01	-
18 Nov 22	17:02	0.05	22.52	-	14.01	-
18 Nov 22	17:03	0.05	22.50	-	14.01	-
18 Nov 22	17:04	0.05	22.50	-	14.00	-
Max		0.05	22.84	-	14.02	-
Avg		0.05	22.69	-	14.01	-

Run No: 11

Time Base : 21 min

Run No: 12

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	17:05	0.05	22.47	-	14.01	-
18 Nov 22	17:06	0.05	22.49	-	14.01	-
18 Nov 22	17:07	0.05	22.46	-	14.01	-
18 Nov 22	17:08	0.05	22.40	-	14.01	-
18 Nov 22	17:09	0.04	22.30	-	14.00	-
18 Nov 22	17:10	0.05	22.07	-	13.99	-
18 Nov 22	17:11	0.05	22.00	-	13.99	-
18 Nov 22	17:12	0.05	21.92	-	13.98	-
18 Nov 22	17:13	0.05	21.93	-	13.98	-
18 Nov 22	17:14	0.05	21.94	-	13.98	-
18 Nov 22	17:15	0.05	21.87	-	13.99	-
18 Nov 22	17:16	0.05	21.82	-	13.98	-
18 Nov 22	17:17	0.05	21.85	-	13.99	-
18 Nov 22	17:18	0.05	21.93	-	13.98	-
18 Nov 22	17:19	0.06	21.95	-	13.98	-
18 Nov 22	17:20	0.06	21.87	-	13.98	-
18 Nov 22	17:21	0.05	21.85	-	13.98	-
18 Nov 22	17:22	0.05	21.87	-	13.98	-
18 Nov 22	17:23	0.05	21.84	-	13.98	-
18 Nov 22	17:24	0.04	21.79	-	13.98	-
18 Nov 22	17:25	0.05	21.70	-	13.98	-
Max		0.06	22.49	-	14.01	-
Avg		0.05	22.02	-	13.98	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
18 Nov 22	17:26	0.05	21.62	-	13.97	-
18 Nov 22	17:27	0.05	21.50	-	13.96	-
18 Nov 22	17:28	0.05	21.43	-	13.97	-
18 Nov 22	17:29	0.05	21.38	-	13.97	-
18 Nov 22	17:30	0.05	21.32	-	13.96	-
18 Nov 22	17:31	0.05	21.29	-	13.96	-
18 Nov 22	17:32	0.05	21.22	-	13.96	-
18 Nov 22	17:33	0.05	21.13	-	13.95	-
18 Nov 22	17:34	0.05	21.12	-	13.94	-
18 Nov 22	17:35	0.05	21.14	-	13.95	-
18 Nov 22	17:36	0.04	21.12	-	13.94	-
18 Nov 22	17:37	0.05	21.01	-	13.94	-
18 Nov 22	17:38	0.05	20.95	-	13.94	-
18 Nov 22	17:39	0.05	20.94	-	13.93	-
18 Nov 22	17:40	0.05	20.87	-	13.94	-
18 Nov 22	17:41	0.05	20.82	-	13.93	-
18 Nov 22	17:42	0.04	20.84	-	13.94	-
18 Nov 22	17:43	0.04	20.88	-	13.94	-
18 Nov 22	17:44	0.05	20.87	-	13.93	-
18 Nov 22	17:45	0.04	20.83	-	13.93	-
18 Nov 22	17:46	0.05	20.84	-	13.93	-
Max		0.05	21.62	-	13.97	-
Avg		0.05	21.10	-	13.94	-



Lot No. 22119272-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ 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	8.02	8.02	8.04	0.08
Span Gas	16.02	16.03	16.06	0.12

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	0.01	0.01
Low-Level Gas	54.64	54.63	54.60	0.03
Span Gas	81.85	81.82	81.76	0.06

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	54.34	54.30	54.27	0.03
Span Gas	79.92	79.90	79.88	0.02

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group



Lot No. 22119272-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.01	0.04	0.00	0.00	0.04
Upscale Gas	16.03	16.09	0.24	16.11	0.32	0.08

NO_x ANALYZER

Cylinder Conc. (ppm) : 81.85 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	0.01	0.01	0.02	0.02	0.01
Upscale Gas	81.82	81.78	0.04	81.80	0.02	0.02

SO₂ ANALYZER

Cylinder Conc. (ppm) : 79.92 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	79.90	79.83	0.07	79.78	0.12	0.05

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group



CEMs Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 17 Nov 22
Location HRSG 12

Run No: 1

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	15:00	0.00	15.62	-	14.10	43.67
17 Nov 22	15:01	0.00	15.82	-	14.10	43.56
17 Nov 22	15:02	0.00	15.58	-	14.11	43.54
17 Nov 22	15:03	0.00	15.62	-	14.10	43.44
17 Nov 22	15:04	0.00	15.68	-	14.12	43.38
17 Nov 22	15:05	0.01	15.62	-	14.12	43.41
17 Nov 22	15:06	0.00	15.59	-	14.11	43.42
17 Nov 22	15:07	0.00	15.24	-	14.10	43.53
17 Nov 22	15:08	0.00	15.15	-	14.09	43.50
17 Nov 22	15:09	0.00	15.10	-	14.08	43.45
17 Nov 22	15:10	0.00	15.16	-	14.06	43.29
17 Nov 22	15:11	0.00	15.08	-	14.07	43.15
17 Nov 22	15:12	0.00	14.89	-	14.09	43.19
17 Nov 22	15:13	0.00	14.83	-	14.09	43.26
17 Nov 22	15:14	0.00	14.88	-	14.07	43.24
17 Nov 22	15:15	0.00	14.77	-	14.07	43.21
17 Nov 22	15:16	0.00	14.94	-	14.10	43.29
17 Nov 22	15:17	0.00	14.95	-	14.10	43.41
17 Nov 22	15:18	0.00	15.10	-	14.09	43.41
17 Nov 22	15:19	0.00	15.05	-	14.10	43.47
17 Nov 22	15:20	0.00	15.00	-	14.08	43.54
Max		0.01	15.82	-	14.12	43.67
Avg		0.00	15.22	-	14.09	43.40

Run No: 2

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	15:21	0.00	14.87	-	14.09	43.56
17 Nov 22	15:22	0.00	15.15	-	14.07	43.44
17 Nov 22	15:23	0.00	15.19	-	14.07	43.36
17 Nov 22	15:24	0.00	15.15	-	14.08	43.28
17 Nov 22	15:25	0.00	15.21	-	14.11	43.36
17 Nov 22	15:26	0.00	15.02	-	14.11	43.52
17 Nov 22	15:27	0.00	15.00	-	14.09	43.61
17 Nov 22	15:28	0.00	15.22	-	14.08	43.56
17 Nov 22	15:29	0.00	15.27	-	14.10	43.55
17 Nov 22	15:30	0.00	15.26	-	14.10	43.59
17 Nov 22	15:31	0.00	15.23	-	14.10	43.68
17 Nov 22	15:32	0.00	15.34	-	14.08	43.59
17 Nov 22	15:33	0.00	15.48	-	14.10	43.58
17 Nov 22	15:34	0.00	15.29	-	14.10	43.63
17 Nov 22	15:35	0.00	15.35	-	14.09	43.59
17 Nov 22	15:36	0.00	15.44	-	14.08	43.48
17 Nov 22	15:37	0.00	15.35	-	14.10	43.50
17 Nov 22	15:38	0.00	15.35	-	14.10	43.53
17 Nov 22	15:39	0.00	15.34	-	14.10	43.56
17 Nov 22	15:40	0.00	15.18	-	14.10	43.67
17 Nov 22	15:41	0.00	15.15	-	14.09	43.69
Max		0.00	15.48	-	14.11	43.69
Avg		0.00	15.23	-	14.09	43.54

Run No: 3

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	15:42	0.00	15.50	-	14.08	43.55
17 Nov 22	15:43	0.00	15.47	-	14.09	43.53
17 Nov 22	15:44	0.00	15.58	-	14.09	43.46
17 Nov 22	15:45	0.00	15.63	-	14.09	43.45
17 Nov 22	15:46	0.00	15.27	-	14.10	43.52
17 Nov 22	15:47	0.00	15.05	-	14.10	43.63
17 Nov 22	15:48	0.00	15.26	-	14.09	43.59
17 Nov 22	15:49	0.00	15.27	-	14.10	43.68
17 Nov 22	15:50	0.00	15.29	-	14.09	43.70
17 Nov 22	15:51	0.00	15.29	-	14.07	43.62
17 Nov 22	15:52	0.00	15.53	-	14.08	43.51
17 Nov 22	15:53	0.00	15.56	-	14.08	43.45
17 Nov 22	15:54	0.00	15.40	-	14.09	43.42
17 Nov 22	15:55	0.00	15.39	-	14.11	43.56
17 Nov 22	15:56	0.00	15.29	-	14.10	43.59
17 Nov 22	15:57	0.00	15.45	-	14.09	43.57
17 Nov 22	15:58	0.00	15.25	-	14.09	43.55
17 Nov 22	15:59	0.00	15.28	-	14.08	43.55
17 Nov 22	16:00	0.00	15.30	-	14.09	43.60
17 Nov 22	16:01	0.00	14.92	-	14.07	43.66
17 Nov 22	16:02	0.00	14.95	-	14.07	43.73
Max		0.00	15.63	-	14.11	43.73
Avg		0.00	15.33	-	14.09	43.57

Run No: 4

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	16:03	0.00	14.62	-	14.05	43.83
17 Nov 22	16:04	0.00	14.69	-	14.05	43.83
17 Nov 22	16:05	0.00	14.50	-	14.03	43.85
17 Nov 22	16:06	0.00	14.48	-	14.03	43.85
17 Nov 22	16:07	0.00	14.27	-	14.06	44.06
17 Nov 22	16:08	0.00	14.54	-	14.03	43.99
17 Nov 22	16:09	0.00	14.68	-	14.06	44.08
17 Nov 22	16:10	0.00	14.69	-	14.04	44.04
17 Nov 22	16:11	0.00	14.73	-	14.02	44.00
17 Nov 22	16:12	0.00	14.55	-	14.07	44.24
17 Nov 22	16:13	0.00	14.60	-	14.05	44.30
17 Nov 22	16:14	0.00	14.79	-	14.02	44.23
17 Nov 22	16:15	0.00	14.62	-	14.05	44.31
17 Nov 22	16:16	0.00	14.61	-	14.04	44.31
17 Nov 22	16:17	0.00	14.72	-	14.04	44.29
17 Nov 22	16:18	0.00	14.61	-	14.02	44.27
17 Nov 22	16:19	0.00	14.52	-	14.04	44.26
17 Nov 22	16:20	0.00	14.49	-	14.02	44.28
17 Nov 22	16:21	0.00	14.71	-	14.02	44.24
17 Nov 22	16:22	0.00	14.68	-	14.02	44.23
17 Nov 22	16:23	0.00	14.71	-	14.03	44.29
Max		0.00	14.79	-	14.07	44.31
Avg		0.00	14.61	-	14.04	44.13

Run No: 5

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	16:24	0.00	14.60	-	14.04	44.37
17 Nov 22	16:25	0.00	14.85	-	14.00	44.26
17 Nov 22	16:26	0.00	14.69	-	14.02	44.26
17 Nov 22	16:27	0.00	14.41	-	14.03	44.36
17 Nov 22	16:28	0.00	14.58	-	14.05	44.47
17 Nov 22	16:29	0.00	14.85	-	14.05	44.56
17 Nov 22	16:30	0.00	15.02	-	14.03	44.51
17 Nov 22	16:31	0.00	15.06	-	14.03	44.42
17 Nov 22	16:32	0.00	14.94	-	14.04	44.37
17 Nov 22	16:33	0.00	14.85	-	14.02	44.35
17 Nov 22	16:34	0.00	14.73	-	14.04	44.36
17 Nov 22	16:35	0.00	15.04	-	14.02	44.29
17 Nov 22	16:36	0.00	14.99	-	14.03	44.29
17 Nov 22	16:37	0.00	14.52	-	14.02	44.35
17 Nov 22	16:38	0.00	14.49	-	14.02	44.37
17 Nov 22	16:39	0.00	14.50	-	14.01	44.35
17 Nov 22	16:40	0.00	14.39	-	14.03	44.44
17 Nov 22	16:41	0.00	14.56	-	14.03	44.48
17 Nov 22	16:42	0.00	14.58	-	14.03	44.50
17 Nov 22	16:43	0.00	14.71	-	14.02	44.44
17 Nov 22	16:44	0.00	14.94	-	14.03	44.37
Max		0.00	15.06	-	14.05	44.56
Avg		0.00	14.73	-	14.03	44.39

Run No: 6

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	16:45	0.00	14.76	-	14.03	44.43
17 Nov 22	16:46	0.00	14.82	-	14.03	44.46
17 Nov 22	16:47	0.00	14.94	-	14.02	44.41
17 Nov 22	16:48	0.00	14.86	-	14.03	44.38
17 Nov 22	16:49	0.00	14.57	-	14.02	44.42
17 Nov 22	16:50	0.00	14.58	-	14.03	44.44
17 Nov 22	16:51	0.00	14.62	-	14.02	44.43
17 Nov 22	16:52	0.00	14.68	-	14.02	44.43
17 Nov 22	16:53	0.00	14.58	-	14.04	44.49
17 Nov 22	16:54	0.00	14.60	-	14.04	44.67
17 Nov 22	16:55	0.00	14.79	-	14.03	44.72
17 Nov 22	16:56	0.00	14.77	-	14.03	44.66
17 Nov 22	16:57	0.00	14.91	-	14.03	44.63
17 Nov 22	16:58	0.00	14.86	-	14.04	44.53
17 Nov 22	16:59	0.00	14.80	-	14.06	43.99
17 Nov 22	17:00	0.00	14.26	-	14.08	43.96
17 Nov 22	17:01	0.00	13.95	-	14.08	44.10
17 Nov 22	17:02	0.00	13.83	-	14.08	44.13
17 Nov 22	17:03	0.00	13.84	-	14.07	44.07
17 Nov 22	17:04	0.00	13.93	-	14.07	44.01
17 Nov 22	17:05	0.00	13.81	-	14.06	43.95
Max		0.00	14.94	-	14.08	44.72
Avg		0.00	14.51	-	14.04	44.35



CEMs Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 17 Nov 22
Location HRSG 12

Run No: 7 Time Base : 21 min

Run No: 8 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	17:06	0.00	13.73	-	14.06	43.92
17 Nov 22	17:07	0.00	13.65	-	14.07	44.09
17 Nov 22	17:08	0.00	13.66	-	14.07	44.02
17 Nov 22	17:09	0.00	13.89	-	14.06	43.96
17 Nov 22	17:10	0.00	13.82	-	14.06	44.00
17 Nov 22	17:11	0.00	13.70	-	14.07	43.98
17 Nov 22	17:12	0.00	13.90	-	14.07	44.03
17 Nov 22	17:13	0.00	13.96	-	14.06	43.98
17 Nov 22	17:14	0.00	13.97	-	14.06	43.93
17 Nov 22	17:15	0.00	13.95	-	14.06	44.00
17 Nov 22	17:16	0.00	13.82	-	14.06	44.02
17 Nov 22	17:17	0.00	13.75	-	14.06	44.02
17 Nov 22	17:18	0.00	13.75	-	14.05	43.97
17 Nov 22	17:19	0.00	13.76	-	14.05	43.94
17 Nov 22	17:20	0.00	13.73	-	14.05	43.97
17 Nov 22	17:21	0.00	13.70	-	14.06	43.90
17 Nov 22	17:22	0.00	13.89	-	14.04	43.94
17 Nov 22	17:23	0.00	13.93	-	14.04	43.98
17 Nov 22	17:24	0.00	13.91	-	14.04	43.96
17 Nov 22	17:25	0.01	13.99	-	14.03	43.87
17 Nov 22	17:26	0.00	13.97	-	14.03	43.83
Max		0.01	13.99	-	14.07	44.09
Avg		0.00	13.83	-	14.05	43.97

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	17:27	0.00	13.94	-	14.04	43.79
17 Nov 22	17:28	0.00	13.99	-	14.02	43.74
17 Nov 22	17:29	0.00	14.03	-	14.03	43.66
17 Nov 22	17:30	0.00	13.86	-	14.03	43.68
17 Nov 22	17:31	0.00	13.72	-	14.03	43.68
17 Nov 22	17:32	0.00	13.92	-	14.02	43.65
17 Nov 22	17:33	0.00	13.96	-	14.03	43.60
17 Nov 22	17:34	0.00	13.98	-	14.03	43.61
17 Nov 22	17:35	0.00	13.86	-	14.02	43.59
17 Nov 22	17:36	0.00	13.90	-	14.02	43.57
17 Nov 22	17:37	0.00	13.91	-	14.03	43.70
17 Nov 22	17:38	0.05	13.82	-	14.03	43.68
17 Nov 22	17:39	0.10	13.98	-	14.02	43.75
17 Nov 22	17:40	0.14	13.96	-	14.03	43.80
17 Nov 22	17:41	0.11	13.86	-	14.02	43.75
17 Nov 22	17:42	0.00	13.82	-	14.02	43.82
17 Nov 22	17:43	0.00	13.77	-	14.01	43.78
17 Nov 22	17:44	0.00	13.81	-	14.02	43.78
17 Nov 22	17:45	0.00	13.80	-	14.02	43.71
17 Nov 22	17:46	0.00	13.89	-	14.01	43.63
17 Nov 22	17:47	0.00	13.80	-	14.02	43.63
Max		0.14	14.03	-	14.04	43.82
Avg		0.02	13.88	-	14.02	43.70

Run No: 9 Time Base : 21 min

Run No: 10 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	17:48	0.00	13.81	-	14.01	43.51
17 Nov 22	17:49	0.00	13.86	-	14.01	43.53
17 Nov 22	17:50	0.00	13.78	-	14.01	43.53
17 Nov 22	17:51	0.04	13.90	-	14.01	43.42
17 Nov 22	17:52	0.14	13.86	-	14.01	43.52
17 Nov 22	17:53	0.17	13.98	-	14.01	43.51
17 Nov 22	17:54	0.14	13.85	-	14.02	43.55
17 Nov 22	17:55	0.03	13.86	-	14.01	43.57
17 Nov 22	17:56	0.00	13.86	-	14.01	43.48
17 Nov 22	17:57	0.00	13.73	-	14.02	43.50
17 Nov 22	17:58	0.00	13.68	-	14.01	43.47
17 Nov 22	17:59	0.00	13.69	-	14.01	43.49
17 Nov 22	18:00	0.00	13.63	-	14.01	43.50
17 Nov 22	18:01	0.00	13.77	-	14.01	43.50
17 Nov 22	18:02	0.00	13.75	-	14.02	43.55
17 Nov 22	18:03	0.00	13.74	-	14.01	43.46
17 Nov 22	18:04	0.00	13.82	-	14.01	43.47
17 Nov 22	18:05	0.00	13.85	-	14.02	43.47
17 Nov 22	18:06	0.02	13.89	-	14.01	43.44
17 Nov 22	18:07	0.09	13.79	-	14.02	43.51
17 Nov 22	18:08	0.13	13.79	-	14.01	43.45
Max		0.17	13.98	-	14.02	43.57
Avg		0.04	13.80	-	14.01	43.50

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	18:09	0.15	13.99	-	14.00	43.41
17 Nov 22	18:10	0.07	13.92	-	14.01	43.48
17 Nov 22	18:11	0.00	13.71	-	14.01	43.52
17 Nov 22	18:12	0.00	13.79	-	14.00	43.42
17 Nov 22	18:13	0.00	13.78	-	14.00	43.39
17 Nov 22	18:14	0.00	13.83	-	14.00	43.39
17 Nov 22	18:15	0.00	13.77	-	14.00	43.41
17 Nov 22	18:16	0.00	13.80	-	14.00	43.41
17 Nov 22	18:17	0.00	13.84	-	14.00	43.46
17 Nov 22	18:18	0.00	13.64	-	14.01	43.47
17 Nov 22	18:19	0.00	13.93	-	14.00	43.48
17 Nov 22	18:20	0.00	14.05	-	14.01	43.46
17 Nov 22	18:21	0.09	13.98	-	14.01	43.58
17 Nov 22	18:22	0.15	13.98	-	14.01	43.50
17 Nov 22	18:23	0.20	14.05	-	14.01	43.46
17 Nov 22	18:24	0.18	14.06	-	14.01	43.59
17 Nov 22	18:25	0.04	13.93	-	14.00	43.57
17 Nov 22	18:26	0.00	13.76	-	14.00	43.57
17 Nov 22	18:27	0.00	13.71	-	14.00	43.53
17 Nov 22	18:28	0.00	13.72	-	14.00	43.45
17 Nov 22	18:29	0.00	13.79	-	14.00	43.39
Max		0.20	14.06	-	14.01	43.59
Avg		0.04	13.86	-	14.00	43.47

Run No: 11 Time Base : 21 min

Run No: 12 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	18:30	0.00	13.77	-	14.00	43.41
17 Nov 22	18:31	0.00	13.70	-	14.00	43.46
17 Nov 22	18:32	0.00	13.69	-	14.00	43.43
17 Nov 22	18:33	0.00	13.80	-	14.00	43.40
17 Nov 22	18:34	0.00	13.76	-	14.00	43.41
17 Nov 22	18:35	0.00	13.84	-	14.00	43.44
17 Nov 22	18:36	0.04	13.84	-	14.00	43.43
17 Nov 22	18:37	0.12	14.07	-	14.00	43.44
17 Nov 22	18:38	0.14	13.91	-	14.01	43.52
17 Nov 22	18:39	0.15	13.99	-	14.00	43.49
17 Nov 22	18:40	0.03	13.94	-	14.00	43.45
17 Nov 22	18:41	0.00	13.87	-	14.00	43.51
17 Nov 22	18:42	0.00	13.81	-	13.99	43.49
17 Nov 22	18:43	0.00	13.77	-	14.01	43.47
17 Nov 22	18:44	0.00	13.97	-	14.00	43.43
17 Nov 22	18:45	0.00	13.87	-	14.00	43.33
17 Nov 22	18:46	0.00	13.86	-	14.00	43.35
17 Nov 22	18:47	0.00	13.87	-	14.00	43.42
17 Nov 22	18:48	0.00	13.80	-	14.00	43.33
17 Nov 22	18:49	0.00	13.76	-	14.00	43.34
17 Nov 22	18:50	0.00	13.81	-	14.01	43.37
Max		0.15	14.07	-	14.01	43.52
Avg		0.02	13.84	-	14.00	43.42

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
17 Nov 22	18:51	0.01	13.92	-	14.01	43.44
17 Nov 22	18:52	0.10	13.96	-	14.00	43.34
17 Nov 22	18:53	0.14	14.00	-	14.01	43.36
17 Nov 22	18:54	0.15	13.83	-	14.01	43.37
17 Nov 22	18:55	0.12	13.92	-	14.00	43.34
17 Nov 22	18:56	0.00	13.78	-	14.01	43.43
17 Nov 22	18:57	0.00	13.79	-	14.00	43.33
17 Nov 22	18:58	0.00	13.90	-	14.00	43.27
17 Nov 22	18:59	0.00	13.68	-	14.01	43.28
17 Nov 22	19:00	0.00	13.79	-	14.01	43.27
17 Nov 22	19:01	0.00	13.82	-	14.00	43.28
17 Nov 22	19:02	0.00	13.73	-	14.01	43.33
17 Nov 22	19:03	0.00	13.68	-	14.01	43.36
17 Nov 22	19:04	0.00	13.80	-	14.00	43.33
17 Nov 22	19:05	0.00	13.77	-	14.01	43.32
17 Nov 22	19:06	0.00	13.82	-	14.00	43.31
17 Nov 22	19:07	0.03	13.78	-	14.01	43.33
17 Nov 22	19:08	0.09	13.81	-	14.01	43.28
17 Nov 22	19:09	0.11	13.90	-	14.01	43.24
17 Nov 22	19:10	0.11	13.82	-	14.01	43.25
17 Nov 22	19:11	0.02	13.84	-	14.01	43.31
Max		0.15	14.00	-	14.01	43.44
Avg		0.04	13.83	-	14.01	43.32



Reference Method Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 17 Nov 22
Location HRSG 12

Run No: 1

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	15:00	0.05	16.46	-	13.98	-
17 Nov 22	15:01	0.05	16.64	-	13.97	-
17 Nov 22	15:02	0.05	16.76	-	13.97	-
17 Nov 22	15:03	0.05	16.82	-	13.98	-
17 Nov 22	15:04	0.06	16.81	-	13.99	-
17 Nov 22	15:05	0.06	16.84	-	13.97	-
17 Nov 22	15:06	0.06	16.89	-	13.99	-
17 Nov 22	15:07	0.03	16.91	-	13.98	-
17 Nov 22	15:08	0.03	16.90	-	13.99	-
17 Nov 22	15:09	0.03	16.95	-	13.99	-
17 Nov 22	15:10	0.03	16.93	-	14.00	-
17 Nov 22	15:11	0.03	16.75	-	13.98	-
17 Nov 22	15:12	0.02	16.50	-	13.97	-
17 Nov 22	15:13	0.02	16.36	-	13.96	-
17 Nov 22	15:14	0.02	16.38	-	13.95	-
17 Nov 22	15:15	0.02	16.44	-	13.94	-
17 Nov 22	15:16	0.02	16.44	-	13.97	-
17 Nov 22	15:17	0.01	16.32	-	13.98	-
17 Nov 22	15:18	0.01	16.16	-	13.96	-
17 Nov 22	15:19	0.02	16.09	-	13.95	-
17 Nov 22	15:20	0.02	16.11	-	13.97	-
Max		0.06	16.95	-	14.00	-
Avg		0.03	16.59	-	13.97	-

Run No: 2

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	15:21	0.02	16.17	-	13.98	-
17 Nov 22	15:22	0.01	16.22	-	13.98	-
17 Nov 22	15:23	0.02	16.29	-	13.98	-
17 Nov 22	15:24	0.01	16.34	-	13.98	-
17 Nov 22	15:25	0.01	16.40	-	13.97	-
17 Nov 22	15:26	0.02	16.45	-	13.96	-
17 Nov 22	15:27	0.02	16.52	-	13.96	-
17 Nov 22	15:28	0.01	16.52	-	13.96	-
17 Nov 22	15:29	0.01	16.54	-	13.97	-
17 Nov 22	15:30	0.01	16.38	-	13.99	-
17 Nov 22	15:31	0.01	16.30	-	13.98	-
17 Nov 22	15:32	0.01	16.33	-	13.97	-
17 Nov 22	15:33	0.01	16.53	-	13.97	-
17 Nov 22	15:34	0.01	16.60	-	13.98	-
17 Nov 22	15:35	0.02	16.55	-	13.99	-
17 Nov 22	15:36	0.01	16.57	-	13.97	-
17 Nov 22	15:37	0.01	16.69	-	13.97	-
17 Nov 22	15:38	0.01	16.69	-	13.98	-
17 Nov 22	15:39	0.02	16.62	-	13.98	-
17 Nov 22	15:40	0.01	16.58	-	13.96	-
17 Nov 22	15:41	0.01	16.63	-	13.98	-
Max		0.02	16.69	-	13.99	-
Avg		0.01	16.47	-	13.97	-

Run No: 3

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	15:42	0.02	16.63	-	13.98	-
17 Nov 22	15:43	0.02	16.61	-	13.98	-
17 Nov 22	15:44	0.03	16.60	-	13.98	-
17 Nov 22	15:45	0.03	16.53	-	13.98	-
17 Nov 22	15:46	0.02	16.59	-	13.96	-
17 Nov 22	15:47	0.02	16.64	-	13.97	-
17 Nov 22	15:48	0.02	16.66	-	13.97	-
17 Nov 22	15:49	0.02	16.68	-	13.97	-
17 Nov 22	15:50	0.02	16.66	-	13.98	-
17 Nov 22	15:51	0.02	16.54	-	13.99	-
17 Nov 22	15:52	0.03	16.43	-	13.98	-
17 Nov 22	15:53	0.02	16.46	-	13.98	-
17 Nov 22	15:54	0.02	16.49	-	13.98	-
17 Nov 22	15:55	0.03	16.45	-	13.96	-
17 Nov 22	15:56	0.02	16.55	-	13.96	-
17 Nov 22	15:57	0.03	16.66	-	13.96	-
17 Nov 22	15:58	0.03	16.68	-	13.97	-
17 Nov 22	15:59	0.03	16.64	-	13.99	-
17 Nov 22	16:00	0.02	16.63	-	14.00	-
17 Nov 22	16:01	0.03	16.67	-	13.98	-
17 Nov 22	16:02	0.04	16.69	-	13.98	-
Max		0.04	16.69	-	14.00	-
Avg		0.02	16.59	-	13.98	-

Run No: 4

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	16:03	0.03	16.65	-	13.98	-
17 Nov 22	16:04	0.04	16.61	-	13.98	-
17 Nov 22	16:05	0.04	16.51	-	13.98	-
17 Nov 22	16:06	0.03	16.25	-	13.96	-
17 Nov 22	16:07	0.03	16.03	-	13.95	-
17 Nov 22	16:08	0.04	15.90	-	13.95	-
17 Nov 22	16:09	0.04	15.84	-	13.94	-
17 Nov 22	16:10	0.04	15.87	-	13.93	-
17 Nov 22	16:11	0.04	15.70	-	13.96	-
17 Nov 22	16:12	0.04	15.68	-	13.94	-
17 Nov 22	16:13	0.04	15.81	-	13.95	-
17 Nov 22	16:14	0.04	15.93	-	13.96	-
17 Nov 22	16:15	0.05	15.92	-	13.93	-
17 Nov 22	16:16	0.05	15.91	-	13.95	-
17 Nov 22	16:17	0.05	15.86	-	13.96	-
17 Nov 22	16:18	0.05	15.88	-	13.93	-
17 Nov 22	16:19	0.06	15.96	-	13.95	-
17 Nov 22	16:20	0.06	15.96	-	13.94	-
17 Nov 22	16:21	0.06	15.99	-	13.94	-
17 Nov 22	16:22	0.06	16.00	-	13.93	-
17 Nov 22	16:23	0.06	15.94	-	13.92	-
Max		0.06	16.65	-	13.98	-
Avg		0.05	16.01	-	13.95	-

Run No: 5

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	16:24	0.06	15.83	-	13.93	-
17 Nov 22	16:25	0.06	15.80	-	13.91	-
17 Nov 22	16:26	0.06	15.83	-	13.91	-
17 Nov 22	16:27	0.06	15.84	-	13.92	-
17 Nov 22	16:28	0.06	15.78	-	13.93	-
17 Nov 22	16:29	0.07	15.79	-	13.91	-
17 Nov 22	16:30	0.06	15.84	-	13.91	-
17 Nov 22	16:31	0.06	15.83	-	13.91	-
17 Nov 22	16:32	0.07	15.76	-	13.93	-
17 Nov 22	16:33	0.07	15.85	-	13.95	-
17 Nov 22	16:34	0.07	16.11	-	13.93	-
17 Nov 22	16:35	0.07	16.26	-	13.93	-
17 Nov 22	16:36	0.07	16.34	-	13.93	-
17 Nov 22	16:37	0.07	16.26	-	13.92	-
17 Nov 22	16:38	0.07	16.11	-	13.92	-
17 Nov 22	16:39	0.07	16.08	-	13.92	-
17 Nov 22	16:40	0.08	16.10	-	13.91	-
17 Nov 22	16:41	0.06	16.05	-	13.93	-
17 Nov 22	16:42	0.05	15.85	-	13.91	-
17 Nov 22	16:43	0.05	15.69	-	13.91	-
17 Nov 22	16:44	0.05	15.62	-	13.91	-
Max		0.08	16.34	-	13.95	-
Avg		0.06	15.93	-	13.92	-

Run No: 6

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	16:45	0.05	15.66	-	13.92	-
17 Nov 22	16:46	0.05	15.73	-	13.93	-
17 Nov 22	16:47	0.05	15.91	-	13.92	-
17 Nov 22	16:48	0.05	16.05	-	13.92	-
17 Nov 22	16:49	0.05	16.08	-	13.93	-
17 Nov 22	16:50	0.05	15.97	-	13.92	-
17 Nov 22	16:51	0.05	15.97	-	13.92	-
17 Nov 22	16:52	0.05	16.06	-	13.92	-
17 Nov 22	16:53	0.05	16.02	-	13.91	-
17 Nov 22	16:54	0.06	15.82	-	13.91	-
17 Nov 22	16:55	0.05	15.77	-	13.93	-
17 Nov 22	16:56	0.05	15.88	-	13.92	-
17 Nov 22	16:57	0.05	15.94	-	13.93	-
17 Nov 22	16:58	0.05	15.96	-	13.94	-
17 Nov 22	16:59	0.06	15.96	-	13.93	-
17 Nov 22	17:00	0.05	16.04	-	13.93	-
17 Nov 22	17:01	0.04	16.15	-	13.92	-
17 Nov 22	17:02	0.05	16.13	-	13.93	-
17 Nov 22	17:03	0.05	16.06	-	13.94	-
17 Nov 22	17:04	0.05	15.78	-	13.96	-
17 Nov 22	17:05	0.05	15.41	-	13.97	-
Max		0.06	16.15	-	13.97	-
Avg		0.05	15.92	-	13.93	-



Reference Method Data

Client Name Gulf BP Co.,Ltd.
Plant Name GBP

Date 17 Nov 22
Location HRSG 12

Run No: 7

Time Base : 21 min

Run No: 8

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	17:06	0.05	15.14	-	13.98	-
17 Nov 22	17:07	0.05	15.07	-	13.97	-
17 Nov 22	17:08	0.05	15.09	-	13.96	-
17 Nov 22	17:09	0.04	15.12	-	13.96	-
17 Nov 22	17:10	0.05	15.09	-	13.96	-
17 Nov 22	17:11	0.04	15.06	-	13.97	-
17 Nov 22	17:12	0.03	15.04	-	13.97	-
17 Nov 22	17:13	0.03	15.07	-	13.96	-
17 Nov 22	17:14	0.04	15.09	-	13.95	-
17 Nov 22	17:15	0.03	15.05	-	13.96	-
17 Nov 22	17:16	0.03	14.99	-	13.95	-
17 Nov 22	17:17	0.03	15.02	-	13.96	-
17 Nov 22	17:18	0.04	15.06	-	13.95	-
17 Nov 22	17:19	0.03	15.10	-	13.95	-
17 Nov 22	17:20	0.03	15.07	-	13.95	-
17 Nov 22	17:21	0.04	15.03	-	13.95	-
17 Nov 22	17:22	0.03	15.01	-	13.95	-
17 Nov 22	17:23	0.03	15.04	-	13.94	-
17 Nov 22	17:24	0.03	15.00	-	13.94	-
17 Nov 22	17:25	0.02	14.97	-	13.95	-
17 Nov 22	17:26	0.03	14.99	-	13.93	-
Max		0.05	15.14	-	13.98	-
Avg		0.04	15.05	-	13.95	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	17:27	0.03	15.05	-	13.93	-
17 Nov 22	17:28	0.03	15.07	-	13.94	-
17 Nov 22	17:29	0.03	15.07	-	13.93	-
17 Nov 22	17:30	0.03	15.09	-	13.92	-
17 Nov 22	17:31	0.03	15.07	-	13.92	-
17 Nov 22	17:32	0.02	15.06	-	13.92	-
17 Nov 22	17:33	0.03	15.09	-	13.91	-
17 Nov 22	17:34	0.03	15.12	-	13.92	-
17 Nov 22	17:35	0.03	15.10	-	13.92	-
17 Nov 22	17:36	0.03	15.06	-	13.92	-
17 Nov 22	17:37	0.03	15.05	-	13.92	-
17 Nov 22	17:38	0.03	15.06	-	13.93	-
17 Nov 22	17:39	0.03	15.11	-	13.92	-
17 Nov 22	17:40	0.03	15.10	-	13.92	-
17 Nov 22	17:41	0.03	15.08	-	13.92	-
17 Nov 22	17:42	0.03	14.98	-	13.93	-
17 Nov 22	17:43	0.03	14.96	-	13.92	-
17 Nov 22	17:44	0.03	15.01	-	13.92	-
17 Nov 22	17:45	0.02	15.02	-	13.93	-
17 Nov 22	17:46	0.02	14.99	-	13.92	-
17 Nov 22	17:47	0.02	14.95	-	13.92	-
Max		0.03	15.12	-	13.94	-
Avg		0.03	15.05	-	13.92	-

Run No: 9

Time Base : 21 min

Run No: 10

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	17:48	0.03	14.96	-	13.91	-
17 Nov 22	17:49	0.03	14.97	-	13.91	-
17 Nov 22	17:50	0.03	14.97	-	13.91	-
17 Nov 22	17:51	0.02	14.96	-	13.91	-
17 Nov 22	17:52	0.02	14.92	-	13.92	-
17 Nov 22	17:53	0.02	14.92	-	13.91	-
17 Nov 22	17:54	0.03	14.93	-	13.91	-
17 Nov 22	17:55	0.02	14.94	-	13.91	-
17 Nov 22	17:56	0.03	14.92	-	13.91	-
17 Nov 22	17:57	0.02	14.97	-	13.91	-
17 Nov 22	17:58	0.03	14.98	-	13.91	-
17 Nov 22	17:59	0.02	14.96	-	13.92	-
17 Nov 22	18:00	0.03	14.99	-	13.91	-
17 Nov 22	18:01	0.02	15.01	-	13.91	-
17 Nov 22	18:02	0.02	15.02	-	13.91	-
17 Nov 22	18:03	0.02	15.00	-	13.91	-
17 Nov 22	18:04	0.02	15.00	-	13.91	-
17 Nov 22	18:05	0.03	14.97	-	13.92	-
17 Nov 22	18:06	0.03	14.93	-	13.92	-
17 Nov 22	18:07	0.03	14.91	-	13.92	-
17 Nov 22	18:08	0.02	14.95	-	13.91	-
Max		0.03	15.02	-	13.92	-
Avg		0.02	14.96	-	13.91	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	18:09	0.02	14.98	-	13.92	-
17 Nov 22	18:10	0.03	14.99	-	13.92	-
17 Nov 22	18:11	0.03	14.95	-	13.91	-
17 Nov 22	18:12	0.03	14.89	-	13.92	-
17 Nov 22	18:13	0.03	14.86	-	13.91	-
17 Nov 22	18:14	0.03	14.97	-	13.91	-
17 Nov 22	18:15	0.03	14.96	-	13.92	-
17 Nov 22	18:16	0.03	14.92	-	13.91	-
17 Nov 22	18:17	0.03	14.91	-	13.91	-
17 Nov 22	18:18	0.03	14.91	-	13.91	-
17 Nov 22	18:19	0.03	14.90	-	13.91	-
17 Nov 22	18:20	0.03	14.89	-	13.91	-
17 Nov 22	18:21	0.03	14.92	-	13.90	-
17 Nov 22	18:22	0.03	14.93	-	13.91	-
17 Nov 22	18:23	0.03	14.95	-	13.90	-
17 Nov 22	18:24	0.03	15.04	-	13.90	-
17 Nov 22	18:25	0.03	15.07	-	13.91	-
17 Nov 22	18:26	0.03	15.03	-	13.91	-
17 Nov 22	18:27	0.03	15.01	-	13.91	-
17 Nov 22	18:28	0.03	15.03	-	13.91	-
17 Nov 22	18:29	0.03	15.02	-	13.91	-
Max		0.03	15.07	-	13.92	-
Avg		0.03	14.96	-	13.91	-

Run No: 11

Time Base : 21 min

Run No: 12

Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	18:30	0.03	14.96	-	13.90	-
17 Nov 22	18:31	0.03	14.96	-	13.90	-
17 Nov 22	18:32	0.03	14.97	-	13.90	-
17 Nov 22	18:33	0.03	15.03	-	13.90	-
17 Nov 22	18:34	0.03	15.01	-	13.90	-
17 Nov 22	18:35	0.03	15.00	-	13.90	-
17 Nov 22	18:36	0.02	14.97	-	13.89	-
17 Nov 22	18:37	0.03	14.96	-	13.90	-
17 Nov 22	18:38	0.03	14.96	-	13.90	-
17 Nov 22	18:39	0.03	14.95	-	13.90	-
17 Nov 22	18:40	0.03	14.95	-	13.90	-
17 Nov 22	18:41	0.03	15.03	-	13.89	-
17 Nov 22	18:42	0.03	15.04	-	13.90	-
17 Nov 22	18:43	0.03	15.05	-	13.90	-
17 Nov 22	18:44	0.03	15.04	-	13.90	-
17 Nov 22	18:45	0.03	15.07	-	13.90	-
17 Nov 22	18:46	0.03	15.09	-	13.90	-
17 Nov 22	18:47	0.03	15.06	-	13.90	-
17 Nov 22	18:48	0.02	15.10	-	13.90	-
17 Nov 22	18:49	0.03	15.10	-	13.90	-
17 Nov 22	18:50	0.03	15.12	-	13.90	-
Max		0.03	15.12	-	13.90	-
Avg		0.03	15.02	-	13.90	-

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
17 Nov 22	18:51	0.03	15.10	-	13.89	-
17 Nov 22	18:52	0.02	15.08	-	13.90	-
17 Nov 22	18:53	0.03	15.07	-	13.90	-
17 Nov 22	18:54	0.03	15.05	-	13.90	-
17 Nov 22	18:55	0.03	15.01	-	13.91	-
17 Nov 22	18:56	0.02	14.98	-	13.90	-
17 Nov 22	18:57	0.03	15.05	-	13.90	-
17 Nov 22	18:58	0.03	15.04	-	13.90	-
17 Nov 22	18:59	0.03	14.97	-	13.90	-
17 Nov 22	19:00	0.03	14.92	-	13.90	-
17 Nov 22	19:01	0.03	14.91	-	13.90	-
17 Nov 22	19:02	0.03	14.99	-	13.89	-
17 Nov 22	19:03	0.02	15.00	-	13.91	-
17 Nov 22	19:04	0.03	14.96	-	13.91	-
17 Nov 22	19:05	0.03	14.91	-	13.90	-
17 Nov 22	19:06	0.03	14.97	-	13.90	-
17 Nov 22	19:07	0.03	14.95	-	13.91	-
17 Nov 22	19:08	0.03	14.97	-	13.90	-
17 Nov 22	19:09	0.02	14.95	-	13.90	-
17 Nov 22	19:10	0.02	14.95	-	13.89	-
17 Nov 22	19:11	0.02	14.95	-	13.90	-
Max		0.03	15.10	-	13.91	-
Avg		0.03	14.99	-	13.90	-



Lot No. 22119286-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ 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	0.01	0.04
Low-Level Gas	8.02	8.03	8.01	0.08
Span Gas	16.02	16.01	16.05	0.16

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	0.03	0.03
Low-Level Gas	54.42	54.43	54.38	0.05
Span Gas	79.73	79.71	79.67	0.04

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 22119286-1**SYSTEM CALIBRATION BIAS AND DRIFT DATA**

Client : Gulf BP Co.,Ltd. Location : HRSG 11
Date : 18 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.02	0.08	0.08
Upscale Gas	16.01	16.06	0.20	16.08	0.28	0.08

CO ANALYZER

Cylinder Conc. (ppm) : 79.73 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	0.02	0.02	0.01	0.01	0.01
Upscale Gas	79.71	79.75	0.04	79.80	0.09	0.05

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	1
Date	18 Nov 22	Location	HRSG 11
Start Time	13:35	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	13:55
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:35	13.92	4.21	-	-	0.98	
13:36	13.99	4.17	-	-	1.01	
13:37	13.99	4.22	-	-	0.98	
13:38	13.97	4.18	-	-	0.95	
13:39	14.02	4.15	-	-	0.91	
13:40	14.02	4.17	-	-	0.88	
13:41	14.02	4.19	-	-	0.85	
13:42	14.02	4.17	-	-	0.89	
13:43	14.02	4.21	-	-	0.92	
13:44	14.02	4.18	-	-	0.89	
13:45	14.02	4.20	-	-	0.89	
13:46	14.02	4.17	-	-	0.96	
13:47	14.01	4.18	-	-	0.99	
13:48	14.01	4.17	-	-	0.95	
13:49	14.01	4.21	-	-	0.91	
13:50	14.01	4.21	-	-	0.90	
13:51	14.01	4.18	-	-	0.92	
13:52	14.00	4.18	-	-	0.92	
13:53	14.00	4.15	-	-	0.90	
13:54	14.01	4.18	-	-	0.89	
13:55	14.01	4.20	-	-	0.92	
Average	14.00	4.18	-	-	0.92	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	2
Date	18 Nov 22	Location	HRSG 11
Start Time	13:56	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	14:16
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
13:56	14.00	4.18	-	-	0.92	
13:57	14.00	4.18	-	-	0.89	
13:58	14.01	4.14	-	-	0.94	
13:59	14.00	4.16	-	-	0.98	
14:00	14.00	4.18	-	-	0.96	
14:01	14.00	4.18	-	-	0.93	
14:02	13.99	4.18	-	-	0.94	
14:03	13.99	4.16	-	-	1.00	
14:04	14.01	4.20	-	-	0.97	
14:05	14.00	4.18	-	-	0.96	
14:06	14.00	4.17	-	-	0.93	
14:07	14.01	4.17	-	-	0.98	
14:08	14.00	4.17	-	-	0.97	
14:09	14.00	4.20	-	-	0.89	
14:10	14.01	4.21	-	-	0.89	
14:11	14.00	4.20	-	-	0.91	
14:12	14.01	4.19	-	-	0.97	
14:13	14.01	4.20	-	-	1.00	
14:14	14.00	4.19	-	-	0.92	
14:15	13.99	4.22	-	-	0.93	
14:16	13.99	4.19	-	-	0.94	
Average	14.00	4.18	-	-	0.94	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	3
Date	18 Nov 22	Location	HRSG 11
Start Time	14:17	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	14:37
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
14:17	13.99	4.19	-	-	0.90	
14:18	13.98	4.19	-	-	0.91	
14:19	13.99	4.16	-	-	0.91	
14:20	14.00	4.20	-	-	0.86	
14:21	13.99	4.20	-	-	0.90	
14:22	14.00	4.19	-	-	0.95	
14:23	14.00	4.19	-	-	0.88	
14:24	14.01	4.15	-	-	0.88	
14:25	14.00	4.20	-	-	0.92	
14:26	14.00	4.18	-	-	0.94	
14:27	14.00	4.19	-	-	0.93	
14:28	14.01	4.22	-	-	0.88	
14:29	14.01	4.16	-	-	0.15	
14:30	14.02	4.18	-	-	0.87	
14:31	13.99	4.21	-	-	1.02	
14:32	14.00	4.18	-	-	0.93	
14:33	14.01	4.16	-	-	0.94	
14:34	14.02	4.19	-	-	0.90	
14:35	14.01	4.19	-	-	0.92	
14:36	14.02	4.16	-	-	0.90	
14:37	14.01	4.19	-	-	0.90	
Average	14.00	4.18	-	-	0.88	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



Lot No. 22119287-1

ANALYZER CALIBRATION DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ 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	8.02	8.02	8.04	0.08
Span Gas	16.02	16.03	16.06	0.12

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	0.01	0.01
Low-Level Gas	54.42	54.40	54.39	0.01
Span Gas	79.73	79.75	79.69	0.06

CO₂ ANALYZER

Model : TELEDYNE API T300M Serial No. : 377
Span (%) : 25

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.04
Low-Level Gas	15.03	15.04	15.08	0.16
Span Gas	21.97	21.98	21.94	0.16

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



Lot No. 22119287-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co.,Ltd. Location : HRSG 12
Date : 17 Nov 22 Test Operator : Worawich T.

O₂ ANALYZER

Cylinder Conc. (%) : 16.02 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	0.01	0.04	0.00	0.00	0.04
Upscale Gas	16.03	16.09	0.24	16.11	0.32	0.08

CO ANALYZER

Cylinder Conc. (ppm) : 79.73 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	0.01	0.01	0.00
Upscale Gas	79.75	79.72	0.03	79.69	0.06	0.03

CO₂ ANALYZER

Cylinder Conc. (%) : 21.97 Span (%) : 25

	CO 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	0.01	0.04	0.01	0.04	0.00
Upscale Gas	21.98	21.82	0.64	21.85	0.52	0.12

Calibrated by

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	1
Date	17 Nov 22	Location	HRSG 12
Start Time	15:00	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	15:20
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:00	13.98	4.19	-	-	1.03	
15:01	13.97	4.14	-	-	1.00	
15:02	13.97	4.17	-	-	1.00	
15:03	13.98	4.14	-	-	0.97	
15:04	13.99	4.16	-	-	0.99	
15:05	13.97	4.14	-	-	0.96	
15:06	13.99	4.13	-	-	0.93	
15:07	13.98	4.17	-	-	0.96	
15:08	13.99	4.17	-	-	1.02	
15:09	13.99	4.18	-	-	1.01	
15:10	14.00	4.14	-	-	1.02	
15:11	13.98	4.17	-	-	1.01	
15:12	13.97	4.17	-	-	0.97	
15:13	13.96	4.15	-	-	0.92	
15:14	13.95	4.18	-	-	0.95	
15:15	13.94	4.19	-	-	0.97	
15:16	13.97	4.17	-	-	1.01	
15:17	13.98	4.20	-	-	0.98	
15:18	13.96	4.17	-	-	0.97	
15:19	13.95	4.19	-	-	0.94	
15:20	13.97	4.17	-	-	0.96	
Average	13.97	4.16	-	-	0.98	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	2
Date	17 Nov 22	Location	HRSG 12
Start Time	15:21	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	15:41
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:21	13.98	4.18	-	-	0.97	
15:22	13.98	4.15	-	-	0.99	
15:23	13.98	4.19	-	-	1.01	
15:24	13.98	4.19	-	-	0.96	
15:25	13.97	4.18	-	-	0.93	
15:26	13.96	4.18	-	-	0.94	
15:27	13.96	4.15	-	-	0.97	
15:28	13.96	4.16	-	-	0.97	
15:29	13.97	4.18	-	-	0.97	
15:30	13.99	4.17	-	-	0.95	
15:31	13.98	4.18	-	-	1.01	
15:32	13.97	4.16	-	-	1.00	
15:33	13.97	4.14	-	-	1.00	
15:34	13.98	4.16	-	-	0.97	
15:35	13.99	4.16	-	-	0.90	
15:36	13.97	4.19	-	-	0.92	
15:37	13.97	4.15	-	-	0.94	
15:38	13.98	4.15	-	-	0.97	
15:39	13.98	4.16	-	-	0.97	
15:40	13.96	4.11	-	-	0.97	
15:41	13.98	4.15	-	-	0.95	
Average	13.97	4.16	-	-	0.96	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf BP Co.,Ltd.	Run #	3
Date	17 Nov 22	Location	HRSG 12
Start Time	15:42	Test Operator	Worawich T.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	16:02
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 (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:42	13.98	4.16	-	-	0.93	
15:43	13.98	4.17	-	-	0.93	
15:44	13.98	4.19	-	-	0.90	
15:45	13.98	4.15	-	-	0.92	
15:46	13.96	4.18	-	-	0.96	
15:47	13.97	4.15	-	-	0.97	
15:48	13.97	4.16	-	-	0.95	
15:49	13.97	4.14	-	-	0.91	
15:50	13.98	4.13	-	-	0.94	
15:51	13.99	4.18	-	-	0.96	
15:52	13.98	4.14	-	-	0.97	
15:53	13.98	4.15	-	-	0.95	
15:54	13.98	4.18	-	-	0.92	
15:55	13.96	4.18	-	-	0.89	
15:56	13.96	4.14	-	-	0.98	
15:57	13.96	4.19	-	-	0.97	
15:58	13.97	4.15	-	-	0.98	
15:59	13.99	4.15	-	-	0.98	
16:00	14.00	4.15	-	-	0.99	
16:01	13.98	4.13	-	-	1.05	
16:02	13.98	4.15	-	-	1.04	
Average	13.98	4.16	-	-	0.96	

Worawich T.

(Mr.Worawich Tongpoom)

Environmental Field Scientist (2)

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A0664	Reference Number:	160-401907846-1
Cylinder Number:	EB0136209	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Oct 06, 2020

Expiration Date: Oct 06, 2028

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.64 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
CARBON MONOXIDE	55.00 PPM	54.42 PPM	G1	+/- 0.8% NIST Traceable	09/29/2020
NITRIC OXIDE	55.00 PPM	54.64 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	55.00 PPM	54.34 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
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	17060226	EB0079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	16010203	KAL003087	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	Sep 21, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg, Net Weight: 4.6 Kg.



Signature
Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E3HA0002 Reference Number: 160-402138465-1
Cylinder Number: ND11218 Cylinder Volume: 247.2 Cubic Feet
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	80.00 PPM	81.85 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.73 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	81.85 PPM	G1	+/- 1.1% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.92 PPM	G1	+/- 0.9% 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: 48.0 Kg
Net Weight: 7.8 Kg



Michael A. Miller
Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE
(THAILAND) LTD
Part Number: E02NI84E3HA0001
Cylinder Number: GN0027207
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: O2,BALN
Reference Number: 160-402340010-1
Cylinder Volume: 249.8 CF
Cylinder Pressure: 2214 PSIG
Valve Outlet: 590
Certification Date: Feb 02, 2022

Expiration Date: Feb 02, 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	15.00 %	16.02 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010230	K005228	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 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: 48.8 Kg

Net Weight: 8.2 Kg



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Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E02NI92E3HA0000	Reference Number:	160-401948144-1
Cylinder Number:	GN0025083	Cylinder Volume:	248.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2214 PSIG
PGVP Number:	A12020	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Nov 11, 2020

Expiration Date: Nov 11, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are 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 %	8.019 %	G1	+/- 0.3% NIST Traceable	11/11/20
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010802	1D38055	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Oct 26, 2020

Triad Data Available Upon Request

NOTES:

Gross Weight: 48.1 Kg
Net Weight: 8.2 Kg



[Signature]

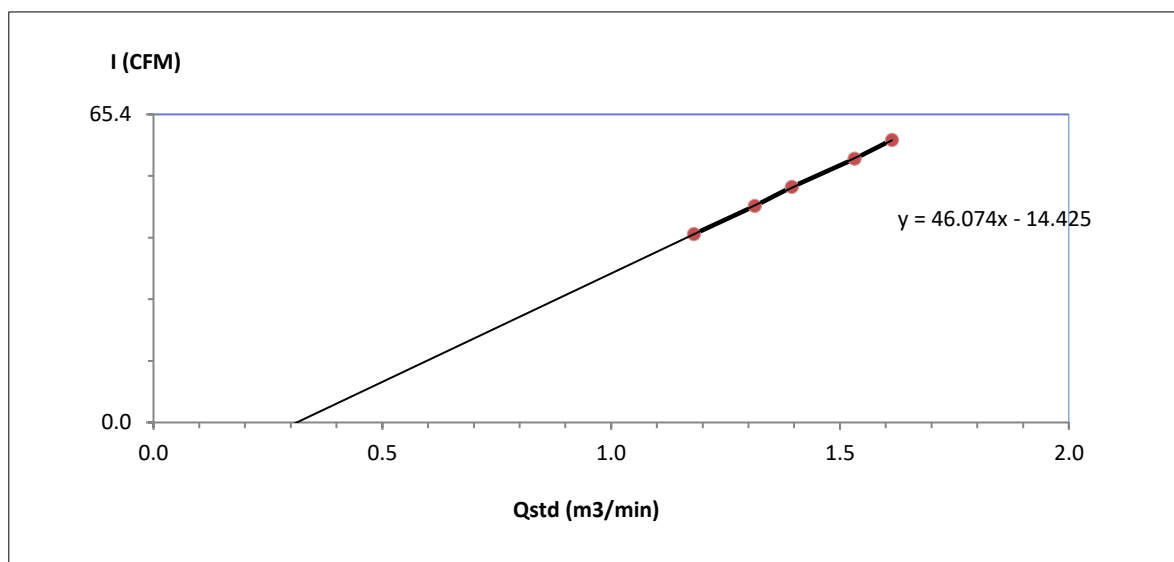
Approved for Release



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	รพ.สต.บ้านหว้า	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS1059
CalibrationSheet No.:	C-141122-BKK_FS1059	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5693
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.7	1.1810	40	Slope : 46.0742 Intercept : -14.4247 Correlation Coefficient : 0.9999
2	4.6	1.3135	46	
3	5.2	1.3947	50	
4	6.3	1.5322	56	
5	7.0	1.6135	60	



Calibrated by _____

(Mr.Teeravut Sukdee)
Field Scientist(1)

Approved by : _____

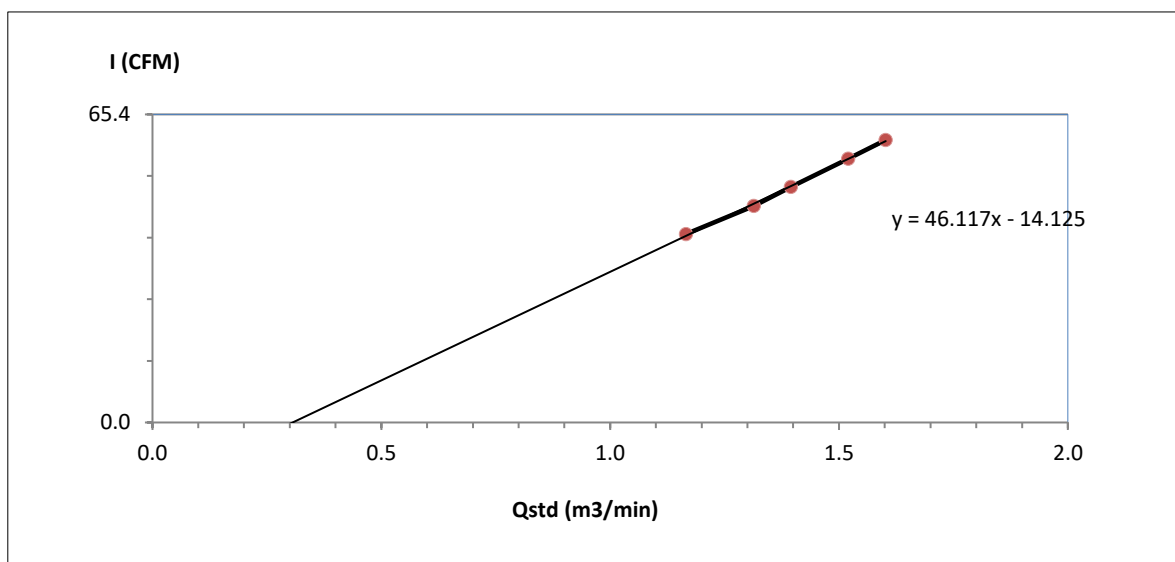
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)






High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	โรงเรียนเจ้าฟ้าสร้าง	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS1057
CalibrationSheet No.:	C-141122-BKK_FS1057	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5500
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.6	1.1653	40	Slope : 46.1170 Intercept : -14.1251 Correlation Coefficient : 0.9991
2	4.6	1.3135	46	
3	5.2	1.3947	50	
4	6.2	1.5202	56	
5	6.9	1.6021	60	



Calibrated by  
 (Mr. Teeravut Sukdee)
 Field Scientist(1)

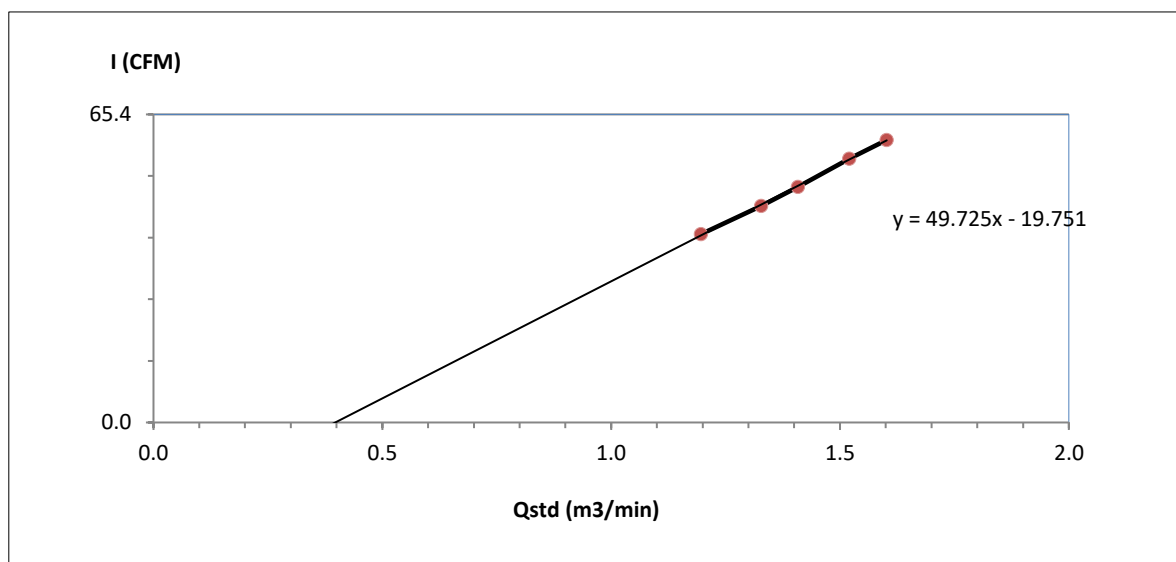
Approved by : 
 (Mr. Noppong Juntarupan)
 Enviro Field Coordinator Scientist (3)






High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	หมู่ที่ 3 ตำบลบ้านเลน	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0364
CalibrationSheet No.:	C-141122-BKK_FS0364	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4154
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.8	1.1964	40	Slope : 49.7253 Intercept : -19.7514 Correlation Coefficient : 0.9996
2	4.7	1.3274	46	
3	5.3	1.4077	50	
4	6.2	1.5202	56	
5	6.9	1.6021	60	



Calibrated by  
(Mr. Teeravut Sukdee)
Field Scientist(1)

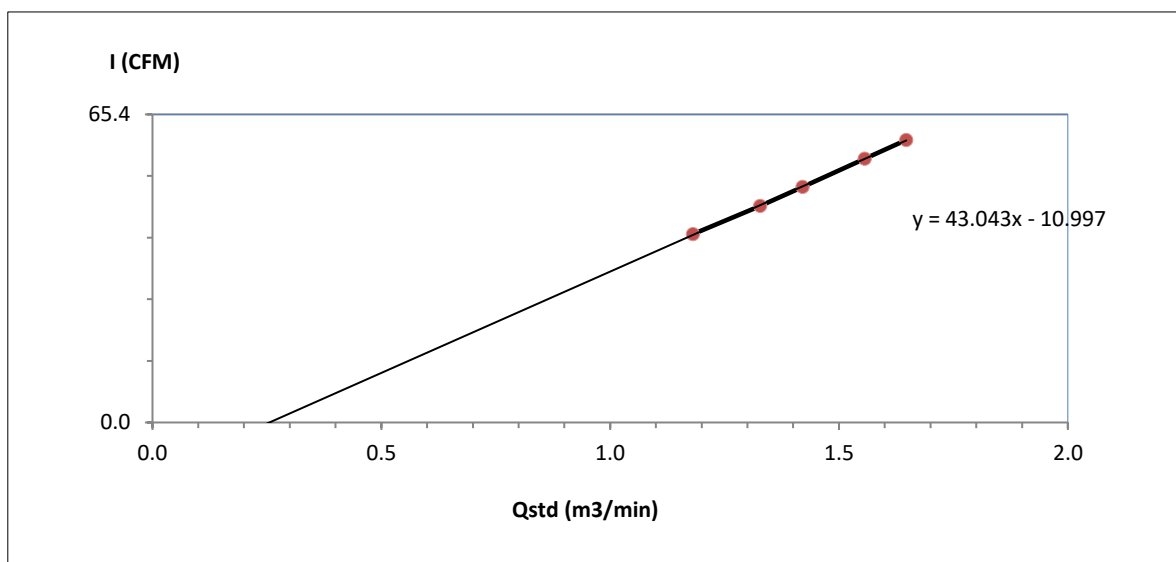
Approved by : 
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)





High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	หมู่ที่ 2 ตำบลบ้านหว้า	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0359
CalibrationSheet No.:	C-141122-BKK_FS0359	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5194
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.7	1.1810	40	Slope : 43.0434 Intercept : -10.9970 Correlation Coefficient : 0.9998
2	4.7	1.3274	46	
3	5.4	1.4207	50	
4	6.5	1.5559	56	
5	7.3	1.6471	60	



Calibrated by 
 (Mr. Teeravut Sukdee)
 Field Scientist(1)

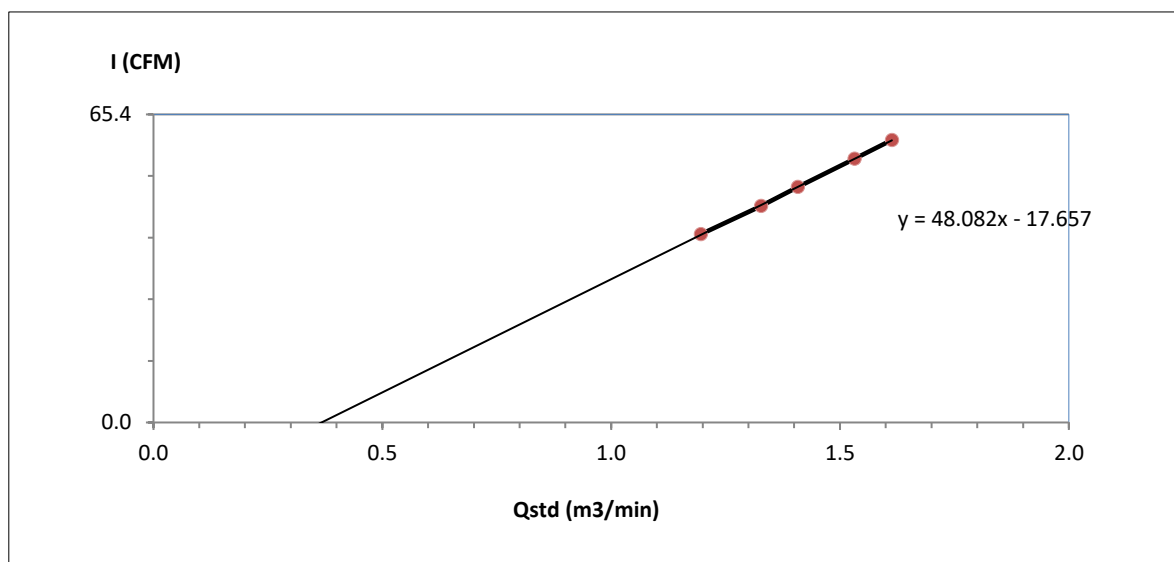
Approved by : 
 (Mr. Noppong Juntarupan)
 Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co.,Ltd.	Barometric Pressure (mm Hg) :	759
Calibrate Location :	พื้นที่ก่อสร้างโครงการ	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0373
CalibrationSheet No.:	C-141122-BKK_FS0373	High Volume Model :	G1051
Calibrator ID:	BKK_FS0624	High Volume S/N :	1330
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.8	1.1964	40	Slope : 48.0818 Intercept : -17.6573 Correlation Coefficient : 0.9999
2	4.7	1.3274	46	
3	5.3	1.4077	50	
4	6.3	1.5322	56	
5	7.0	1.6135	60	



Calibrated by

(Mr.Teeravut Sukdee)
Field Scientist(1)

Approved by :

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



Certificate of Calibration

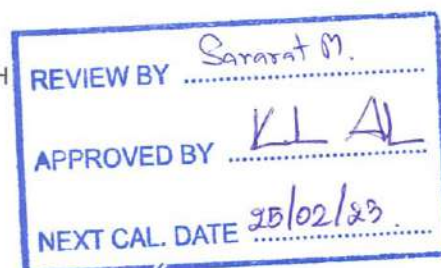
Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.:	PTC/07/22072	Page:	1 of 3
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	METTLER TOLEDO	Serial No:	1123091884
Model:	XP105	ID No:	BKK_EN0004
Type of Balance:	Multi interval		



Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

Environment Condition: Temperature 21.0 °C \pm 0.4 °C
Humidity 62.8 %RH \pm 3.7 %RH
Air density 1.20 kg/m³



Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO., LTD

(Mr.Kriangsak Kalasri)
Reviewed by

Approved By :

(Mr. Keattisak Kerdto)
Laboratory Manager

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 recognised national standard laboratories.

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

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

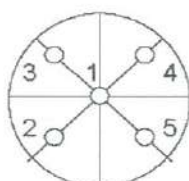
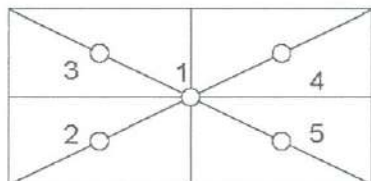
Page: 2 of 3

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 30 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	0.0000	0.0000	0.0000
Maximum deviation:				0.0000

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
100	0.00005

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
40	40.00005	40.0000	0.0000	0.00016	2.11
50	50.00001	50.0000	0.0000	0.00015	2.13
60	60.00003	60.0000	0.0000	0.00016	2.08
70	70.00003	70.0000	0.0000	0.00017	2.07
80	80.00005	80.0001	-0.0001	0.00019	2.04
90	90.00006	90.0001	0.0000	0.00020	2.03
100	100.00002	99.9999	0.0001	0.00018	2.06

Note: Weight of adjust - (g)



Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

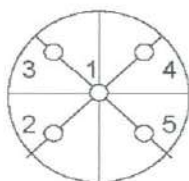
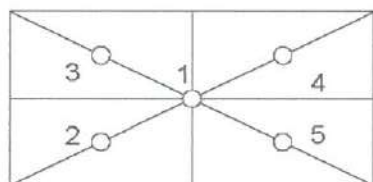
Page: 3 of 3

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 30 (g)

Position (g)				
1	2	3	4	5
0.00000	-0.00001	-0.00002	0.00000	0.00000
Maximum deviation:			0.00002	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.00001 (g)

Nominal test value (g)	Standard Deviation
20	0.000005

Error of indication : from nominal value., Readability 0.00001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.000000	0.00000	0.00000	0.000016	2.52
0.1	0.100000	0.10000	0.00000	0.000019	2.00
0.5	0.499999	0.50000	0.00000	0.000019	2.00
2	2.000010	1.99999	0.00002	0.000024	2.00
5	5.000005	5.00001	0.00000	0.000027	2.00
10	10.000015	10.00001	0.00000	0.000031	2.00
20	20.000019	20.00001	0.00001	0.000042	2.00
30	30.000034	30.00006	-0.00003	0.000069	2.00

Note: Weight of adjust - (g)

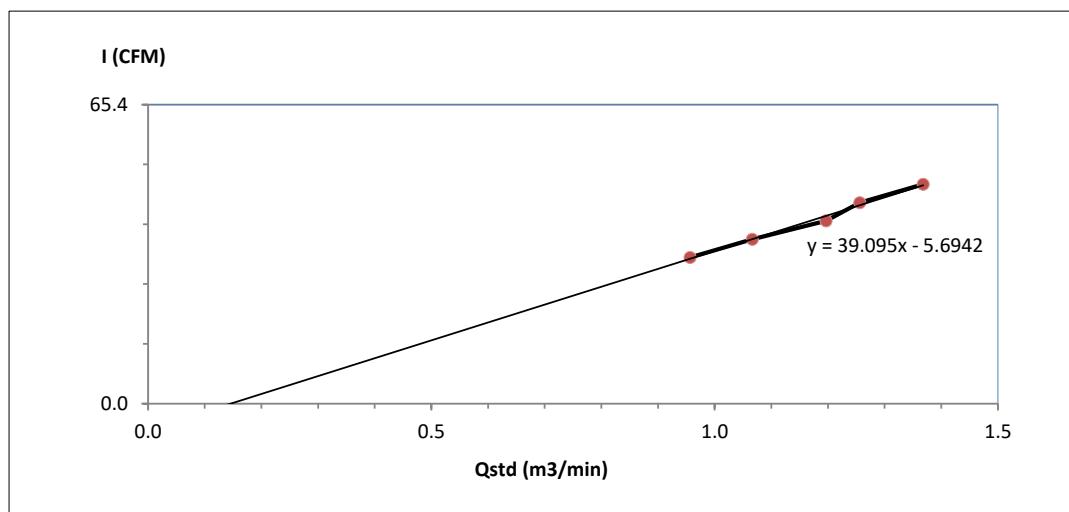
The End of Certificate



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	รพ.สต.บ้านหว้า	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0375
Calibration Sheet No.:	C-141122-BKK_FS0375	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5196
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.9568	32	Slope : 39.0946 Intercept : -5.6942 Correlation Coefficient : 0.9949
2	3.0	1.0663	36	
3	3.8	1.1964	40	
4	4.2	1.2564	44	
5	5.0	1.3682	48	



Calibrated by

Mr. Teeravut Sukdee

(Mr. Teeravut Sukdee)
Field Scientist(1)

Approved by :

Mr. Noppong Juntarupan

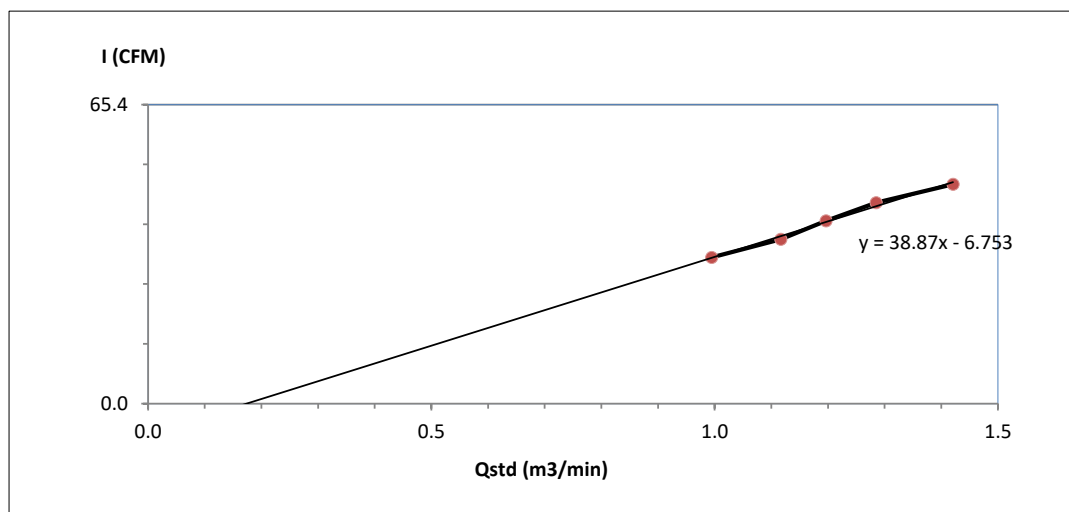
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	โรงเรียนเจ้าฟ้าสร้าง	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS1063
Calibration Sheet No.:	C-141122-BKK_FS1063	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5685
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.6	0.9947	32	Slope : 38.8702 Intercept : -6.7530 Correlation Coefficient : 0.9957
2	3.3	1.1169	36	
3	3.8	1.1964	40	
4	4.4	1.2852	44	
5	5.4	1.4207	48	



Calibrated by

Mr. Teeravut Sukdee

(Mr. Teeravut Sukdee)
Field Scientist(1)

Approved by :

Mr. Noppong Juntarupan

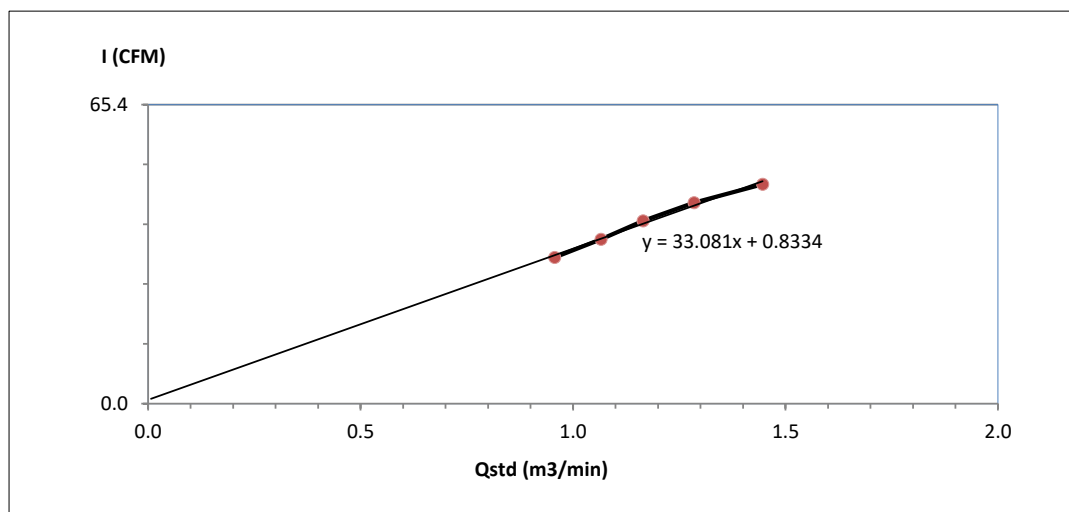
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	หมู่ที่ 3 ตำบลบ้านเลน	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0386
Calibration Sheet No.:	C-141122-BKK_FS0386	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4790
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.9568	32	Slope : 33.0806 Intercept : 0.8334 Correlation Coefficient : 0.9953
2	3.0	1.0663	36	
3	3.6	1.1653	40	
4	4.4	1.2852	44	
5	5.6	1.4462	48	



Calibrated by

(Mr. Teeravut Sukdee)
Field Scientist(1)

Approved by :



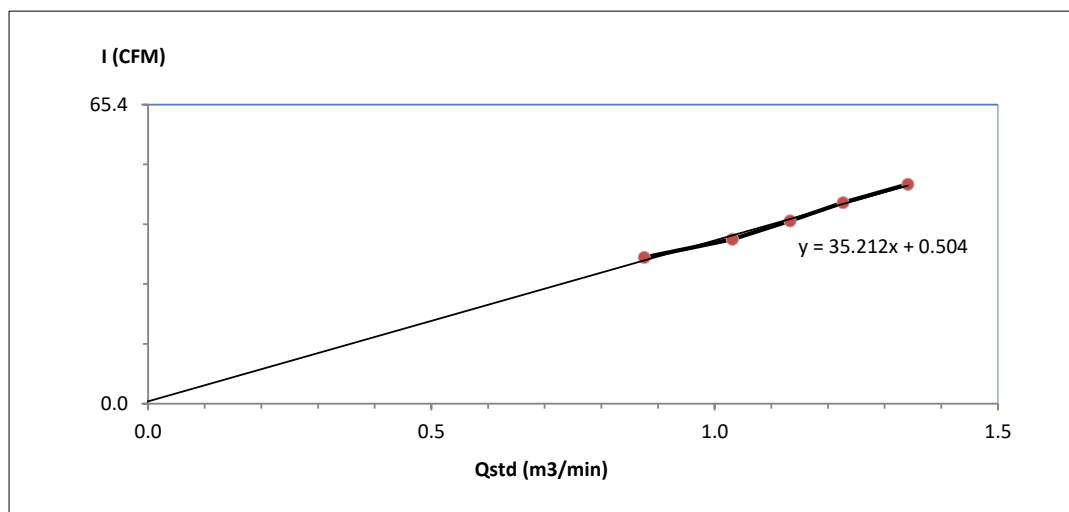
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd	Barometric Pressure (mm Hg) :	759
Calibrate Location :	หมู่ที่ 2 ตำบลบ้านหว้า	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS0382
Calibration Sheet No.:	C-141122-BKK_FS0382	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4786
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.8760	32	Slope : 35.2123 Intercept : 0.5040 Correlation Coefficient : 0.9956
2	2.8	1.0311	36	
3	3.4	1.1333	40	
4	4.0	1.2268	44	
5	4.8	1.3411	48	



Calibrated by

Mr. Teeravut Sukdee

(Mr. Teeravut Sukdee)
Field Scientist(1)

Approved by :

Mr. Noppong Juntarupan

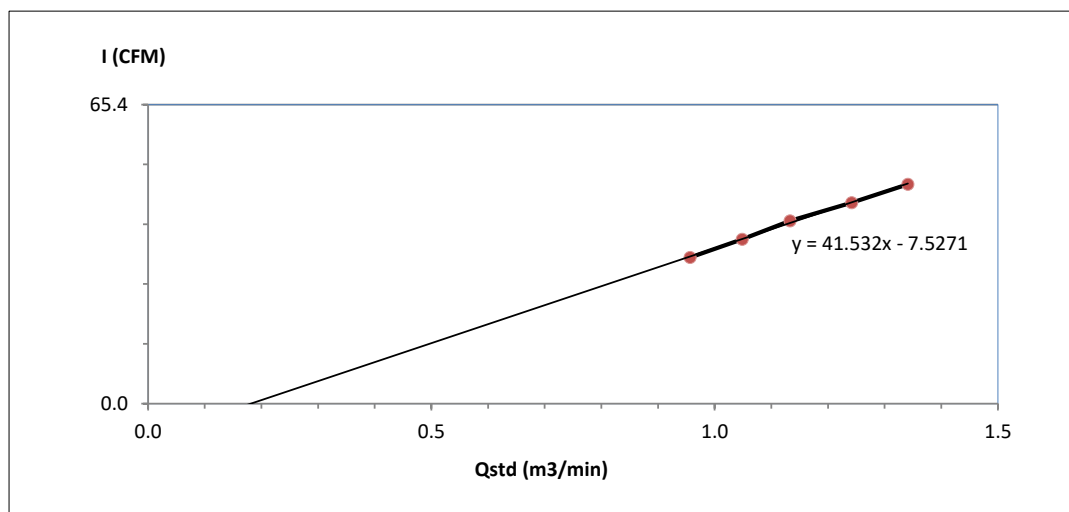
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co.,Ltd.	Barometric Pressure (mm Hg) :	759
Calibrate Location :	พื้นที่ก่อสร้างโครงการ	Temperature (°C) :	32
Calibrate Date :	14-Nov-22	High Volume ID :	BKK_FS1061
Calibration Sheet No.:	C-141122-BKK_FS1061	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5504
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.9568	32	Slope : 41.5322 Intercept : -7.5271 Correlation Coefficient : 0.9991
2	2.9	1.0489	36	
3	3.4	1.1333	40	
4	4.1	1.2417	44	
5	4.8	1.3411	48	



Calibrated by

Mr. Teeravut Sukdee

(Mr. Teeravut Sukdee)
Field Scientist(1)

Approved by :

Mr. Noppong Juntarupan

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

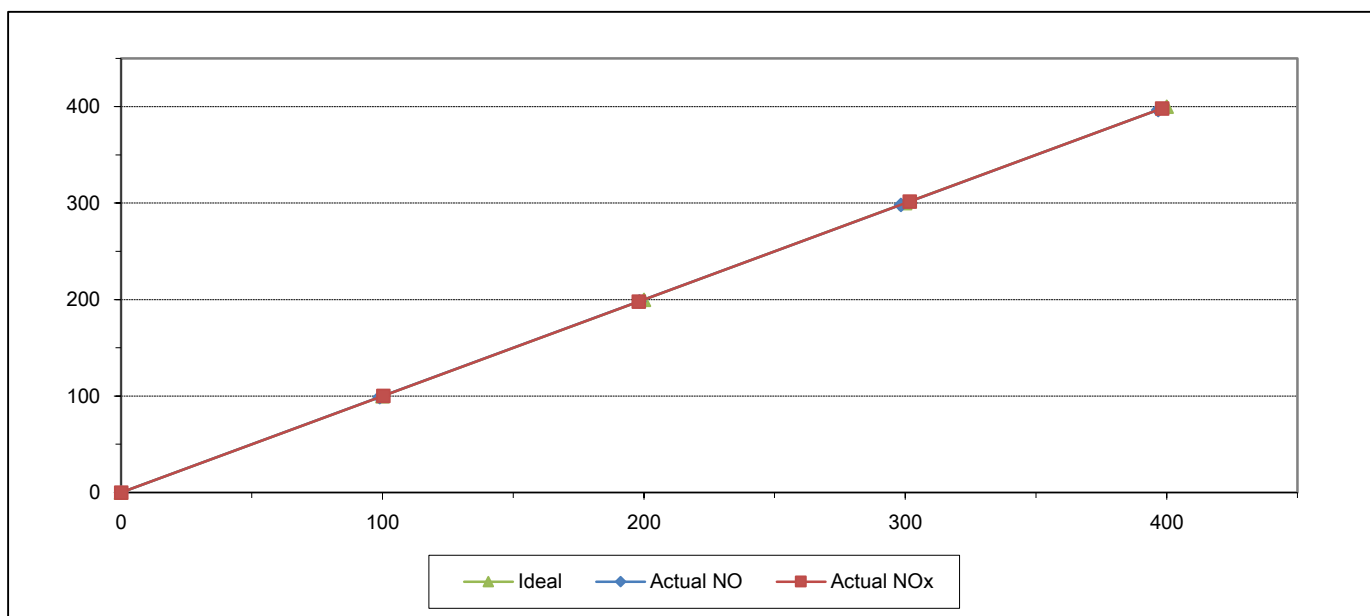


MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-22
Manufacturer HORIBA
Serial No. PX13CWA0
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 55.88
Cylinder Pressure (psi) 1800
Certified Date 9-Feb-22

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID BKK_FS1088
Model 700
Cylinder No. GN0027222
Certified By Airgas Inc.
Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.30	0.30	0.30
2	200.00	198.30	-1.70	-0.85	198.10	-1.90	-0.95
3	300.00	298.40	-1.60	-0.53	301.70	1.70	0.57
4	400.00	396.70	-3.30	-0.83	398.30	-1.70	-0.42
AVERAGE (%)				-0.62			-0.08



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

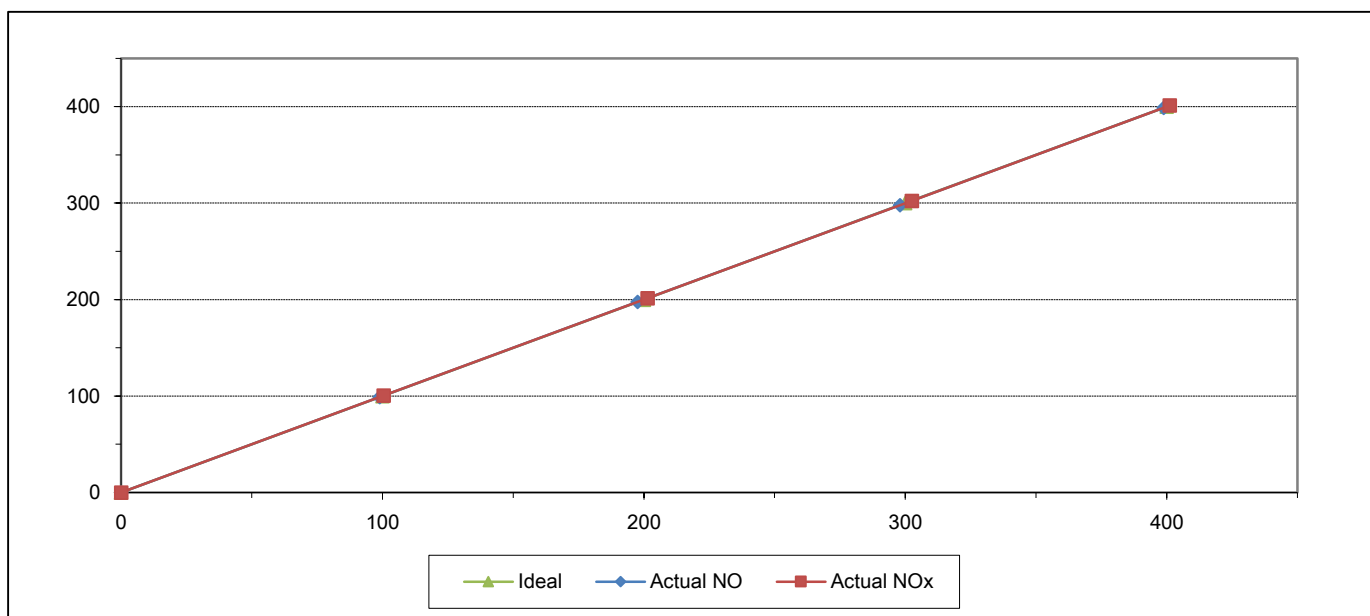


MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-22
Manufacturer HORIBA
Serial No. HCWSR681
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 55.88
Cylinder Pressure (psi) 1800
Certified Date 9-Feb-22

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID BKK_FS0800
Model 700
Cylinder No. GN0027222
Certified By Airgas Inc.
Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.50	0.50	0.50
2	200.00	197.60	-2.40	-1.20	201.50	1.50	0.75
3	300.00	298.00	-2.00	-0.67	302.50	2.50	0.83
4	400.00	398.80	-1.20	-0.30	401.20	1.20	0.30
AVERAGE (%)				-0.61			0.50



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

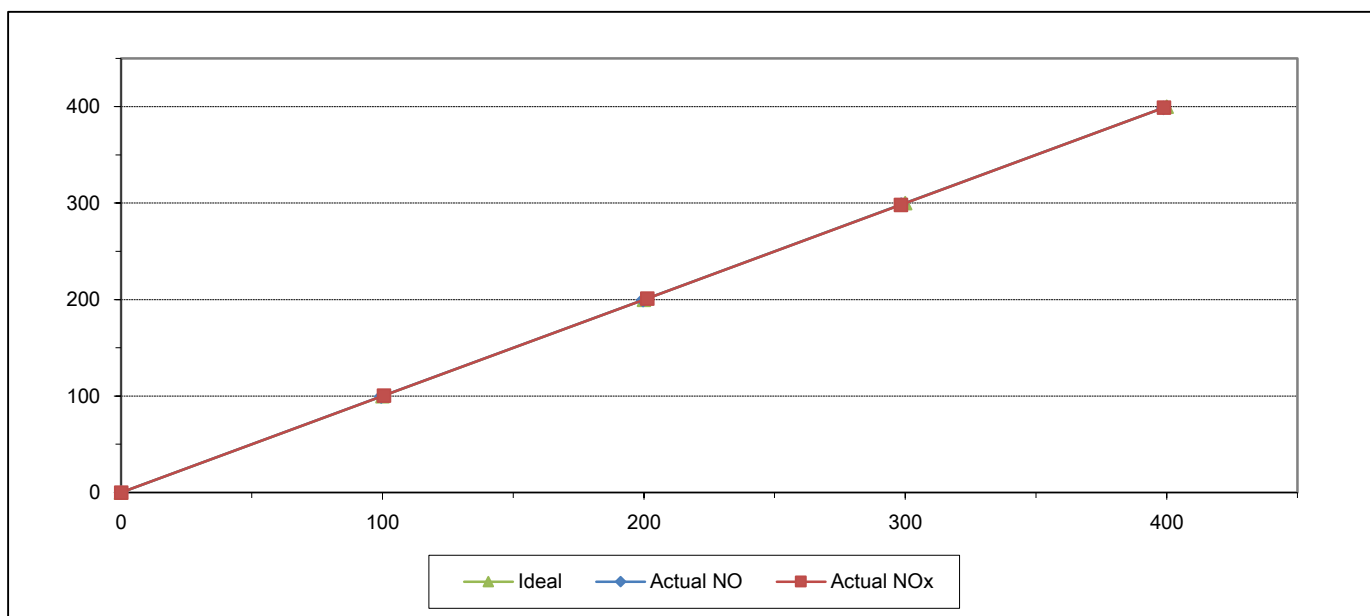


MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-22
Manufacturer HORIBA
Serial No. WPY0JMWD
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 55.88
Cylinder Pressure (psi) 1800
Certified Date 9-Feb-22

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID BKK_FS0782
Model 700
Cylinder No. GN0027222
Certified By Airgas Inc.
Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	100.60	0.60	0.60
2	200.00	199.70	-0.30	-0.15	201.30	1.30	0.65
3	300.00	298.50	-1.50	-0.50	298.30	-1.70	-0.57
4	400.00	398.70	-1.30	-0.33	399.00	-1.00	-0.25
AVERAGE (%)				-0.26			0.11



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

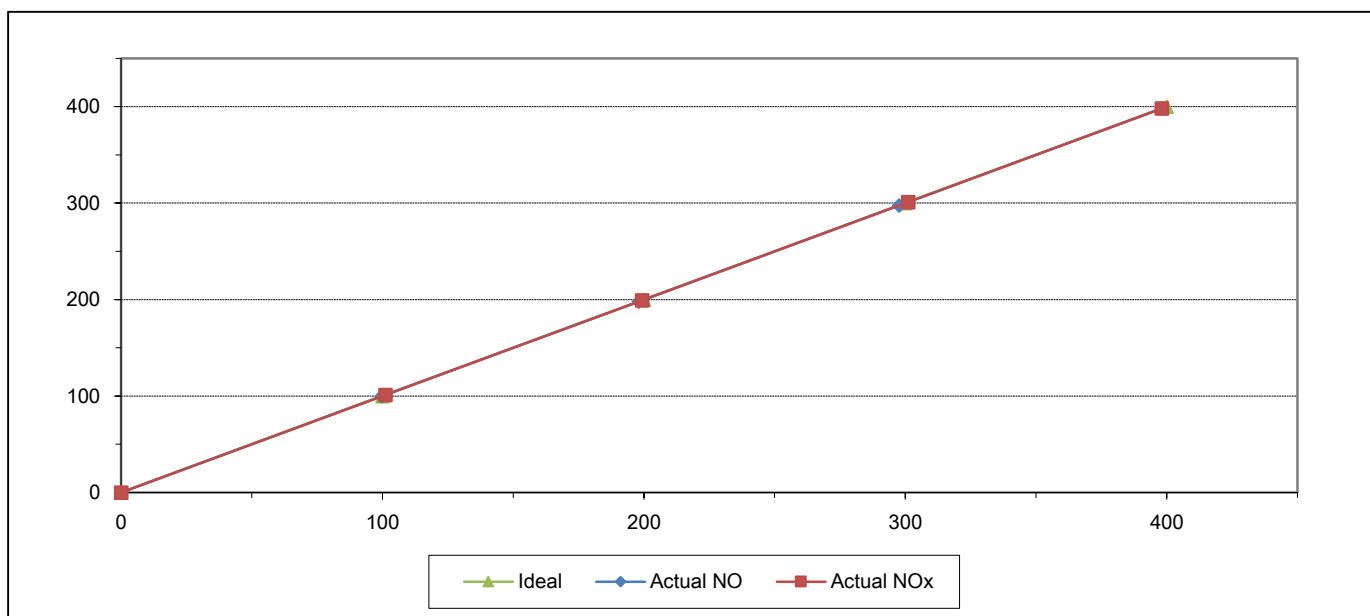


MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-22
Manufacturer Teledyne API
Serial No. 060
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 55.88
Cylinder Pressure (psi) 1800
Certified Date 9-Feb-22

Equipment Name NOx Analyzer
Model T200
Equipment ID BKK_FS0741
Model 700
Cylinder No. GN0027222
Certified By Airgas Inc.
Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.80	-0.20	-0.20	101.20	1.20	1.20
2	200.00	198.10	-1.90	-0.95	199.30	-0.70	-0.35
3	300.00	297.60	-2.40	-0.80	301.10	1.10	0.37
4	400.00	398.20	-1.80	-0.45	398.20	-1.80	-0.45
AVERAGE (%)				-0.46			0.17



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

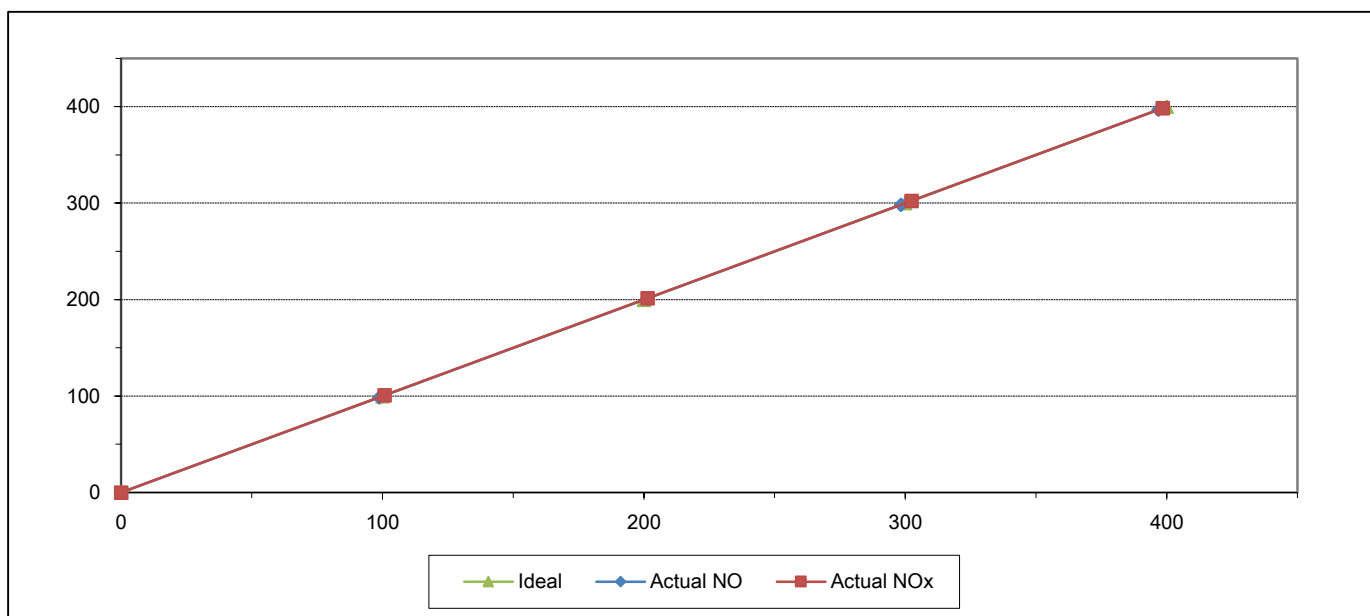


MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-22
Manufacturer HORIBA
Serial No. PPGM9HKH
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 55.88
Cylinder Pressure (psi) 1800
Certified Date 9-Feb-22

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID BKK_FS1070
Model 700
Cylinder No. GN0027222
Certified By Airgas Inc.
Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.80	0.80	0.80
2	200.00	201.30	1.30	0.65	201.50	1.50	0.75
3	300.00	298.30	-1.70	-0.57	302.40	2.40	0.80
4	400.00	396.90	-3.10	-0.78	398.50	-1.50	-0.38
AVERAGE (%)				-0.36			0.41



Calibrated By

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

Approved By

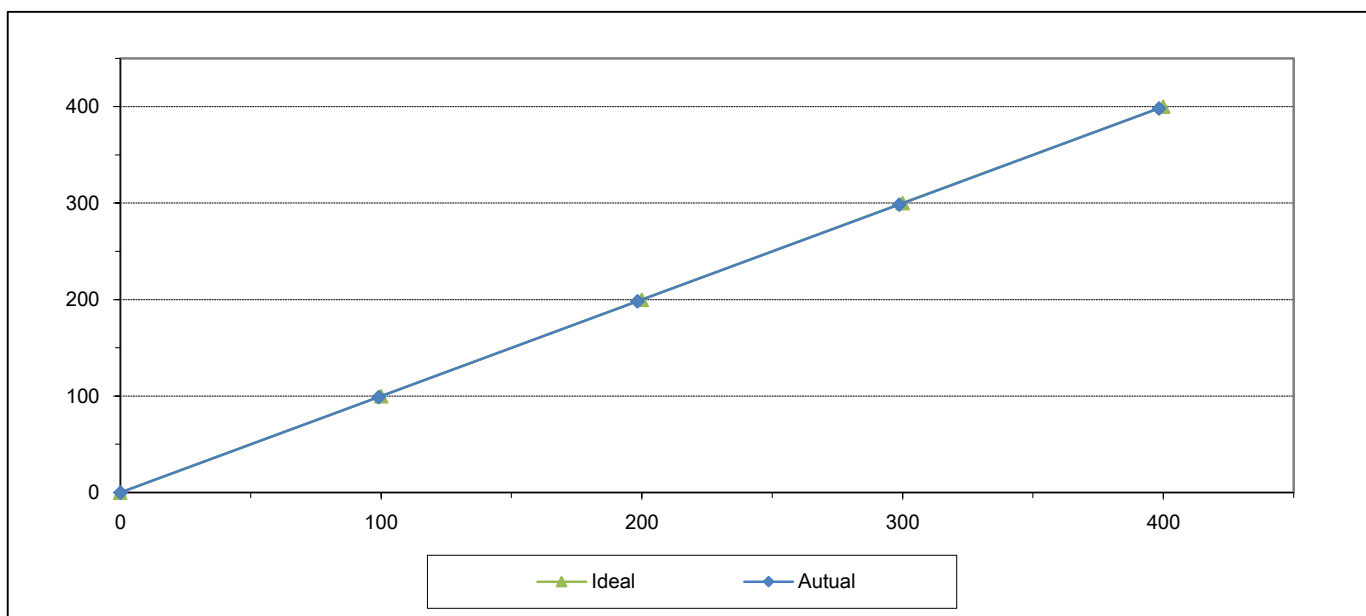
(Mr.Sarayuth Jitranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	XHV1S59F	Equipment ID	BKK_FS1087
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	99.10	-0.90	-0.90
2	200.00	198.30	-1.70	-0.85
3	300.00	298.70	-1.30	-0.43
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				-0.50



Calibrated By

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

Approved By

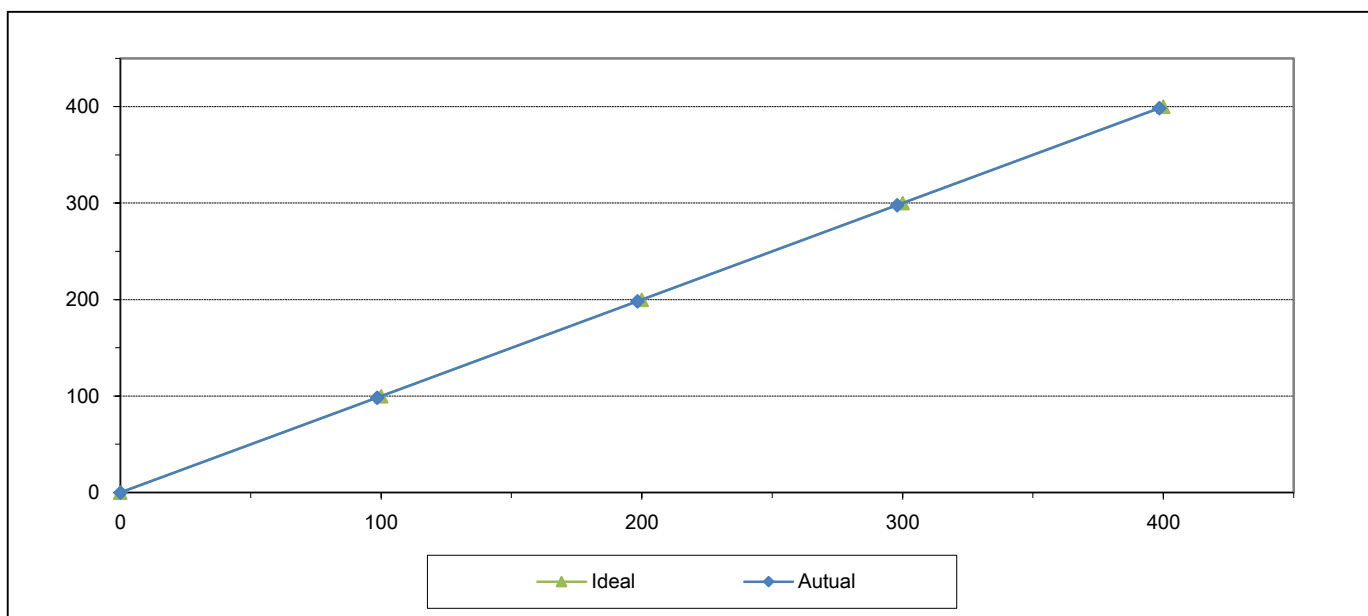
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	6BVW9P1K	Equipment ID	BKK_FS1091
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	98.50	-1.50	-1.50
2	200.00	198.30	-1.70	-0.85
3	300.00	297.90	-2.10	-0.70
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				-0.67



Calibrated By

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

Approved By

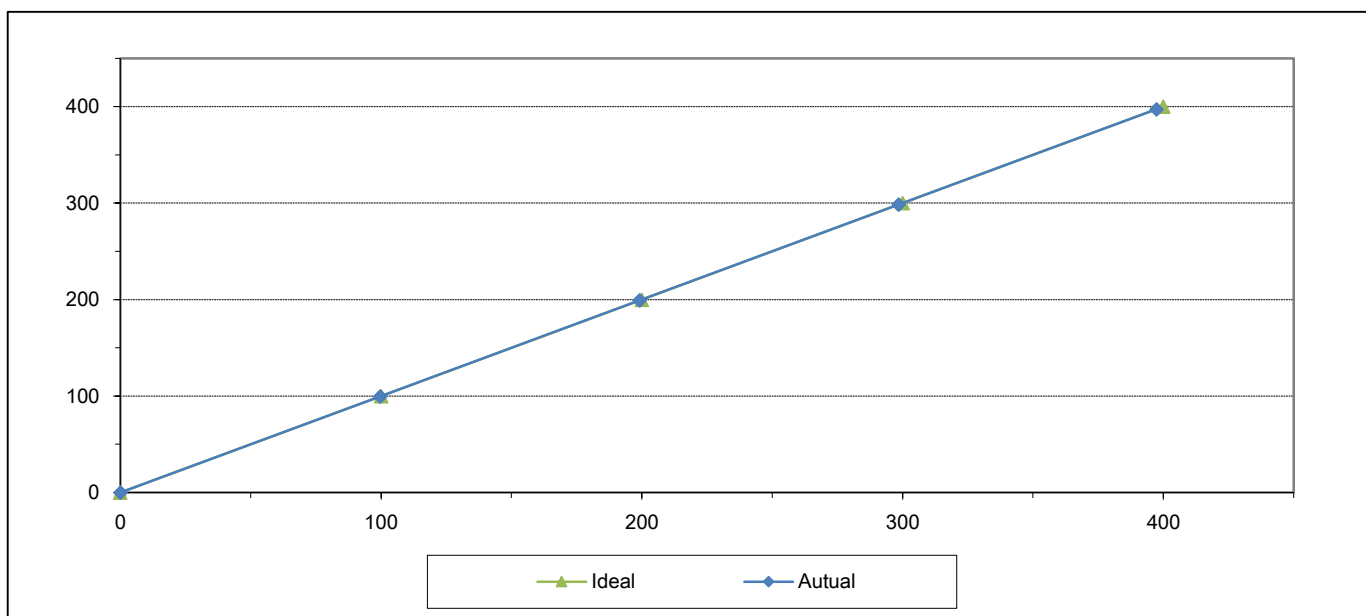
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	Y53SNSFB	Equipment ID	BKK_FS0781
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	99.70	-0.30	-0.30
2	200.00	199.20	-0.80	-0.40
3	300.00	298.50	-1.50	-0.50
4	400.00	397.40	-2.60	-0.65
AVERAGE (%)				-0.35



Calibrated By

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

Approved By

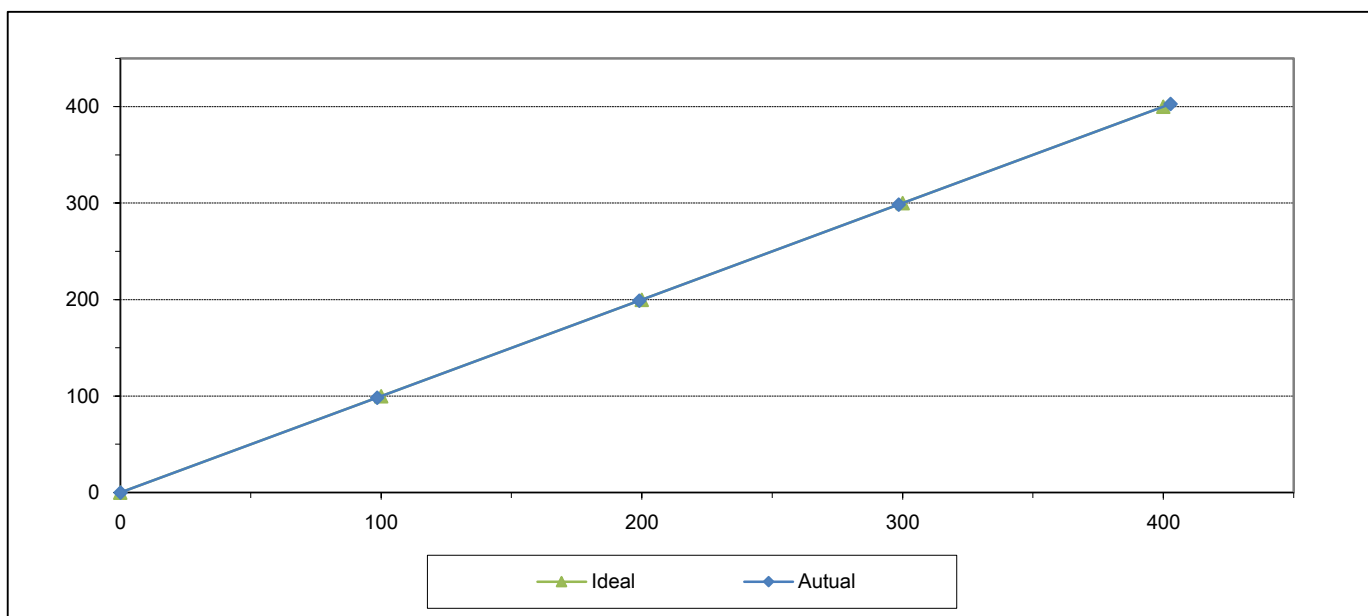
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	060	Equipment ID	BKK_FS0740
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	98.50	-1.50	-1.50
2	200.00	199.00	-1.00	-0.50
3	300.00	298.50	-1.50	-0.50
4	400.00	402.80	2.80	0.70
AVERAGE (%)				-0.34



Calibrated By

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

Approved By

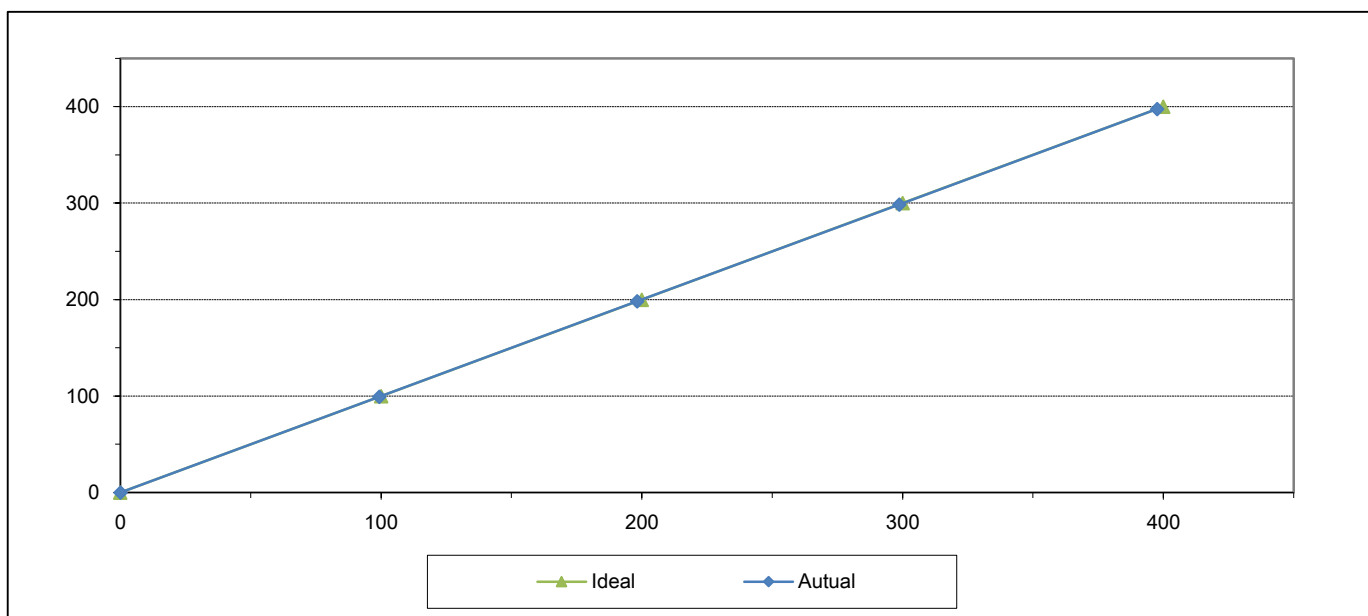
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	70Y1R8R0	Equipment ID	BKK_FS1069
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	99.30	-0.70	-0.70
2	200.00	198.20	-1.80	-0.90
3	300.00	298.70	-1.30	-0.43
4	400.00	397.70	-2.30	-0.58
AVERAGE (%)				-0.50



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-04012022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 110-WS-25DL-D
: Cup anemometer: WS-02F

Serial Number : Data logger: A5444
: Cup anemometer: WSD-003

ID No : Data logger: RYG_FS0435
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Test Conditions	: Wind tunnel cross test section area	900	cm ²
	: Anemometer frontal area	100	cm ²
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]

Test Conditions	: Air temperature	24.4	±0.8 °C
	: Air pressure	1011.2	±0.4 hPa
	: Relative air humidity	55.6	±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 6D.1: 2005-Power Performance Measurements of Electricity Producing Wind
Turbines;
MEASNET Anemometer Calibration Procedure - Version 2: 2009;

Traceability : This calibration documents the traceable to national standard, Which realize the unit of
measurements according to the international system of units (SI) through National Institute of
Metrology Thailand (NIMT).

Measurement Date : JAN 26, 2022.
Issued Date : JAN 31, 2022.

Calibrated by
☒ Mr. Sorawit Thacheled
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-04012022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC*} Reading m/s	Error (m/s)	Uncertainty (%)
2.070	2.0	-0.1	2.4
4.105	4.1	0.0	1.2
6.01	6.0	0.0	0.99
8.01	8.0	0.0	0.71
10.01	10.1	0.1	1.1
12.01	12.2	0.2	0.65
13.98	14.3	0.3	0.61
15.94	16.1	0.2	1.4
14.98	15.1	0.1	1.0
13.00	13.1	0.1	0.76
11.02	11.1	0.1	0.63
9.02	9.0	0.0	0.97
7.03	7.0	0.0	0.84
5.166	5.1	-0.1	1.2
2.996	3.0	0.0	1.6
1.029	0.9	-0.1	4.5

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TCSTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	CSSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-04012022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5444
: Wind direction sensor: WSD-003

ID No : Data logger: RYG_PS0435
: Wind direction sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 25, 2022.

Issued Date : JAN 31, 2022.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-04012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	317	2	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	317	2	3.0

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

End of Certificate of Calibration



CALIBRATION REPORT

Calibration No. : RH-04012022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Relative humidity sensor: HMP60

Serial Number : Data logger: A5444
: Relative humidity sensor: R1131112

ID No : Data logger: RYG_FSD435
: Relative humidity sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25\pm3)^{\circ}\text{C}$, and relative humidity of $(50\pm15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : JAN 24, 2022

Issued Date : JAN 25, 2022

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC _(Reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.3	-0.2
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.5	-0.4
KCl : Potassium Chloride	84.34	84.1	-0.2

Performed by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wlwattittaya



Approved Signatory: _____



Mr. Parinya Booncharoen.
Calibration Department Manager

CALIBRATION REPORT

Calibration Number. : RG-04012022

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novalynx.
: Rain gauge: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Rain gauge: 110-WS-25RG

Serial Number : Data logger: A5444
: Rain gauge: RG-003

ID NO : RYG_FSO435

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge Inlet area:
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = $R^2 \times 3.14$ (UUC diameter=20.3 cm, UUC radius=10.15 cm)
Rain gauge area = 323.6 cm^2 .
2. Obtain theoretical correct rain gauge answer (number of tippings) using 323.6 cm^2 inlet area and 0.5 L of rain.
 - a) $10,000 \text{ cm}^3 / 323.6 \text{ cm}^2$ inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
 - b) $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$ (mm of rain over 1 m^2 surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.
 - c) Number of tipping = $15.45 / 0.25 \text{ mm} = 62$ tippings.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : JAN 28, 2022

Issued Date : JAN 31, 2022

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: _____


Mr. Parinya Booncharoen,
Calibration Department Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG-04012022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	64	60 - 64
500	62	63	60 - 64
500	62	62	60 - 64
500	62	63	60 - 64
500	62	62	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ different from the 62 tipping (correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



CERTIFICATE OF CALIBRATION

Certificate No. : CL-005-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : 110-WS-25BP
SERIAL NUMBER : A5444
ID NUMBER : RYG_FS0435
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.
RECEIVED DATE : 12 Jan 2022
MEASUREMENT DATE : 29 Jan 2022
ISSUE DATE : 31 Jan 2022

Calibration procedure:

The pressure calibration was done by In-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1

Traceability:

The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC17025:2017, ANSI/NCSL Z540-1 via Certificate number: 201479

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	410018L1	201479	13 Sep 2022

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:

Pressure transmitting medium : Air
 $\rho_{Fl}(20^{\circ}\text{C}, 1\text{bar})$: 1.19 kg/m³
 Δh : -0.080 m
 t_{amb} : (23±2) °C
 p_{amb} : 1009.5 mbar

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

Calibrated by:

- ☒ Mr. Sorawit Thachalad
☐ Miss Oratai Wiwatwittaya



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 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)
950.32	951.181	0.856	1.3
970.14	970.682	0.538	0.70
990.05	990.524	0.470	0.58
1009.95	1010.106	0.157	0.34
1029.84	1029.946	0.107	0.25
1049.78	1049.594	-0.190	0.35

Note: UUC* Unit Under Calibration

End of certificate



CERTIFICATE OF CALIBRATION

Certificate No.: CL-004-65

Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx

Model: 110-WS-25DL-D

Serial No.: A5444

ID No.: RYG_FS0435

Customer

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

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

Received date: 12 JAN 2022

Calibration date: 24 JAN 2022

Issue date: 25 JAN 2022

Reference Used During Calibration

1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022

2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^\circ\text{C}$

Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

2Kmp6
Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R1131114

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.053	19.8	-0.3	0.099
60	25.005	24.5	-0.5	0.099
60	29.995	29.5	-0.5	0.099
60	34.976	34.4	-0.6	0.099
60	39.957	39.3	-0.7	0.099

UUC*: Unit Under Calibration

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



CERTIFICATE OF CALIBRATION

Certificate No.: CL-076-65

Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx

Model: 200-WS-25LB

Serial No.: A5244

ID No.: BKK_FS0887

Customer

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

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

Received date: 23 May 2022

Calibration date: 30 May 2022

Issue date: 02 Jun 2022

Reference Used During Calibration

1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 23 Mar 2023

2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0032-
21

REVIEW BY

APPROVED BY

NEXT CAL. DATE

Calibrated by

☒ Mr. Sorawit Thachalad

☐ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : N0330782

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
60	19.98	20.0	0.0	0.30
60	24.98	24.9	-0.1	0.30
60	30.02	29.8	-0.2	0.30
60	35.01	34.6	-0.4	0.30
60	40.01	39.5	-0.5	0.30

UUC*: Unit Under Calibration

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

✱ End of Certificate ✱

CALIBRATION REPORT

Calibration No. : RH-01062022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 200-WS-25LB
Serial Number : A5244
ID No. : BKK_PS0887
Customer : ALS laboratory group (Thailand) Co.,Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

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

Traceability:

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

Measurement Date : Jun 01, 2022

Issued Date : Jun 02, 2022

Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: N0330782

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty \pm (%RH)
20	20.02	18.9	-1.1	0.51
50	50.22	49.4	-0.8	0.51
80	80.56	79.3	-1.3	0.65

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory: _____

Mr. Parinya Booncharoen.
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-01062022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Cup anemometer: WS-02F

Serial Number : Data logger: A5244
: Cup anemometer: -

ID No : Data logger: BKK_FS0887
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.7 ±0.8 °C
: Air pressure 1003.5 ±0.4 hPa
: Relative air humidity 51.1 ±3.5 %RH

Calibration Procedure Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jun 01, 2022.

Issued Date : Jun 02, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:

(Signature)

Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-01062022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.086	2.0	-0.1	2.4
4.179	4.1	-0.1	1.2
6.01	6.0	0.0	0.95
8.00	8.1	0.1	0.66
10.00	10.1	0.1	0.66
12.00	12.1	0.1	0.69
13.99	14.2	0.2	0.59
15.98	16.3	0.3	0.43
15.00	15.3	0.3	0.43
12.99	13.1	0.1	0.52
11.01	11.1	0.1	0.48
9.03	9.0	0.0	0.64
7.03	7.0	0.0	0.81
5.184	5.2	0.0	0.83
3.019	3.1	0.1	1.4
1.050	0.9	-0.2	4.5

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TCSTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2022	CL-027-65	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2022	RH-03032022	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2022	BP-01032022	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration

CERTIFICATE OF CALIBRATION

Certificate No.: WD-01062022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5244
: Wind direction sensor: -

ID No : Data logger: BKK_FS0887
: Wind direction sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : Jun 01, 2022.

Issued Date : Jun 02, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-01062022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	135	0	3.0
5		180	180	182	2	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	135	0	3.0
13		180	180	182	2	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-01012022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 110-WS-25DL-D
: Cup anemometer: WS-02F

Serial Number : Data logger: A5445
: Cup anemometer: WSD-004

ID No : Data logger: RYG_FS0436
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.7 ±0.8 °C
: Air pressure 1013.4 ±0.4 hPa
: Relative air humidity 52.9 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MSASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability : This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : JAN 06, 2022.

Issued Date : JAN 10, 2022.



Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

2kayos
Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-01012022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC*} Reading m/s	Error (m/s)	Uncertainty (%)
2.043	2.0	0.0	2.4
4.113	4.1	0.0	1.3
6.00	6.1	0.1	1.0
7.99	8.1	0.1	0.82
10.01	10.3	0.3	0.67
12.00	12.3	0.3	0.57
13.99	14.4	0.4	0.54
16.00	16.4	0.4	0.57
15.01	15.5	0.5	0.51
12.98	13.4	0.4	0.52
11.02	11.1	0.1	0.53
9.02	9.1	0.1	0.65
7.01	7.1	0.1	0.98
5.145	5.1	0.0	0.96
2.984	3.1	0.1	1.6
1.038	0.9	-0.1	4.5

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-01012022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5445
: Wind direction sensor: WSD-004

ID No : Data logger: RYG_FS0436
: Wind direction sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of (23 ± 3) °C. and relative humidity of (40 ± 10) %.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 06, 2022.

Issued Date : JAN 10, 2022.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-01012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	181	1	3.0
6		225	225	228	3	3.0
7		270	270	274	4	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	181	1	3.0
14		225	225	228	3	3.0
15		270	270	274	4	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CL-001-65

Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx

Model: 110-WS-25DL-D

Serial No.: A5445

ID No.: RYG_FS0436

Customer

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

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

Received date: 28 DEC 2021

Calibration date: 07 JAN 2022

Issue date: 10 JAN 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022

2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21.

Calibrated by

☒ Mr. Sorawit Thachalad

☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

Certificate No.: CL-001-65
Page 2 of 2

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R1131113

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.055	19.9	-0.2	0.099
60	24.895	24.6	-0.3	0.099
60	29.868	29.5	-0.4	0.099
60	34.849	34.5	-0.3	0.099
60	39.837	39.4	-0.4	0.099

UUC*: Unit Under Calibration

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

* End of Certificate *



CALIBRATION REPORT

Calibration No. : RH-01012022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Relative humidity sensor: HMP60

Serial Number : Data logger: A5445
: Relative humidity sensor: R1131113

ID No : Data logger: RYG_FS0436
: Relative humidity sensor: -

Customer : ALS laboratory group (Thailand) Co.,Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : JAN 07, 2022

Issued Date : JAN 10, 2022

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC (Reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.4	-0.1
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.5	-0.4
KCl : Potassium Chloride	84.34	83.8	-0.5

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: _____

25mp05
Mr. Parinya Booncharoen.
Calibration Department Manager

CERTIFICATE REPORT

Certificate No. : BP-01012022

Page 1 of 2 Pages

Measurement Item : Barometric pressure with data logger.

Manufacturer : Data logger: Novalynx.
: Barometric pressure: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Barometric pressure: 110-WS-25BP

Serial Number : Data logger: A5445
: Barometric pressure: A5445

ID Number : RYG_FS0436

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Barometric pressure sensor, Unit Under Calibration (UUC) was calibrated in the pressure conditioning chamber. The standard pressure (P_{STD}) at 990 – 1015 hPa was generated by digital pressure generator. The pressure reading of UUC (P_{UUC}) were compared to the pressure reading of standard to determine the error.

Traceability:

This calibration documents the traceability to national standard which realize the unit of measurements according to the national system of units (SI) through Druck Limited via Certificate No: PS1206, Certificate No: PS1237.

Measurement Date : JAN 05, 2022

Issued Date : JAN 10, 2022

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

25005

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate report number

Certificate No: BP-01012022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

Calibration in the range of: 950 - 1150 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)
950.33	951.0	0.7	0.89
999.89	1000.0	0.1	0.22
1050.00	1049.7	-0.3	0.47
1099.89	1099.1	-0.8	0.99
1149.29	1147.9	-1.4	1.7

Note: UUC* Unit Under Calibration

End of calibration report



CALIBRATION REPORT

Calibration Number. : RG-01012022

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novalynx.
: Rain gauge: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Rain gauge: 110-WS-25RG

Serial Number : Data logger: A5445
: Rain gauge: RG-004

ID NO : RYG_FS0436

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge inlet area:

Rain gauge precise diameter in cm = Diameter/2 = R (radius)

Rain gauge area= $R^2 \times 3.14$ (UUC diameter=20.3 cm, UUC radius=10.15 cm)

Rain gauge area= 323.6 cm^2 .

2. Obtain theoretical correct rain gauge answer (number of tippings) using 323.6 cm^2 inlet area and 0.5 L of rain.

a) $10,000 \text{ cm}^2 / 323.6 \text{ cm}^2 \text{ inlet area} = 30.90$ (rain gauge area = 1/30.90 of square meter)

b) $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$ (mm of rain over 1 m^2 surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.

c) Number of tipping= $15.45 / 0.25 \text{ mm} = 62$ tippings.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : JAN 06, 2022

Issued Date : JAN 10, 2022

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

21 Jan 22

Mr. Parinya Booncharoen,
Calibration Department Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG-01012022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	62	60 - 64
500	62	62	60 - 64
500	62	63	60 - 64
500	62	62	60 - 64
500	62	63	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ different from the 62 tipping (correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



CERTIFICATE OF CALIBRATION

Certificate No: WS-03012022

Page 1 of 2 pages

Measurement Item	: Cup anemometer with data logger.		
Manufacturer	: Data logger: Novalynx : Cup anemometer: Novalynx		
Model/Type	: Data logger: 110-WS-25DL-D : Cup anemometer: WS-02F		
Serial Number	: Data logger: A5443 : Cup anemometer: WSD-002		
ID No	: Data logger: BKK_FS0975 : Cup anemometer: -		
Customer	: ALS laboratory group (Thailand) co., ltd. : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.		
Test Conditions	: Wind tunnel cross test section area	900	cm ²
	: Anemometer frontal area	100	cm ²
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]
Test Conditions	: Air temperature	24.1	±0.8 °C
	: Air pressure	1010.9	±0.4 hPa
	: Relative air humidity	52.4	±3.5 %RH
Calibration Procedure	Calibration was carried out base on; IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines; MSASNET Anemometer Calibration Procedure – Version 2: 2009;		
Traceability	This calibration documents the traceable to national standard, Which realize the unit of measurements according to the International system of units (SI) through National Institute of Metrology Thailand (NIMT).		
Measurement Date	: JAN 26, 2022.		
Issued Date	: JAN 31, 2022.		



Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



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

Continuation of Certificate of Calibration Number

Certificate No: WS-03012022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC*} Reading m/s	Error (m/s)	Uncertainty (%)
2.078	1.9	-0.2	2.5
4.105	4.0	-0.1	1.2
6.00	6.0	0.0	0.95
8.01	8.0	0.0	0.84
10.02	10.1	0.1	0.87
12.02	11.8	-0.2	2.4
13.99	14.1	0.1	0.53
15.99	16.2	0.2	0.42
14.98	15.2	0.2	1.2
12.99	13.0	0.0	0.77
11.01	11.1	0.1	0.48
9.02	9.1	0.1	0.87
6.96	7.0	0.0	1.2
5.145	5.1	0.0	0.96
3.002	3.0	0.0	1.6
1.028	0.8	-0.2	4.8

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TCSTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-03012022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5443
: Wind direction sensor: WSD-002

ID No : Data logger: BKK_FS0975
: Wind direction sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control, The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 25, 2022.

Issued Date : JAN 31, 2022.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss. Orathai Wiwatwittaya



Signatory:.....



Mr. Panya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-03012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration



CALIBRATION REPORT

Calibration No. : RH-03012022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Relative humidity sensor: HMP60

Serial Number : Data logger: A5443
: Relative humidity sensor: R1131111

ID No : Data logger: BKK_FS0975
: Relative humidity sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : JAN 24, 2022

Issued Date : JAN 25, 2022

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC(Reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.1	-0.4
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.5	-0.4
KCl : Potassium Chloride	84.34	84.2	-0.1

Performed by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory: _____



Mr. Parinya Booncharoen.
Calibration Department Manager

CALIBRATION REPORT

Calibration Number. : RG-03012022

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novalynx.
: Rain gauge: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Rain gauge: 110-WS-25RG

Serial Number : Data logger: A5443
: Rain gauge: RG-002

ID NO : BKK_PS0975

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge inlet area:
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = $R^2 \times 3.14$ (UUC diameter=20.3 cm, UUC radius=10.15 cm)
Rain gauge area = 323.6 cm^2 .
2. Obtain theoretical correct rain gauge answer (number of tippings) using 323.6 cm^2 inlet area and 0.5 L of rain.
 - a) $10,000 \text{ cm}^3 / 323.6 \text{ cm}^2$ inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
 - b) $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$ (mm of rain over 1 m^2 surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.
 - c) Number of tipping = $15.45 / 0.25 \text{ mm} = 62$ tippings.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : JAN 28, 2022

Issued Date : JAN 31, 2022

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....



Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG-03012022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	60	60 - 64
500	62	61	60 - 64
500	62	61	60 - 64
500	62	62	60 - 64
500	62	61	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ different from the 62 tipping (correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



CERTIFICATE OF CALIBRATION

Certificate No. : CL-004-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : 110-WS-25BP
SERIAL NUMBER : A5443
ID NUMBER : BKK_FS0975
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.
RECEIVED DATE : 12 Jan 2022
MEASUREMENT DATE : 29 Jan 2022
ISSUE DATE : 31 Jan 2022

Calibration procedure:

The pressure calibration was done by In-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1

Traceability:

The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC17025:2017, ANSI/NCSL Z540-1 via Certificate number: 201479

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	410018L1	201479	13 Sep 2022

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:

Pressure transmitting medium : Air
 $\rho_{H_2O}(20^{\circ}\text{C}, 1\text{bar})$: 1.19 kg/m^3
 Δh : -0.080 m
 t_{amb} : $(23 \pm 2)^{\circ}\text{C}$
 p_{amb} : 1009.5 mbar

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

Calibrated by:

- ☒ Mr. Sorawit Thachalad
☐ Miss Oratai Wiwatwittaya



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 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)
950.17	950.838	0.664	0.88
970.13	970.514	0.385	0.57
990.10	990.493	0.389	0.55
1009.98	1010.064	0.080	0.21
1029.91	1029.743	-0.171	0.28
1049.79	1049.531	-0.263	0.36

Note: UUC* Unit Under Calibration

End of certificate



CERTIFICATE OF CALIBRATION

Certificate No.: CL-003-65
Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx

Model: 110-WS-25DL-D

Serial No.: A5443

ID No.: BKK_FS0975

Customer

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

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

Received date: 12 JAN 2022

Calibration date: 24 JAN 2022

Issue date: 25 JAN 2022

Reference Used During Calibration

1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022

2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: (23±3)*°C

Relative Humidity: (55±15)%

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21.

Calibrated by

☐ Mr. Sorawit Thachalad

☒ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R1131111

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.053	19.8	-0.3	0.099
60	25.001	24.6	-0.4	0.099
60	29.991	29.7	-0.3	0.099
60	34.980	34.5	-0.5	0.099
60	39.960	39.5	-0.5	0.099

UUC*: Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No.: CL-077-65

Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx

Model: 200-WS-25LB

Serial No.: A5261

ID No.: BKK_FS0888

Customer

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

Received date: 23 May 2022

Calibration date: 30 May 2022

Issue date: 02 Jun 2022

Reference Used During Calibration

- 1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 23 Mar 2023
- 2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$
Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0032-
21

REVIEW BY	<i>Manakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	28/11/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : N0330783

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	19.98	20.0	0.1	0.30
60	24.98	24.7	-0.3	0.30
60	30.02	29.6	-0.4	0.30
60	35.01	34.5	-0.5	0.30
60	40.01	39.3	-0.7	0.30

UUC*: Unit Under Calibration

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

✱ End of Certificate ✱



CALIBRATION REPORT

Calibration No. : RH-02062022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 200-WS-25LB
Serial Number : A5261
ID No. : BKK_FS0888
Customer : ALS laboratory group (Thailand) Co.,Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25\pm3)^{\circ}\text{C}$, and relative humidity of $(50\pm15)\%$.

Measurement Method:

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

Traceability:

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

Measurement Date : Jun 01, 2022

Issued Date : Jun 02, 2022

Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: N0330783

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty \pm (%RH)
20	20.02	18.8	-1.2	0.61
50	50.22	49.4	-0.8	0.57
80	80.56	79.3	-1.3	0.69

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen.
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-02062022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Cup anemometer: WS-02F

Serial Number : Data logger: A5261
: Cup anemometer: -

ID No : Data logger: BKK_FS0888
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260 Thailand.

Test Conditions

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

Test Conditions

: Air temperature	24.7	±0.8 °C
: Air pressure	1005.2	±0.4 hPa
: Relative air humidity	46.1	±3.5 %RH

Calibration Procedure Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jun 01, 2022.
Issued Date : Jun 02, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory: _____

Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-02062022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.087	2.0	-0.1	2.4
4.140	4.2	0.1	1.0
6.02	6.0	0.0	0.88
8.00	8.0	0.0	0.74
10.00	10.0	0.0	0.59
11.99	12.1	0.1	0.55
14.02	14.3	0.3	0.42
16.00	16.4	0.4	0.63
15.01	15.4	0.4	0.39
12.97	13.1	0.1	0.59
11.00	11.0	0.0	0.52
9.01	9.0	0.0	0.66
7.01	7.0	0.0	0.85
5.186	5.2	0.0	0.96
3.003	3.1	0.1	1.6
1.053	0.8	-0.3	4.8

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2600	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2022	CL-027-65	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2022	RH-03032022	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2022	BP-01032022	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-02062022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx
: Wind direction sensor: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5261
: Wind direction sensor: -

ID No : Data logger: BKK_FS0888
: Wind direction sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : Jun 01, 2022.

Issued Date : Jun 02, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-02062022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	181	1	3.0
6		225	225	229	4	3.0
7		270	270	274	4	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	181	1	3.0
14		225	225	229	4	3.0
15		270	270	274	4	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration



SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



NSC-TISI-TIS 17025
CALIBRATION 0394

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

Cert. No. : ACC22003

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178119
ID No.: BKK_FS0632

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2022
Calibration Date : 14 JANUARY 2022
Date of Issue : 17 JANUARY 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	14 / 1 / 23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACC22003

Job No. : VC65AC0041

Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-21	10-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACC22003

Job No. : VC65AC0041

Pages : 3 of 3

Result of calibration :**1. Sound pressure level**

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	93.94	-0.06	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.0	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.73	0.10	3.0

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

————— End of Calibration Certificate —————

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22244

Pages : 1 of 8

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 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 11 OCTOBER 2022
Calibration Date : 25-26 OCTOBER 2022
Date of Issue : 27 OCTOBER 2022



Calibrated by : Nathakorn Pisutpaisan

Approved by :

()
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22244
Job No. : VC65AC0090
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22244
Job No. : VC65AC0090
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22244

Job No. : VC65AC0090

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.5
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.4	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.7	-1.6	-1.6	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22244
 Job No. : VC65AC0090
 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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22244

Job No. : VC65AC0090

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	28.1	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

Continuation of Calibration Certificate

Cert. No. : ACL22244

Job No. : VC65AC0090

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22244

Job No. : VC65AC0090

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

————— End of Calibration Certificate —————

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22043

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00873053 / 171587 / 73329
ID No.: BKK_FS0930

Condition As Found : GOOD

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

Location : -

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

Received Date : 05 JANUARY 2022
Calibration Date : 12-14 JANUARY 2022
Date of Issue : 17 JANUARY 2022

REVIEW BY	<i>Marakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	12/1/23

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22043

Job No. : VC65AC0041

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22043
Job No. : VC65AC0041
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22043

Job No. : VC65AC0041

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.4
Flat	24.7

3. Acoustical signal tests of frequency weightings

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22043
Job No. : VC65AC0041
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz**5.1 Frequency weightings at 1 kHz**

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22043

Job No. : VC65AC0041

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	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	25.0	0.0	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22043
Job No. : VC65AC0041
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	93.9	-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

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL22043

Job No. : VC65AC0041

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL21169

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00858520 / 158771 / 58772
ID No.: BKK_FS0110

Condition As Found : GOOD

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

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

Received Date : 09 DECEMBER 2021
Calibration Date : 14-15 DECEMBER 2021
Date of Issue : 16 DECEMBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	14/12/22

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21169

Job No. : VC65AC0033

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21169
Job No. : VC65AC0033
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21169
Job No. : VC65AC0033
Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.6

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	16.9
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	0.4	0.4	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.3	-1.2	-1.2	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21169
Job No. : VC65AC0033
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21169
Job No. : VC65AC0033
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 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

Continuation of Calibration Certificate

Cert. No. : ACL21169

Job No. : VC65AC0033

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21169

Job No. : VC65AC0033

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22178

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01022263 / 136951 / 22311
ID No.: BKK_FS0032

Condition As Found : GOOD

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

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

Received Date : 25 JULY 2022
Calibration Date : 15-18 AUGUST 2022
Date of Issue : 19 AUGUST 2022

REVIEW BY	Narakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	15/8/23

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL22178
Job No. : VC65AC0071
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22178

Job No. : VC65AC0071

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22178

Job No. : VC65AC0071

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.5
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.5	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.4	-2.4	-2.3	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22178

Job No. : VC65AC0071

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	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.1	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22178
Job No. : VC65AC0071
Pages : 6 of 8

7. Level linearity on the reference level range

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

Continuation of Calibration Certificate

Cert. No. : ACL22178
 Job No. : VC65AC0071
 Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL22178

Job No. : VC65AC0071

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

————— **End of Calibration Certificate** —————

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22177

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00658241 / 158767 / 58769
ID No.: BKK_FS0098

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 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 25 JULY 2022
Calibration Date : 15-18 AUGUST 2022
Date of Issue : 19 AUGUST 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	15/8/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	18.0
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.5	0.5	0.6	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.7	-1.7	-1.7	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
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

Continuation of Calibration Certificate

 Cert. No. : ACL22177
 Job No. : VC65AC0071
 Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22177
Job No. : VC65AC0071
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



Cert. No. : ACL22149

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,
KHWAEANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 17 JUNE 2022
Calibration Date : 20-22 JUNE 2022
Date of Issue : 27 JUNE 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	20/6/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.7

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

Frequency Weighting	Measured value (dB)
A - weight	12.5
C - weight	18.7
Flat	24.5

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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.6	0.6	0.6	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	0.0	0.1	0.1	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22149
Job No. : VC65AC0068
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 6 of 8

7. Level linearity on the reference level range

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

Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.0	-0.4	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL22149

Job No. : VC65AC0068

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22252

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00858517 / 157784 / 48099
ID No.: BKK_FS0107

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 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 01 NOVEMBER 2022
Calibration Date : 02-03 NOVEMBER 2022
Date of Issue : 04 NOVEMBER 2022

REVIEW BY	<i>Manakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	2/11/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL22252

Job No. : VC66AC0004

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22252
Job No. : VC66AC0004
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22252

Job No. : VC66AC0004

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.3

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

Frequency Weighting	Measured value (dB)
A - weight	12.6
C - weight	18.7
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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.2	-1.1	-1.1	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22252
 Job No. : VC66AC0004
 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	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22252

Job No. : VC66AC0004

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	63.9	-0.1	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	48.9	-0.1	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22252
 Job No. : VC66AC0004
 Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22252

Job No. : VC66AC0004

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

CERTIFICATE OF CALIBRATION

Certificate No. : CL-018-65
Page 1 of 2

Equipment Name: Heat Stress Monitor with Sensor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15036132
ID No: BKK_FS0680

Customer

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

Received date: 10 JAN 2022
Calibration date: 15 FEB 2022
Issue date: 17 FEB 2022

Reference Used During Calibration

- 1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022
- 2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$
Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

REVIEW BY

Narakee P.

APPROVED BY

[Signature]

NEXT CAL. DATE

15/2/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15015846.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.053	20.1	0.0	0.099
30	25.034	25.1	0.1	0.099
30	30.014	30.1	0.1	0.099
30	35.019	35.1	0.1	0.099
30	40.006	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 14032362.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.051	20.1	0.0	0.099
70	24.990	25.0	0.0	0.099
70	29.917	29.8	-0.1	0.099
70	34.873	34.7	-0.2	0.099
70	39.864	39.6	-0.3	0.099

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

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.054	20.0	-0.1	0.099
110	25.036	25.0	0.0	0.099
110	30.017	30.0	0.0	0.099
110	35.024	35.0	0.0	0.099
110	40.001	40.0	0.0	0.099

UUC* : Unit Under Calibration

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



CERTIFICATE OF CALIBRATION

Certificate No. : CL-074-64

Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor

Manufacturer. : DeltaOHM

Model: HD32.2

Serial No: 15036012

ID No: BKK_FS0673

Customer

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

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

Received date : 8 SEP 2021

Calibration date : 1 OCT 2021

Issue date : 4 OCT 2021

Reference Used During Calibration

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

Serial No.: 667682-09, Due date: 25 Mar 2022

2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21.

REVIEW BY	<i>Parinya P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	1/10/22

Calibrated by

☐ Mr. Sorawit Thachalad

☒ Miss Orathai Wiwatwittaya



Approved Signatory: *[Signature]*

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008211.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u>	<u>Standard</u>	<u>UUC</u>	<u>Error</u>	<u>Uncertainty</u>
<u>Depth</u>	<u>Reading</u>	<u>Reading</u>	<u>(°C)</u>	<u>(°C)</u>
<u>(mm)</u>	<u>(°C)</u>	<u>(°C)</u>		
30	20.050	19.9	-0.2	0.099
30	25.042	24.9	-0.1	0.099
30	30.036	29.8	-0.2	0.099
30	35.029	34.8	-0.2	0.099
30	40.018	39.8	-0.2	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 16009354.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u>	<u>Standard</u>	<u>UUC</u>	<u>Error</u>	<u>Uncertainty</u>
<u>Depth</u>	<u>Reading</u>	<u>Reading</u>	<u>(°C)</u>	<u>(°C)</u>
<u>(mm)</u>	<u>(°C)</u>	<u>(°C)</u>		
70	20.055	20.1	0.0	0.099
70	24.860	24.8	-0.1	0.099
70	29.824	29.6	-0.2	0.099
70	34.780	34.5	-0.3	0.099
70	39.707	39.4	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008199.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u>	<u>Standard</u>	<u>UUC</u>	<u>Error</u>	<u>Uncertainty</u>
<u>Depth</u>	<u>Reading</u>	<u>Reading</u>	<u>(°C)</u>	<u>(°C)</u>
<u>(mm)</u>	<u>(°C)</u>	<u>(°C)</u>		
110	20.050	20.1	0.0	0.099
110	25.042	25.1	0.1	0.099
110	30.036	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.018	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

*** End of Certificate ***

CERTIFICATE OF CALIBRATION

Certificate No. : CL-094-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 15006300
ID No: BKK_FS0661

Customer

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

Received date: 8 DEC 2021

Calibration date: 13 DEC 2021

Issue date: 14 DEC 2021

Reference Used During Calibration

- 1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022
- 2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: (23±3)°C

Relative Humidity: (55±15)%

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

REVIEW BY	<i>Parinya P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	13/12/22

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: *[Signature]*

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Result of Calibration:- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15003275.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.061	20.1	0.0	0.099
30	25.051	25.1	0.0	0.099
30	30.036	30.1	0.1	0.099
30	35.033	35.1	0.1	0.099
30	40.025	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15031950.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.059	20.1	0.0	0.099
70	24.877	24.9	0.0	0.099
70	29.822	29.8	0.0	0.099
70	34.778	34.6	-0.2	0.099
70	39.739	39.6	-0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15008168.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.061	20.1	0.0	0.099
110	25.053	25.1	0.0	0.099
110	30.035	30.1	0.1	0.099
110	35.033	35.1	0.1	0.099
110	40.025	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-076-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 16002005
ID No: BKK_FS0682

Customer

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

Received date : 8 SEP 2021

Calibration date : 1 OCT 2021

Issue date : 4 OCT 2021

Reference Used During Calibration

1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022
2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

REVIEW BY	<i>Parinya P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	1/10/22

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008205.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.058	19.9	-0.2	0.099
30	25.041	24.9	-0.1	0.099
30	30.023	29.9	-0.1	0.099
30	35.024	34.9	-0.1	0.099
30	40.034	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 16009355.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.055	20.1	0.0	0.099
70	24.881	24.8	-0.1	0.099
70	29.837	29.7	-0.1	0.099
70	34.775	34.5	-0.3	0.099
70	39.741	39.5	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008196.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.058	20.1	0.0	0.099
110	25.040	25.1	0.1	0.099
110	30.024	30.1	0.1	0.099
110	35.023	35.1	0.1	0.099
110	40.034	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

✱ End of Certificate ✱



CERTIFICATE OF CALIBRATION

Certificate No. : CL-165-65
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer.: Delta OHM
Model: HD32.2
Serial No: 16002005
ID No: BKK_FS0682

Customer

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

Received date: 15 Nov 2022

Calibration date: 21 Nov 2022

Issue date: 23 Nov 2022

Reference Used During Calibration

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

Calibration Condition

Temperature: $(23 \pm 3)^\circ\text{C}$
Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

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

REVIEW BY	Marakorn P.
APPROVED BY	
NEXT CAL. DATE	21/11/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol



Approved Signatory:


Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008205.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.065	20.0	-0.1	0.14
30	25.050	24.9	-0.2	0.099
30	30.042	29.9	-0.1	0.099
30	35.040	34.9	-0.1	0.099
30	40.033	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 16010559.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.066	20.1	0.0	0.099
70	25.052	24.8	-0.3	0.099
70	30.042	29.7	-0.3	0.099
70	35.038	34.6	-0.4	0.099
70	40.034	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008196.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.065	20.1	0.0	0.099
110	25.052	25.1	0.0	0.099
110	30.042	30.1	0.1	0.099
110	35.039	35.1	0.1	0.099
110	40.034	40.0	0.0	0.099

UUC* : Unit Under Calibration

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

*** End of Certificate ***



CERTIFICATE OF CALIBRATION

Certificate No.: CL-053-65
Page 1 of 2

Equipment Name: Digital thermometer with RTD
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15006710
ID No: BKK_FS0672

Customer

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

Received date: 15 MAR 2022

Calibration date: 17 MAR 2022

Issue date: 18 MAR 2022

Reference Used During Calibration

1.Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022
2.Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

REVIEW BY *Norakorn P.*

APPROVED BY *[Signature]*

NEXT CAL. DATE *17/3/23*

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory: *[Signature]*

Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15015852
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.082	20.0	-0.1	0.099
30	25.077	25.1	0.0	0.099
30	30.069	30.0	-0.1	0.099
30	35.064	35.0	-0.1	0.099
30	40.056	40.0	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 14036714.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.082	20.2	0.1	0.099
70	25.076	25.0	-0.1	0.099
70	30.068	29.9	-0.4	0.099
70	35.062	34.4	-0.7	0.099
70	40.036	39.6	-0.4	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15021832.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.082	20.1	0.0	0.099
110	25.077	25.1	0.0	0.099
110	30.069	30.1	0.0	0.099
110	35.064	35.1	0.0	0.099
110	40.056	40.1	0.0	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-017-65
Page 1 of 2

Equipment Name: Heat Stress Monitor with Sensor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15036019
ID No: BKK_FS0678

Customer

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

Received date: 10 JAN 2022
Calibration date: 15 FEB 2022
Issue date: 17 FEB 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 25 Mar 2022
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$
Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0036-21, Certificate number: ER-0032-
21

REVIEW BY	<i>Mr. Parinya P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	15/2/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008206.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.040	20.1	0.1	0.099
30	25.034	25.1	0.1	0.099
30	30.019	30.1	0.1	0.099
30	35.018	35.1	0.1	0.099
30	40.004	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 16010556.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.051	20.1	0.0	0.099
70	24.990	25.0	0.0	0.099
70	29.917	29.9	0.0	0.099
70	34.873	34.8	-0.1	0.099
70	39.864	39.7	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008185.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.042	20.1	0.1	0.099
110	25.032	25.1	0.1	0.099
110	30.019	30.1	0.1	0.099
110	35.020	35.1	0.1	0.099
110	40.001	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-149-65

Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15036021
ID No: BKK_FS0679

Customer

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

Received date: 12 Sep 2022

Calibration date: 28 Sep 2022

Issue date: 03 Oct 2022

Reference Used During Calibration

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

Calibration Condition

Temperature: $(23 \pm 3)^{\circ}\text{C}$
Relative Humidity: $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

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

REVIEW BY	<i>Manakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	<i>28/9/23</i>

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008209.
Dimension: Diameter 14 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
30	20.046	19.9	-0.1	0.099
30	25.055	24.9	-0.2	0.099
30	30.053	29.9	-0.2	0.099
30	35.047	34.9	-0.1	0.099
30	40.041	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15037322.
Dimension: Diameter 14 mm. Length 150 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
70	20.046	20.1	0.1	0.099
70	25.055	24.9	-0.2	0.099
70	30.053	29.8	-0.3	0.099
70	35.047	34.6	-0.4	0.099
70	40.041	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008203.
Dimension: Diameter 8 mm. Length 170 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
110	20.046	20.1	0.1	0.099
110	25.056	25.1	0.0	0.099
110	30.053	30.1	0.0	0.099
110	35.047	35.1	0.1	0.099
110	40.041	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

✱ End of Certificate ✱





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



Certificate of Calibration

Certificate No. : 22PH76

Page : 1 of 2

Equipment : Lux Meter
Manufacturer: Delta OHM
Model : 2102.2
Serial No.: 16002028
ID No.: BKK_FS0606
Condition As-Received: Used Item
Received Date: 07 February 2022
Calibration Date: 15 February 2022
Reference: 2202-0252WSC
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 In-house calibration procedure CP-PH01 by measuring against
luminous-intensity standard lamp (source-based method) According to the inverse square law measurement
method.

Condition of this result of calibration

1. Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Photometry & Encoder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2022
2) Luminous intensity standard lamp	OL FEL-U	F-1543	TP-1020-21	02 May 2022

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

3. Test Equipment : Programmable Voltage/Current Source (Model : OL83A, S/N : 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 at:-

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	<i>Narakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	15/2/23

Calibrated by : Nuntawat Khamchai
Issue Date : 17 February 2022

Approved Signatory : *[Signature]*
☒ Phalinee Prabpaipal
☐ Nuntawat Khamchai



Cert. No.: 22PH76

Page.: 2 of 2

Result of calibration:-

(*) Without adjustment () After adjustment

Function : Illuminance Measurement

Range : Autorange

<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(lx)	(lx)	(lx)	(± lx)
0	0.01	0.01	0.060
15	14.17	-0.83	0.20
100	94.76	-5.24	1.3
500	480.1	-19.9	6.5
1000	978.7	-21.3	13
2000	1985.8	-14.3	26
3000	3006	6	39
4000	4022	22	52
5000	5074	74	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 %

Probe sensor s/n. 15030918

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. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH1730

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go
Serial No. :	B553912470
ID No. :	BKK_LG0031
Condition As-Received:	Used Item
Received Date :	22 December 2021
Calibration Date :	23 December 2021
Reference :	2112-0571DSC-3
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Malu

Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 24 December 2021

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Cert. No.: 21CH1730

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	43160066	130RC092	21E1223/1	27 Apr 2022

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	761016	02 Aug 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B553912470	4.00	177.48	177	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor <i>k</i>
pH Electrode S/N.: 0191151	4.008	4.01	171	0.0071	2.00
	6.982	6.98	-4	0.0099	2.00
	10.015	10.01	-179	0.0095	2.00

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

-o0o-

Malu.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 21TM2304

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go

Serial No. : B553912470

ID No. : BKK_LG0031

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 : 22 December 2021

Calibrated Date : 27 December 2021

Ambient Temperature : (26 \pm 10) °C

Relative Humidity : (50 \pm 30) %

AC Line Voltage : (220 \pm 22) V

Calibrated by : Preecha Hlahib

Approved by :

Approved Signatory

- () Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 6 January 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0036304



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2112-0571DSC-2

Cert. No.: 21TM2304

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:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1502A	A52847	2111144	20 Oct 2022

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with thermocouple Type T, S/N.: 0191151

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
20.0	100	20.009	20.1	0.091	0.30	2.00
25.0	100	24.999	25.1	0.101	0.30	2.00
30.0	100	30.003	30.2	0.197	0.30	2.00
35.0	100	35.004	35.2	0.196	0.30	2.00
40.0	100	40.003	40.2	0.197	0.30	2.00
45.0	100	45.008	45.2	0.192	0.30	2.00
50.0	100	50.004	50.2	0.196	0.30	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-

Malu



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH1222

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven Compact S220
Serial No. :	B520948426
ID No. :	BKK_EN0072
Condition As-Received:	Used Item
Received Date :	09 September 2022
Calibration Date :	12 September 2022
Reference :	2209-0312DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

REVIEW BY	<u>Sinluk P.</u>
APPROVED BY	<u>KL AL</u>
NEXT CAL. DATE	<u>12/03/24</u>

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 15 September 2022

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.: 22CH1222

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	823320	20 June 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 2023

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

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B520948426	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	0.0	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor <i>k</i>
pH Electrode S/N.: PCE-86-EX1001	4.008	3.999	153.9	0.0055	2.09
	6.985	7.017	-13.7	0.0084	2.00
	10.008	9.996	-179.0	0.0078	2.06

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-

Mahu.

a 1126274



Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22071

Certificate No.:	PTC/07/22071	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	26207042
Model:	MSE224-100-DU	ID No:	BKK_EN0002
Type of Balance:	Single interval		



Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

Environment Condition: Temperature 21.5 °C \pm 0.7 °C
Humidity 61.8 %RH \pm 4.7 %RH
Air density 1.19 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.



The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO.,LTD

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Mr. Keattisak Kerdto)

Laboratory Manager

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 recognised national standard laboratories.

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

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22071

Certificate No.: PTC/07/22071

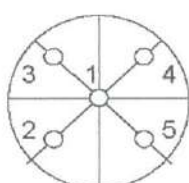
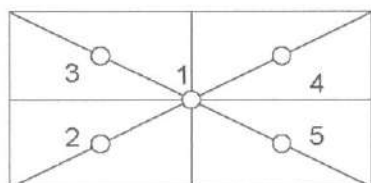
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	-0.0002	-0.0001	0.0001	-0.0001
Maximum deviation:				0.0002

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
200	0.00005

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00016	2.52
0.1	0.10000	0.1000	0.0000	0.00017	2.20
0.5	0.50000	0.5000	0.0000	0.00016	2.28
1	1.00001	1.0000	0.0000	0.00016	2.28
2	2.00001	2.0000	0.0000	0.00016	2.28
5	5.00001	5.0000	0.0000	0.00016	2.28
10	10.00002	10.0000	0.0000	0.00016	2.28
20	20.00002	20.0000	0.0000	0.00016	2.23
50	50.00001	50.0000	0.0000	0.00017	2.15
100	100.00002	99.9999	0.0001	0.00020	2.06
120	120.00004	120.0000	0.0000	0.00023	2.03
150	150.00003	150.0000	0.0000	0.00026	2.00
200	200.00003	199.9999	0.0001	0.00030	2.00

Note: Weight of adjust - (g)

The End of Certificate



Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th



Certificate No. T220139

Page 1 of 3

Certificate of Calibration

Equipment : Liquid Bath (Water)

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611.0135

Customer Code : BKK_EN0148

ID No. : T6455A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

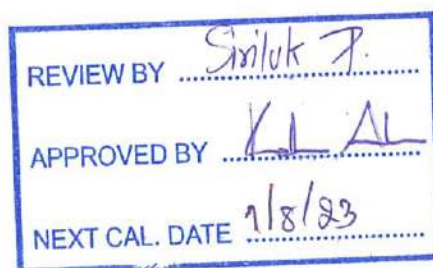
Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 26 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 08 FEB 2022



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

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

Certificate No. T220139

Page 2 of 3

Calibration Report

Equipment : Liquid Bath (Water)
Date of Calibration : 31 January 2022
Environment : Temperature : 22.4-23.9 °C
Line Voltage : 221.4-225.4 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert five resistance thermometer detectors into its water bath , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T36 (based on ASTM E715-80 (Reapproved 2001)).

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	M34 (CH1-CH5)	T210115	2 February 2022
DATA LOGGER	34970A	T47	T210115	2 February 2022

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant 1 Hour - Minute At 60 °C

5. Adjustment :

(X) without adjustment

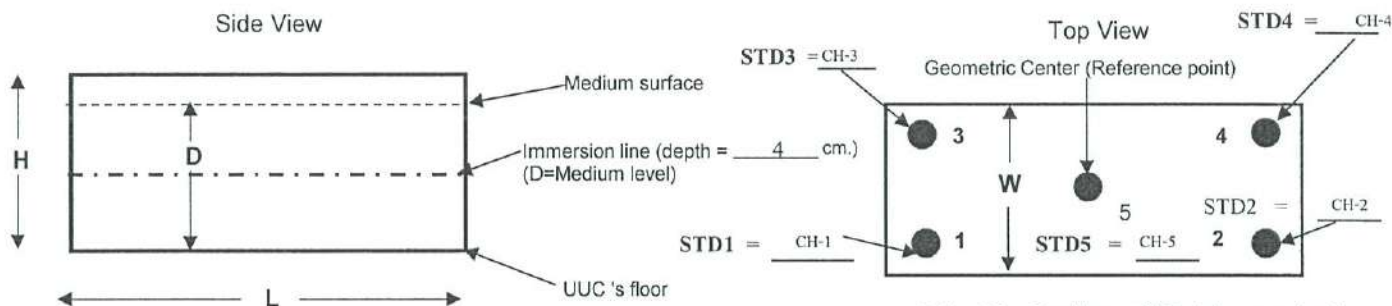
() after adjustment

Approved By. 

Certificate No. T220139

Page 3 of 3

Calibration Report



● 1~●5 = Position of Working standards

- D = Medium level : 8 cm.
 - UUC's medium : Water
 - Working standards are located at 2.5 cm. away from each corner and walls.
- Working space dimension : 62 × 41 × 14 (W×L×H)

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-2	CH-3	CH-4	CH-5
60	59.95	60.04	60.12	60.01	59.89
85	85.17	84.89	85.34	84.78	84.93
95	93.46	93.14	93.81	93.05	93.28

Liquid Bath (Water)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average				
61.0	60.9 , 61	61.0	0.10	0.19	0.25	2.00
86.0	85.9 , 86.1	86.0	0.12	0.39	0.32	2.06
95.0	94.8 , 95.1	94.9	0.14	0.51	0.38	2.11

* 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. 



Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +668 9205 6851 , +669 8247 2360

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



Certificate No. T211650

Page 1 of 3

Certificate of Calibration

Equipment : Chamber (Oven)

Manufacturer : Memmert

Model : UF 450

Serial No. : B7170531

Customer Code : BKK-EN0273

ID No. : T8042A4

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

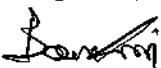
104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250

Customer Location : Oven Room

Date of Receipt : 16 July 2021

Calibrated By : Atiphong Rongrat (Technician)

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 23 JUL 2021

REVIEW BY	<u>Sinluk P.</u>
APPROVED BY	<u>KL AL</u>
NEXT CAL. DATE	<u>20/1/22</u>

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

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

Certificate No. T211650

Page 2 of 3

Calibration Report

Equipment : Chamber (Oven)
Date of Calibration : 22 July 2021
Environment : Temperature : 25.6-25.7 °C
Line Voltage : 227.5-233.3 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 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
RTD	100 ohm	13-(CH1-10)	T202056	24 September 2021
DATA LOGGER	34970A	T121	T202056	24 September 2021

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 104 °C
Fresh Air Damper ☒ Open ☐ Min ☒ Medium ☐ Max
☐ Close
☐ Not Available

5. Adjustment :

(X) without adjustment

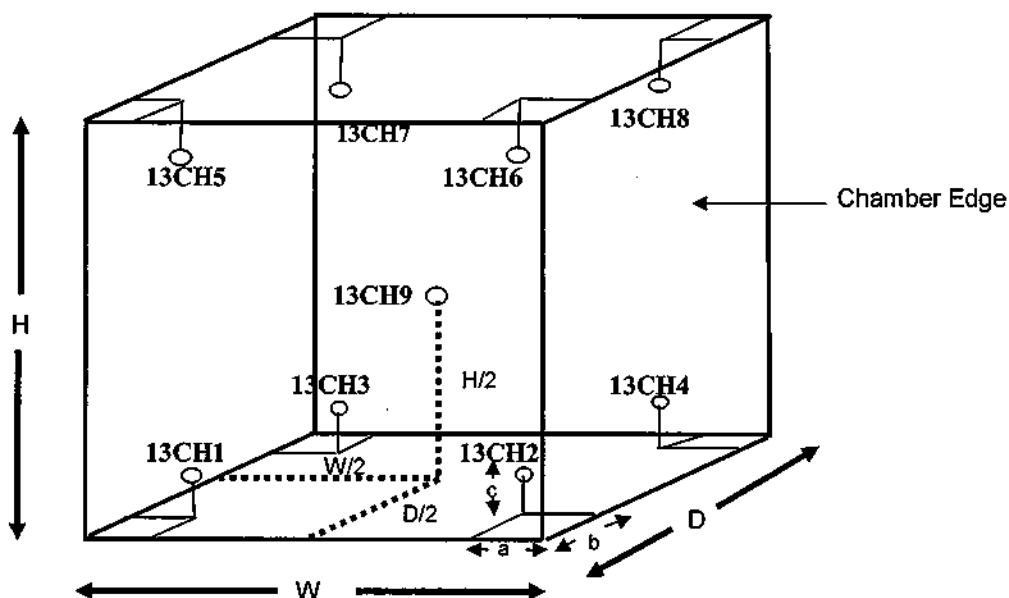
() after adjustment

Approved By. 

Certificate No. T211650

Page 3 of 3

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm. , H(Height)=72 cm. and D(Depth)=60 cm.
 Size of Installed Standard sensor number13CH1to number13CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.
 Size of Installed Standard sensor number13CH9 : W/2=104 cm./2 ,H/2=72 cm./2 and D/2=60 cm./2

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)								
	13CH1	13CH2	13CH3	13CH4	13CH5	13CH6	13CH7	13CH8	13CH9
104	104.34	104.10	103.94	104.63	103.75	104.79	103.41	104.74	103.40
180	180.62	180.63	180.75	180.38	179.47	180.97	178.80	180.63	178.86

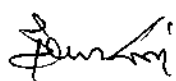
Chamber (Oven)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min , Max	Average				
104.0	104 , 104.1	104.0	0.3	1.7	0.59	2.00
180.0	180 , 180.1	180.0	0.2	2.7	0.73	2.00

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

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

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

Approved By. 



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

Cert.No.: 22TW122

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
Received Date : 20 May 2022
Test Date : 24 May 2022

Reference : 2205-0638DSC-8

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 : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
(☐) Salthip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 31 May 2022

REVIEW BY	<i>Siriluk P.</i>
APPROVED BY	<i>K. An</i>
NEXT CAL. DATE	<i>24/11/23</i>



Cert.No.: 22TW122

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	21MM430	21 Sep 2022

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 16K100498

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.015

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

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Maku

a 1110482



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM83

Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5000-230V

Serial No. : 09J 101147

ID No. : BKK_EN0017

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 : 20 May 2022

Calibrated Date : 30 May 2022

Ambient Temperature : (26 \pm 10) °C

Relative Humidity : (50 \pm 30) %

AC Line Voltage : (220 \pm 22) V

Calibrated by : Tawatchai Pama

Approved by :

Malee

Approved Signatory

- () Pornthippa Tameyakul
(☒) Malee Butkruea
() Suwit Imjai

Issue Date : 31 May 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0039957



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2205-0638DSC-10
Procedure Used :-

Cert. No.: 22LM83

Page.: 2 of 2

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1502A	A09204	2218	04 Jan 2023

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with thermistor sensor , ID No.: 16K100498

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
20.00	60	20.003	20.01	0.007	0.15	2.00

UUC* : Unit Under Calibration

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

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Malu -

a 1090806



Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +668 9205 6851 , +669 8247 2360

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



Certificate No. T212123

Page 1 of 3

Certificate of Calibration

Equipment : Chamber (Incubator)

Manufacturer : SHEL LAB

Model : 2020-2E

Serial No. : 802899

Customer Code : BKK_EN0005

ID No. : T7499A0

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab2

Date of Receipt : 1 October 2021

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By :  /Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 07 OCT 2021

REVIEW BY	Sin'uk P.
APPROVED BY	LL AL
NEXT CAL. DATE	4/4/23

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

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

Certificate No. T212123

Page 2 of 3

Calibration Report

Equipment : Chamber (Incubator)
Date of Calibration : 4-5 October 2021
Environment : Temperature : 23.8-24.9 °C
Line Voltage : 227.5-231.1 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 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
RTD	100 ohm	29-(CH1-10)	T210118	2 February 2022
DATA LOGGER	34970A	T47	T210118	2 February 2022

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 20 Minute At 20 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

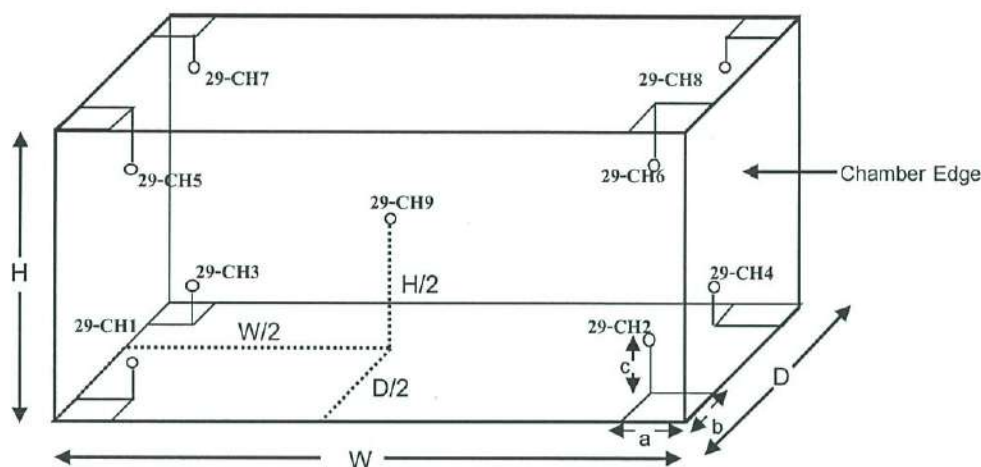
Approved By. _____



Certificate No. T212123

Page 3 of 3

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 70 cm. , H (Height) = 130 cm. and D (Depth) = 55 cm.
 Size of Installed Standard sensor number 29-CH1 to number 29-CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.
 Size of Installed Standard sensor number 29-CH9 : W/2 = 70 cm./2 , H/2 = 130 cm./2 and D/2 = 55cm./2

Measurement Results

Average Standard Reading at each position (°C)									
Calibration Point	29-CH1	29-CH2	29-CH3	29-CH4	29-CH5	29-CH6	29-CH7	29-CH8	29-CH9
20	20.04	20.06	20.19	19.86	19.68	20.08	20.12	19.80	20.07
25	24.99	25.06	25.18	24.89	24.74	25.12	25.16	24.80	25.10

Chamber (Incubator)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average				
20.0	-	20.0	0.05	1.01	0.38	2.00
25.0	-	25.0	0.07	0.96	0.38	2.00

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

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

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

Approved By. 

HACH COMPANY

C/O AB Sciex (Thailand) Limited, Building D Room No. D3 11, 3rd Floor, No. 735/4, Srinakarin Road, Pattanakarn, Suanluang, Bangkok
 | Phone +66 (02) 026-3529 Ext. 0 | Fax: +66(02) 026-3572 | www.sea.hach.com

LABX 2201157

Test Report

Customers	: ALS Laboratory Group (Thailand) Co., Ltd.	Manufacturer	: HACH
Equipment	: Chlorine Meter	Sensor Model	: -
Controller Model	: DR300	Sensor Serial No.	: BKK LG0043
Controller Serial No.	: 20110B004053	Period	: 1 Year
Date of test	: 25/05/2022	Humidity	: 60.0 %RH
Environment temperature	: 25.0 °C		

ResultsInstrument Checked

Item	Characteristic	Before	After	Remark
1	Visual Inspect	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
2	Power Supply (4.5 – 6.5 VDC)	6.5 VDC	6.5 VDC	
3	Display Check	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
4	Keyboard Check	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
5	Function System Program	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	

Warning and Error Checked

Item	Event	Before	After
6	Error list	<input checked="" type="checkbox"/> None <input type="checkbox"/> Appear	<input checked="" type="checkbox"/> None <input type="checkbox"/> Appear

Check with Standard

Item	Characteristic	Before	After	Remark
	DPD-CHLORINE-LR			
7	Blank (0.00 mg/l)	0.00 mg/l	0.00 mg/l	
8	Standard Cl2 No. 1 (0.25 ± 0.09 mg/l)	0.21 mg/l	0.25 mg/l	
9	Standard Cl2 No. 2 (0.94 ± 0.10 mg/l)	0.91 mg/l	0.93 mg/l	
10	Standard Cl2 No. 3 (1.72 ± 0.14 mg/l)	1.66 mg/l	1.70 mg/l	
	DPD-CHLORINE-HR			
11	Blank (0.0 mg/l)	0.0 mg/l	0.0 mg/l	
12	Standard Cl2 No. 1 (2.2 ± 0.2 mg/l)	2.2 mg/l	2.2 mg/l	
13	Standard Cl2 No. 2 (4.1 ± 0.3 mg/l)	4.0 mg/l	4.1 mg/l	
14	Standard Cl2 No. 3 (7.0 ± 0.6 mg/l)	7.0 mg/l	7.0 mg/l	

REVIEW BY Chayathron P.
 APPROVED BY Prakorn P.
 NEXT CAL. DATE 25/5/23



HACH COMPANY

C/O AB Sciex (Thailand) Limited, Building D Room No. D3 11, 3rd Floor, No. 735/4, Srinakarin Road, Pattanakarn, Suanluang, Bangkok
| Phone +66 (02) 026-3529 Ext. 0 | Fax +66(02) 026-3572 | www.sea.hach.com |

LABX 2201157

Summary of checked

- ☒ 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:

Standard Equipment Used

Equipment	Equipment I.D.	
Standard Chlorine DPD-CHLORINE-LR	Lot No. A0197	Exp date : Jul-22
Standard Chlorine DPD-CHLORINE-HR	Lot No. A0164	Exp date : Jun-22
Digital multi meter	S/N : 23390582	Due date : Aug-22
Thermo hygrometer	S/N : 41413945	Due date : Aug-22

Test By :

WILAILAK S.

(Miss Wilailak Sawangpun)

Service Engineer

Approved by :

S. Sanyangkool

(Mr. Suanun Sartyangkool)

Position :

Assistant Service Division Manager





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CG3154

Page.: 1 of 2

Certificate of Calibration

Equipment :	Burette
Capacity :	50 mL
Serial No. :	-
ID. No. :	BKK_EN0171
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 :	759 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Panward Pramklam

REVIEW BY	<i>Sinluk P.</i>
APPROVED BY	<i>KLAL</i>
NEXT CAL. DATE	<i>29/03/2024</i>

Approved by :

Approved Signatory

- () Pornthippa Tameyakul
() Malee Butkruea
(☒) Ponpan Paipim
() Srisuda Khamtha

Issue Date :

31 August 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0044607



Equipment : Burette
Received Date : 26 August 2022
Condition As-Received : Used Item
Calibration Date : 30 August 2022
Reference : 2208-0918DSC-2

Cert.No.: 22CG3154

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID. No.</u>	<u>Certificate No.</u>	<u>Traceability</u>	<u>Due date</u>
1) Balance	AE200S	N03679	140RC001	21MM429	NIMT	22 Sep 2022
2) Thermo-Hygrograph	THDX-CE	00016540	140EC001	22H1243	NIST,NIMT	09 June 2023
3) Thermometer	-	1594592	140EC010	22I181	NIMT	10 Feb 2023

This certification 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 (\pm mL)	k Factor
50	49.9959	0.010	2.00

Remark mL = cm³

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

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a 1123908



Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th



Certificate No. T221644

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK_EN0167

ID No. : T2463A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

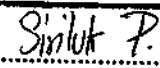
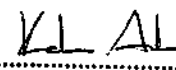
Customer Location : Environmental Laboratory

Date of Receipt : 27 June 2022

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 04 JUL 2022

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	30/12/23

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

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

Certificate No. T221644

Page 2 of 4

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 30 June - 1 July 2022
Environment : Temperature : 18.9-23.7 °C
Line Voltage : 222.9-226.5 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

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

5. Adjustment :

() without adjustment

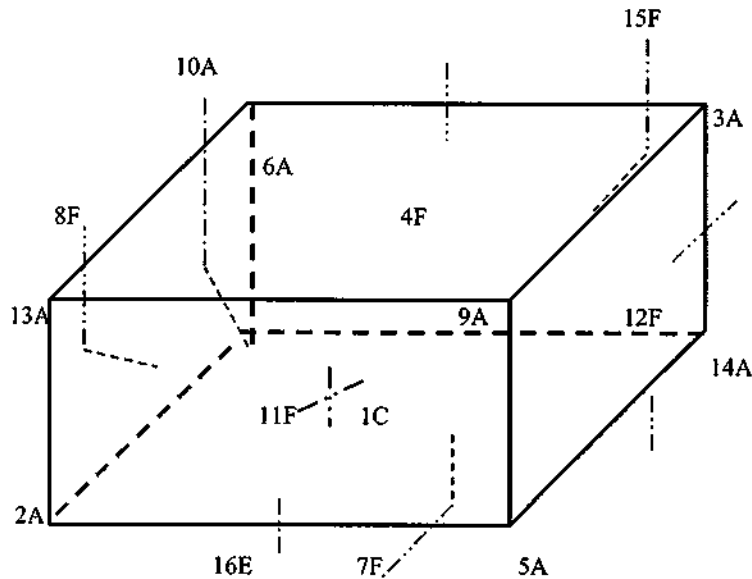
(X) after adjustment

Approved By. 

Certificate No. T221644

Page 3 of 4


Calibration Report



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

1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7F	=	TN167
8F	=	TN168
9A	=	TN169
10A	=	TN170

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By. 

Certificate No. T221644

Page 4 of 4

Calibration Report

Measurement Results:

Average Standard Reading at each position (°C)										
Calibration Point	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.68	3.02	2.96	3.03	2.85
	TN171	TN172	TN173	TN174	TN175	TN176				
	2.97	3.02	2.89	3.04	2.97	3.33				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage
	Min , Max	Average					Factor <i>k</i>
3.0	2.9 , 4.0	3.2	2.99	1.05	1.30	1.66	2.00

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

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

Approved By 

Certificate of System Qualification

ES-OQ

System ID: MY16010005
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250
Date: September 13, 2021 5:49:11 PM
EQP Name: AgilentRecommended
EQP Revision: ES.02.50
Overall Qualification Status: Pass

Preparation

Pass

Instrument Tests

Pass

Autosampler Operation

Pass

REVIEW BY	Thitima B.
APPROVED BY	Saowan N.
NEXT CAL. DATE	12 Mar 23

Date: September 13, 2021 5:49:11 PM
System ID: MY16010005



Metrological Center

SCI ECO Services Company Limited

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

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

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T220730

Page 1 of 6

Certificate of Calibration

Equipment : HEATING BLOCK

Manufacturer : Environmental Express

Model : SC 196

Serial No. : 6974CECW3285

Customer Code : BKK_EL0054

ID No. : T5306A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Acid Digestion Lab

Date of Receipt : 30 March 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 12 APR 2022

REVIEW BY	Tattaporn C.
APPROVED BY	Santun.
NEXT CAL. DATE	7/10/23

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

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

Certificate No. T220730

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 7 April 2022
Environment : Temperature : 21.8-23.1 °C
 Line Voltage : 221.6-226.3 V
 Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.

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	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 25 Minute At 95 °C
 Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

Approved By. 



Metrological Center

SCI ECO Services Company Limited

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

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

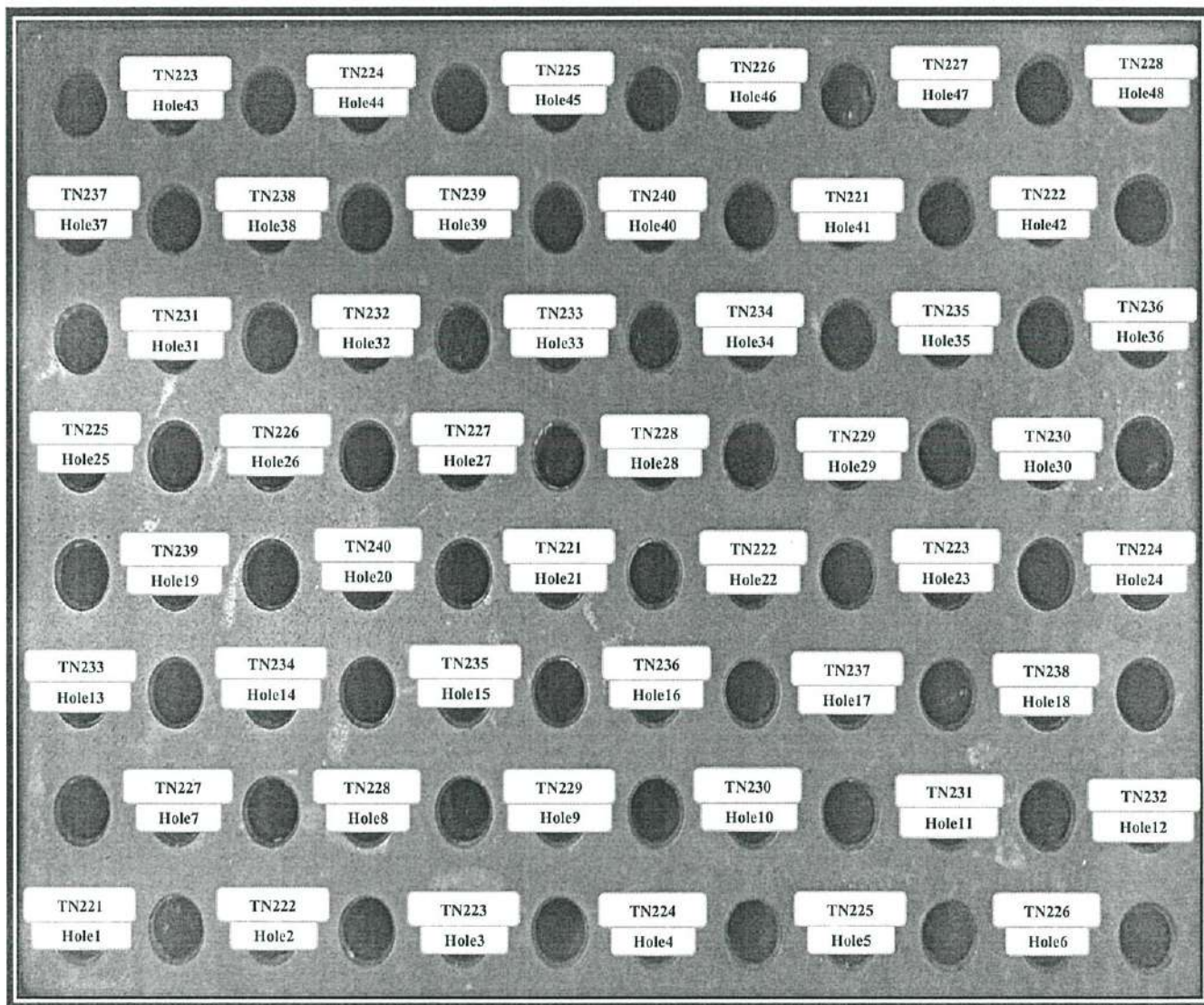
Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T220730

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By. 

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	93.60	93.82	94.05	94.20	94.36	94.26
95	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.46	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73	96.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	96.01	96.10	96.02	96.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95	97.09
	Min	96.13	95.84	95.85	95.72	96.64	96.78
	Average	96.30	95.99	96.02	95.89	96.80	96.93
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By.



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	104.47	104.65	104.79	105.31	105.47	105.46
105	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.68	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.90	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

Approved By.



Certificate No. T220730

Page 5 of 6

Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)	Uncertainty (± °C)
	Min , Max	Average		
100.0	100.0 , 100.4	100.1	0.29	0.83
105.0	105.0 , 105.4	105.1	0.20	0.79

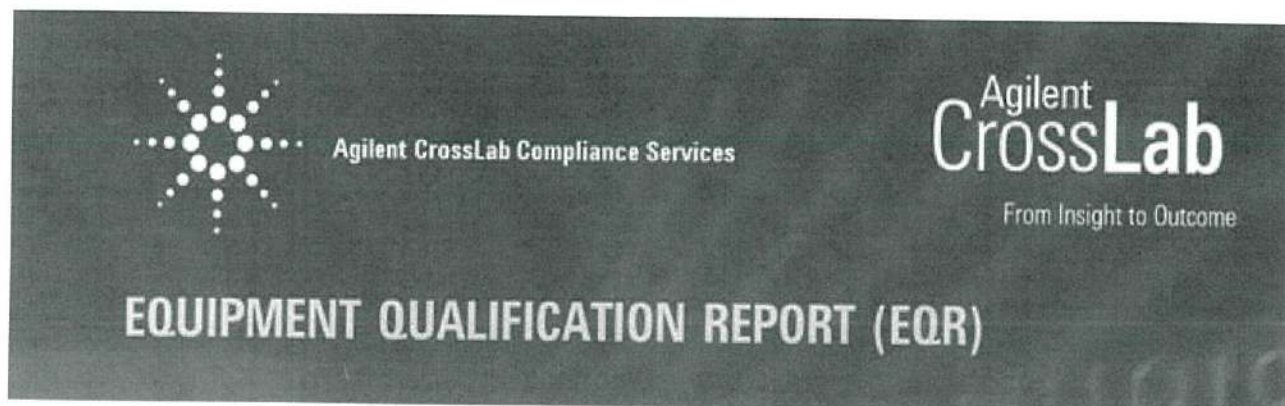
* The quoted uncertainty exclude " uniformity "

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. 



Agilent CrossLab Compliance

Qualification Type:	ICPMS-OQ
System ID:	JP15471169
EQP Name:	AgilentRecommended
EQP Revision:	ICPMS.02.50
EQP Publish Date:	March 2020
Date:	September 30, 2021 4:07:18 PM
Report Type:	Report
Org. Name:	ALS Laboratory Group (Thailand) Co.,Ltd.
Org. Location:	104 Phattanakarn 40, Suan Luang, Bangkok 10250.

REVIEW BY	Supakorn M.
APPROVED BY	Sauntan N.
NEXT CAL. DATE	29 March 2023

Date: September 30, 2021 4:07:18 PM
System ID: JP15471169

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Test Summary

Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

Details

Test	Status	Runs
Autosampler Check : SPS4	Pass	1
Integrated Sample Introduction System (ISIS) Check : ISIS3	Pass	1
Autotune : G8403A	Pass	1
Background (No Gas Mode) : G8403A	Pass	1
Background (Gas Modes) : G8403A	Pass	1
20-Minute Stability (No Gas Mode) : G8403A	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details

Service Order No./Request: 6004837154
EQP Name: AgilentRecommended
EQP Revision: ICPMS.02.50
Report Type: Report

Organization Details

Name: ALS Laboratory Group (Thailand) Co.,Ltd.
Location: 104 Phattanakarn 40, Suan Luang, Bangkok 10250.

Local Contact Details

Name: Chatchanai Komarakul.
Job Title: Manager
Qualification Location: Laboratory

Operator Details

Name: Panthep Kurasathain
Job Title: Field Service Engineer.

Data Acquisition Details

Acquisition Software Name: MassHunter
Acquisition Software Revision: C.01.04

Customer Data System (CDS): IcpMs: MassHunter

Instrument Details

Purpose

This section describes the as found system configuration.

Details

ICP-MS 1

Manufacturer	Agilent Technologies
Name	7900
Model Number	G8403A
Installed Options	#100H: Standard Package with Hydrogen option
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP15471169
Firmware Revision	C.01.04

ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS3
Model Number	G8411A
Type	Peristaltic pump system
Serial Number	JP15510227

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15430722

Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	3U1610713

Calculation Formulas

Purpose

This section includes calculation formulas for all available tests. Depending upon which tests are scheduled, all or some apply to your qualification.

For a description of calculations for ICP-MS tests performed by the MassHunter software, refer to the MassHunter application and documentation.

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ICPMS.02.50	20-Minute Stability (No Gas Mode)
ICPMS.02.50	Autosampler Check
ICPMS.02.50	Autotune
ICPMS.02.50	Background (Gas Modes)
ICPMS.02.50	Background (No Gas Mode)
ICPMS.02.50	Integrated Sample Introduction System (ISIS) Check

Autosampler Check

Purpose

This test demonstrates that the autosampler module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
After the self test, is probe in the home position?	Yes	Yes	Pass
As commanded, is the probe positioned at vial 2?	Yes	Yes	Pass
Setpoint Status:	Pass		Runs: 1

Overall Autosampler Check Test Status

Pass

Integrated Sample Introduction System (ISIS) Check

Purpose

This test demonstrates that the ISIS module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
As commanded, does the pump rotate?	Yes	Yes	Pass
As commanded, do the valves load and inject?	Yes	Yes	Pass

Setpoint Status:

Pass

Runs: 1

Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

Autotune

Purpose

This test uses traceable checkout standards to run a software-executed autotune in all modes. The tune report provides values for peak width, mass axis, sensitivity, oxide species, and doubly-charged species tests.

Setpoint

Results

Peakwidth Mass 7

Agilent Recommended:

	0.719	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Peakwidth Mass 89

Agilent Recommended:

	0.750	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Peakwidth Mass 205

Agilent Recommended:

	0.713	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Mass Axis 7

Agilent Recommended:

	7.05	AMU
>=	6.9	
<=	7.1	

Status:

Pass

Mass Axis 89

Agilent Recommended:

	88.95	AMU
>=	88.9	
<=	89.1	

Status:

Pass

Mass Axis 205

Agilent Recommended:

	205.00	AMU
>=	204.9	
<=	205.1	

Status:

Pass

Mass 7 Sensitivity No Gas

94.28

Mcps/ppm

Agilent Recommended:

>=

25.5

Status:

Pass

Mass 89 Sensitivity No Gas

307.15

Mcps/ppm

Agilent Recommended:

>=

127.5

Status:

Pass

Mass 205 Sensitivity No Gas

203.77

Mcps/ppm

Agilent Recommended:

>=

76.5

Status:

Pass

Mass 59 Sensitivity He

28.38

Mcps/ppm

Agilent Recommended:

>=

23.8

Status:

Pass

Mass 89 Sensitivity H2

129.27

Mcps/ppm

Agilent Recommended:

>=

68

Status:

Pass

Oxide Ratio 156/140

1.047

%

Agilent Recommended:

<=

1.38

Status:

Pass

Doubly Charged Species Ratio 70/140

1.482

%

Agilent Recommended:

<=

2.3

Status:

Pass

Setpoint Status:

Pass

Runs: 1

Overall Autotune Test Status

Pass

Background (No Gas Mode)

Purpose

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run.

Setpoint

Conditions

Masses:	7	AMU
	89	AMU
	205	AMU

Measurements and Results

Masses (AMU):	7	89	205	
Measured Value:	3.200	3.300	9.900	cps
Agilent Recommended:	<= 6.9	<= 4.6	<= 11.5	
Status:	Pass	Pass	Pass	

Setpoint Status:	Pass	Runs:	1
------------------	------	-------	---

Overall Background (No Gas Mode) Test Status

Pass

Background (Gas Mode)

Purpose

This test examines the background of the ICP-MS in the various gas modes by monitoring ions during a blank run.

Setpoint	Gas Mode:	Helium	
Conditions			
Mass:	78	AMU	
Integration Time:	1.0	sec	
Cycles:	20		
Measurements and Results			
Mass (AMU):	78		
Measured Value:	42.8500	cps	
Agilent Recommended:	<=	115	
Status:	Pass		
Setpoint Status:	Pass		Runs: 1

Setpoint	Gas Mode:	Hydrogen	
Conditions			
Mass:	78	AMU	
Integration Time:	1.0	sec	
Cycles:	20		
Measurements and Results			
Mass (AMU):	78		
Measured Value:	2.1500	cps	
Agilent Recommended:	<=	4.6	
Status:	Pass		
Setpoint Status:	Pass		Runs: 1

Overall Background (Gas Mode) Test Status

Pass

20-Minute Stability (No Gas Mode)

Purpose

This test monitors the abundance of ions present in the checkout standard over a 20-minute period to verify that the signal is stable.

The %RSD of the abundance of given ions is calculated internally by the software and compared to the limit.

Setpoint

Conditions

Mode:	Spectrum	
Masses:	7, 9, 59, 89, 140, 205	
Integration Time:	9.99	sec
Peak Pattern:	3	points/peak
Repetitions:	20	
Sweeps/Replicates:	100	

Measurements and Results

Masses (AMU):	7	89	205	
Stability RSD:	0.96400	0.51495	0.73011	%
Agilent Recommended:	<= 2.3	<= 2.3	<= 2.3	
Status:	Pass	Pass	Pass	

Setpoint Status:	Pass	Runs:	1
------------------	------	-------	---

Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
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General

Document Name: Certificate of System Qualification



Agilent Compliance Engine Self Qualification

Date: September 14, 2021 4:59:16 PM

Drive Serial #: ACA025C9

Platform Revision:

ACE 3.11

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	8	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	8	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

Overall Qualification Status

Conforms

Date: September 30, 2021 4:07:18 PM
System ID: JP15471169

General

Document Name: Operator's training certificate and qualifications



Certificate of Completion

Learner Name:	Panthep Kurasathain
Title Of Course:	AN-C5-ICPMS-2-038-A:Agilent 7900 ICPMS FSE update training
Completion Date:	June 7, 2014
Certified By Company:	Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE



Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date: July 7, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name:

Certificate of Qualification for ACE



Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-ICPMS-2-035-B: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-MS Systems

Completion Date: October 31, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

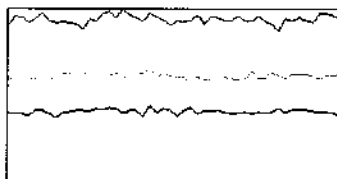
Document Name: Tune reports

Tune Report

Operator Name Supakwan Mak
 AcqData Batch C:\Agilent\ICPM\H1\UserTune_7800.b
 Acq. Date/Time 2021-09-30 14:44:08
 Report Comment OQ 30 Sep 2021
 Instrument Name GS403A JP15471169

[No Gas]

Sensitivity



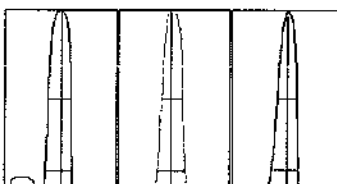
Mass	Range	Count	RSD%	Background
7	10000	9428	2.630	3.200
89	50000	30716	2.825	3.300
205	60000	20377	3.319	3.900

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

Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.047 %
 Doubly Charged 70 / 140 1.482 %

Resolution/Axis



Mass	Peak Height	Axis	W-50%	W-10%
7	9474.89	7.05	0.62	0.719
89	30716.43	88.95	0.59	0.750
205	20596.12	205.00	0.52	0.713

Integration Time [sec] 0.1
 Acquisition Time [sec] 22.74
 Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	—	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	—	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.1 V	Deflect	13.6 V
Extract 2	-205.0 V	Cell Entrance	-30 V	Plate Bias	-35 V
Omega Bias	-80 V	Cell Exit	-50 V		

Cell Parameters

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

Document Name:

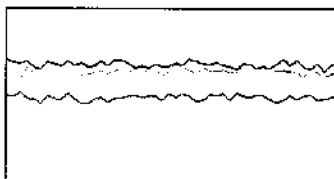
Tune reports

Tune Report

H2 Flow	0.0 mL/min	OctP RF	190 V		
QP Parameters					
Mass Gain	124	Axis Gain	0.9990	QP Bias	-3.0 V
Mass Offset	125	Axis Offset	0.01		
Hardware Settings					
Torch					
Torch H	-0.3 mm	Torch V	0.1 mm		
EM					
Discriminator	4.0 mV	Analog HV	2247 V	Pulse HV	1318 V

[H2]

Sensitivity



Mass	Range	Count	RSD%	Background
69	5000	2453	3.423	0.400
89	20000	12927	2.822	0.200
205	20000	13835	2.445	8.701

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 0.804 %
Doubly Charged 70 / 140 1.020 %

Tune Parameters

Plasma Parameters

Plasma Mode	--	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	--	Auxiliary Gas	0.80 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.0 V	Deflect	6.0 V
Extract 2	-210.0 V	Cell Entrance	-30 V	Plate Bias	-100 V
Omega Bias	-105 V	Cell Exit	-90 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	3.6 V
He Flow	0.0 mL/min	OctP Bias	-22.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	124	Axis Gain	0.9990	QP Bias	-18.5 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch					
Torch H	-0.3 mm	Torch V	0.1 mm		

2 of 3

2021-09-30 2:44 PM

Document Name:

Tune reports

Tune Report

EM

Discriminator

4.0 mV

Analog HV

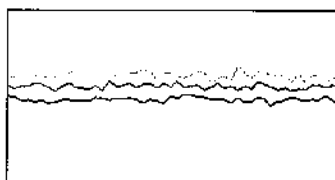
2247 V

Pulse HV

1318 V

[He]

Sensitivity



Mass	Range	Count	RSD%	Background
59	5000	2838	2.592	5.000
89	5000	3149	3.359	5.200
205	20000	9837	2.895	4.201

Sampling Period [sec] 0.31

Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 0.498 %

Doubly Charged 70 / 140 0.788 %

Tune Parameters

Plasma Parameters

Plasma Mode	---	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.2 V	Deflect	12.4 V
Extract 2	-225.0 V	Cell Entrance	-30 V	Plate Bias	-100 V
Omega Bias	-105 V	Cell Exit	-50 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	3.5 V
He Flow	3.8 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	124	Axis Gain	0.9990	QP Bias	-4.5 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch			
Torch H	-0.3 mm	Torch V	0.1 mm

EM

Discriminator

4.0 mV

Analog HV

2247 V

Pulse HV

1318 V

3 of 3

2021-09-30 2:44 PM

General

Document Name: Test Report

Batch Summary Report

Batch Folder: C:\Batch2021\BG He.b\A
Analysis File: BG He.batch.bin
Tune Step: #1 He

	Rect	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 14:21:47	BG He.d	BG He	Sample		1.0000

Document Name: Test Report

Batch Summary Report

Analyte Table

		78 [He]
	Sample Name	CPS
1	BG He	42.8500

Page 2 / 2

2021-09-30 14:23:40

General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\BG H2 new.b\

Analysis File: BG H2 new.batch.bin

Tune Step: #1 H2

	Ret	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:08:58	BG H2.d	BG H2	Sample		1.0000

Document Name:

Test Report

Batch Summary Report

Analyte Table

		78 [H2]
	Sample Name	CPS
1	BG H2	2.1500

General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\20 Min.b\

Analysis File: 20 Min.batch.bin

Tune Step: #1 No Gas

	Rect	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:17:44	20 Min.d	20 Min	Sample		1.0000

Document Name:

Test Report

Batch Summary Report

Analyte Table

		7 [No Gas]	9 [No Gas]	59 [No Gas]	89 [No Gas]	140 [No Gas]	205 [No Gas]
	Sample Name	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD
1	20 Min	0.96400	7.02464	0.46887	0.51495	0.61014	0.73011

Electronic Signature

Purpose

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Details

Full Name of Signer:	Panthep Kurasathain
Logged On User Name:	panthep_kurasathain@agilent.com
Signature Creation Date:	September 30, 2021
Reason for Signature:	Executed protocol and published this original version of document

Regulatory Disclaimer

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User Name: panthep_kurasathain
 Hostname: ASBKKWX315

System Id: JP15471169
 Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:50:07 PM	Audit	SessionCreated	Session	None
September 30, 2021 3:50:07 PM	Start	Configuration	Session	None
September 30, 2021 3:50:07 PM	Audit	Entitlement	Licensing	User Is FieldEngineer and does not require an unlock code
September 30, 2021 3:52:52 PM	Audit	EqpLoaded	Session	EQP details for primary technique [lcpMs] - File path: [ProtocolPacks/lcpMs/Configurations/02.50/lcpMs.02.50.eqp], EQP File Name: [lcpMs.02.50.eqp], EQP Name: [AgilentRecommended]
September 30, 2021 3:52:54 PM	End	Configuration	Session	None
September 30, 2021 3:52:57 PM	Start	Qualification	Session	OQ
September 30, 2021 3:52:57 PM	Start	Execution	Autosampler Check : SPS4: Autosampler Check	None
September 30, 2021 3:53:03 PM	End	Execution	Autosampler Check : SPS4: Autosampler Check	Run Count : 1
September 30, 2021 3:53:04 PM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	None
September 30, 2021 3:53:08 PM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	Run Count : 1

User Name: panthep_kurasathain
 Hostname: ASBKKWX315

System Id: JP15471169
 Print Date: September 30, 2021 4:07:22 PM

ALS QQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:53:10 PM	Start	Execution	Autotune : G8403A: Autotune 1	None
September 30, 2021 3:55:08 PM	End	Execution	Autotune : G8403A: Autotune 1	Run Count : 1
September 30, 2021 3:55:12 PM	Start	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	None
September 30, 2021 3:55:40 PM	End	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	Run Count : 1
September 30, 2021 3:55:43 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	None
September 30, 2021 3:56:17 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	Run Count : 1
September 30, 2021 3:56:19 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	None
September 30, 2021 3:56:38 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	Run Count : 1
September 30, 2021 3:56:41 PM	Start	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	None
September 30, 2021 3:57:22 PM	End	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
September 30, 2021 3:57:24 PM	End	Qualification	Session	OQ
September 30, 2021 3:57:24 PM	Start	Reporting	Session	None

User Name: panthep_kurasathain
Hostname: ASBKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 4:03:07 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:03:17 PM	Audit	Reporting	Session	Report Generated : Report
September 30, 2021 4:03:59 PM	Start	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	End	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	Start	Reporting	Session	None
September 30, 2021 4:04:26 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:04:36 PM	Audit	Reporting	Session	Report Generated : Report

REVIEW BY

Mont Somb

APPROVED BY

KL AL

NEXT CAL. DATE

21/12/23

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-7
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Patthanakarn 40, Patthanakarn rd., Khwang Suan Luang, Khet Suan Luang, Bangkok 10250
Date: June 21, 2022 2:04:12 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.0	psi
Accuracy:			0.0	psi
Agilent Recommended:			<= 1.2	

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: June 21, 2022 2:04:12 PM
System ID: GM-7

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0 230.0 °C

Accuracy:

0.0 °C

Agilent Recommended:

>=	-1.0	% setpoint in K	(-5.0	°C)
<=	1.0	% setpoint in K	(5.0	°C)

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0 100.4 °C

Accuracy:

0.4 °C

Agilent Recommended:

>=	-1.0	% setpoint in K	(-3.7	°C)
<=	1.0	% setpoint in K	(3.7	°C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:

7890

Setpoint Status:

Pass

Setpoint/Average

Temperature:

100.0 100.0333 °C

Stability:

0.1 °C

Agilent Recommended:

<= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

Date:

June 21, 2022 2:04:12 PM

System ID:

GM-7

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:

22

mV

RFPA Voltage:

568

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

Date:

June 21, 2022 2:04:12 PM

System ID:

GM-7

Source: Filament:

Setpoint Status:

Signal to Noise:

Agilent Recommended:

Source: Filament:

Setpoint Status:

Signal to Noise:

Agilent Recommended:

This test's 0 comment(s) and 1 deviation(s) are available in the Attachments section.

Overall Signal to Noise EI Test Status

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	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

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Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	June 21, 2022
Reason for Signature:	Executed protocol and published this original version of document

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Date:	June 21, 2022 2:04:12 PM
System ID:	GM-7

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:25:05 AM	Audit	SessionCreated	Session	None
June 21, 2022 10:25:05 AM	Start	Configuration	Session	None
June 21, 2022 10:25:05 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 21, 2022 10:25:26 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.50/Gc.02.50.eqp], EQP File Name: [Gc.02.50.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.50/GcMs.02.50.eqp], EQP File Name: [GcMs.02.50.eqp], EQP Name: [AgilentRecommended]
June 21, 2022 10:25:39 AM	End	Configuration	Session	None
June 21, 2022 10:25:43 AM	Start	Qualification	Session	OQ
June 21, 2022 10:25:43 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
June 21, 2022 10:25:54 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:26:00 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
June 21, 2022 10:26:10 AM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
June 21, 2022 10:26:12 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 21, 2022 10:34:09 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 21, 2022 10:34:10 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 21, 2022 10:34:11 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 21, 2022 10:38:42 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 21, 2022 10:38:44 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
June 21, 2022 10:38:46 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None

Page 2 / 8

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:01:00 AM	Audit	AceClosed	Session	None
June 21, 2022 11:01:47 AM	Audit	AceRestarted	Session	None
June 21, 2022 11:01:48 AM	Audit	SessionReloaded	Session	None
June 21, 2022 11:01:51 AM	Start	Qualification	Session	OQ
June 21, 2022 11:01:51 AM	Start	Execution	GC Oven Temperature Stability	None
			- 7890: - Temperature : Oven -	
			S: 100.0°C - L: <= 0.5°C	
June 21, 2022 11:03:14 AM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over.
June 21, 2022 11:04:19 AM	Audit	Data	GC Oven Temperature Stability	Manual Data Entry
			- 7890: - Temperature : Oven -	
			S: 100.0°C - L: <= 0.5°C	
June 21, 2022 11:04:22 AM	End	Execution	GC Oven Temperature Stability	Run Count : 1
			- 7890: - Temperature : Oven -	
			S: 100.0°C - L: <= 0.5°C	
June 21, 2022 11:04:24 AM	Start	Execution	Log Amp - 5977A SQ: - Source:	None
			EI - Extractor	
June 21, 2022 11:04:34 AM	End	Execution	Log Amp - 5977A SQ: - Source:	Run Count : 1
			EI - Extractor	
June 21, 2022 11:04:37 AM	Start	Execution	RFP A - 5977A SQ: - Source: EI	None
			- Extractor	
June 21, 2022 11:07:49 AM	End	Execution	RFP A - 5977A SQ: - Source: EI	Run Count : 1
			- Extractor	
June 21, 2022 11:07:52 AM	Start	Execution	Tune EI - 5977A SQ: - Source: -	None
			EI - Extractor Filament 1	
			(Qualitative - No setpoints associated)	

User Name: supasak.nimsongtham
 Hostname: SCG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:08:35 AM	End	Execution	Tune EI - 5977A SQ: - Source: - Run Count : 1 EI - Extractor Filament 1 (Qualitative - No setpoints associated)	
June 21, 2022 11:14:59 AM	Start	Execution	Tune EI - 5977A SQ: - Source: - None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
June 21, 2022 11:16:48 AM	End	Execution	Tune EI - 5977A SQ: - Source: - Run Count : 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
June 21, 2022 11:16:49 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:17:05 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 11:17:10 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:26:09 AM	Audit	AceClosed	Session	None
June 21, 2022 12:36:20 PM	Audit	AceRestarted	Session	None
June 21, 2022 12:36:22 PM	Audit	SessionReloaded	Session	None
June 21, 2022 12:36:26 PM	Start	Qualification	Session	OQ
June 21, 2022 12:36:26 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None

User Name: supasak.nimsongtham
 Hostname: SCG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:37:07 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:37:08 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 12:38:54 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:39:24 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:40:09 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:42:04 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:42:17 PM	Audit	AceClosed	Session	None
June 21, 2022 12:33:31 PM	Audit	AceRestarted	Session	None
June 21, 2022 12:33:33 PM	Audit	SessionReloaded	Session	None
June 21, 2022 12:33:37 PM	Start	Qualification	Session	OQ
June 21, 2022 12:33:37 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:34:44 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:36:26 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 1
June 21, 2022 12:37:11 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:38:15 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:38:30 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:38:45 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:39:00 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:39:14 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:39:45 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:40:16 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:40:40 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:41:09 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:41:29 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 1
June 21, 2022 12:42:30 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 21, 2022 12:42:30 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:42:35 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001.D

User Name: supasak.nimsongtham
Hostname: 5CG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:42:45 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 2
June 21, 2022 12:42:50 PM	End	Qualification	Session	OQ
June 21, 2022 12:42:50 PM	Start	Reporting	Session	None
June 21, 2022 12:45:17 PM	Audit	AceClosed	Session	None
June 21, 2022 1:57:47 PM	Audit	AceRestarted	Session	None
June 21, 2022 1:57:50 PM	Audit	SessionReloaded	Session	None
June 21, 2022 1:57:56 PM	Start	Qualification	Session	OQ
June 21, 2022 2:02:42 PM	Audit	Reporting	Session	Report Generated : Certificate



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)

CALIBRATION AND TESTING EQUIPMENT SERVICES

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000-24 FAX. 0-2719-9484

Cert.No.: 21CH1589

Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact
Serial No. :	B429832167
ID No. :	BKK_EN0065
Condition As-Received:	Used Item
Received Date :	17 November 2021
Calibration Date :	19 November 2021
Reference :	2111-0586DSC-6
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khiet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	$(25 \pm 2.5) ^\circ\text{C}$
Relative Humidity :	$(50 \pm 15) \%$
Calibration Procedure:	In -house method : - CP-CH6 : based on direct measurement by using reference material (RM)

REVIEW BY	<u>Sinlue P.</u>
APPROVED BY	<u>K. A.</u>
NEXT CAL. DATE	<u>20/05/23</u>

Calibrated by : Walalak Sirithean

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 23 November 2021

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 Calibration and Testing Equipment Services.



Cert.No.: 21CH1589

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	21I451	15 Apr 2022

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

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

2. Certified Reference Materials :-

- Conductivity calibration solution, Thermo Scientific (traceable to NIST)

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
84 $\mu\text{S/cm}$	Thermo Scientific	081/02	23 Feb 2022
1413.0 $\mu\text{S/cm}$	Thermo Scientific	171/02	30 Apr 2024
12.880 mS/cm	Thermo Scientific	230/01	07 June 2023

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) $^{\circ}\text{C}$

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 $\mu\text{S/cm}$**

Conductivity Electrode Serial No.: 5821270404

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
84 $\mu\text{S/cm}$	85.92 $\mu\text{S/cm}$	85.52 $\mu\text{S/cm}$	4.3 $\mu\text{S/cm}$	2.00
1413 $\mu\text{S/cm}$	1419 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	15 $\mu\text{S/cm}$	2.00
12.88 mS/cm	12.92 mS/cm	12.79 mS/cm	0.14 mS/cm	2.00

Remark

- UUC* = Unit Under Calibration

- Adjustment Cell constant = 0.559929 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-

Malu

Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-307/22
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533CD
ID No. BKK_EN0018
Date of receipt 16 September 2022
Date of calibration 16 September 2022
Date of issue 23 September 2022

REVIEW BY *Shiruk P.*
APPROVED BY *Ku An*
16/9/23
NEXT CAL. DATE 23/9/22

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

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

Temperature (22.1-23.3) °C (On site)

Humidity (58.8-63.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Prep

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 95917 and 95918
Photometric Accuracy is traceable to certificate No. 95924 and 95937
Stray Light is traceable to certificate No. 95908
The above certificate are traceable to SI unit through Starna Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

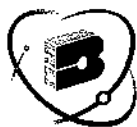
Calibrated by Mr.Waruth Janphung

Approved by



Mr.Kanchit Choothep
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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except in full, without written approval of the Bara Scientific Co., Ltd.



Bara Scientific
Solution of Success

Bara Scientific Co., Ltd.

968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Certificate No.

BSCC-UV-307/22

Number of Page(s)

2 of 3

Calibration Results:

1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (\pm nm)
241.70	241.65	-0.05	0.18
334.02	333.92	-0.10	0.18
418.53	418.46	-0.07	0.18
572.99	572.96	-0.03	0.18
879.41	879.17	-0.24	0.18

2.Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (\pm A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7461	-0.0006	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8647	-0.0015	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2911	0.0007	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6429	0.6426	-0.0003	0.0075

*CNR = Customer not request

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www.barascientific.com



Certificate of Calibration

Certificate No.

BSCC-UV-307/22

Number of Page(s)

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Calibration Results:

3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ($\pm A$)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5777	-0.0006	0.0042
	0.7628	0.7635	0.0007	0.0046
	1.0206	1.0230	0.0024	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5618	-0.0003	0.0042
	0.7455	0.7460	0.0005	0.0048
	0.9985	1.0005	0.0020	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5219	-0.0008	0.0042
	0.6880	0.6884	0.0004	0.0051
	0.9487	0.9503	0.0016	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5199	-0.0008	0.0042
	0.6973	0.6971	-0.0002	0.0049
	0.9959	0.9964	0.0005	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5534	-0.0010	0.0042
	0.7253	0.7242	-0.0011	0.0050
	1.0942	1.0943	0.0001	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5606	-0.0010	0.0042
	0.6927	0.6921	-0.0006	0.0053
	1.0881	1.0885	0.0004	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.96 \pm 0.11nm	200.30	0.9505	2.0229

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

*Stray Light not NSC-ONSC Accredited.

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

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

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

REVIEW BY	Sudarati N.
APPROVED BY	Sudarati N.
NEXT CAL. DATE	06/06/2023

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur / mercur plus

Serial-No.: 1700124 Customer-No.: CO4-C02
Date: 7/06/2022 Carried out by: Mr. Srikanth Palle-ou

Maintenance with following Operational Qualification (OQ)



(requires a separate OQ protocol)

Company	2507 10/10/105 11000000 102/ 10/10/105 102/
User	10/10/105 102/
Department	Lab
Street	104 10/10/105 40 10/10/105 102/
Zip Code, City	10/10/105 102/ 10250
Country	Germany
Phone	
Fax	
E-mail	

Maintenance works basic unit

tightness visual check inside the Mercur	<input checked="" type="checkbox"/>
visual check if gold-traps are broken	<input checked="" type="checkbox"/>
visual check if spectrometer is contaminated	<input checked="" type="checkbox"/>
reactor cleaning	<input checked="" type="checkbox"/>
check pump-hose, if necessary change it	<input checked="" type="checkbox"/>
check drying-hose, output gas-liquid-separator	<input checked="" type="checkbox"/>
test Bubble-Sensor	<input checked="" type="checkbox"/>
check gas flows	<input checked="" type="checkbox"/>
check volume flows, reagents	<input checked="" type="checkbox"/>
recording stray light values	<input checked="" type="checkbox"/>
measurement with 30 ng/l	<input checked="" type="checkbox"/>

Maintenance works Autosampler

Serial No.:

701 239

lubricate the dosing-winding (Teflon-grease-spray)	<input checked="" type="checkbox"/>
clean the dosing cylinder, if necessary exchange it	<input checked="" type="checkbox"/>
lubricate the winding system of the height drive with some drops of oil	<input checked="" type="checkbox"/>
check the toothed belt	<input checked="" type="checkbox"/>
check the position of the mechanical stopper (height: 13mm)	<input checked="" type="checkbox"/>
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	<input checked="" type="checkbox"/>
check the pump rate of washing cup	<input checked="" type="checkbox"/>
check the electrical hose connections for good contact	<input checked="" type="checkbox"/>
check the connectors of the magnetic valves	<input checked="" type="checkbox"/>
check the dosing hose for buckling, if necessary exchange it	<input checked="" type="checkbox"/>

Device parameter		nominal value	actual value
visual check general tightness inside the Mercur		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer			
	cuvette	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
	lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-seperator		o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor		o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow			
	Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
	Valve 1	10 NI/h or 0.166 NL/min	0.167 NL/min
	Valve 2	50 NI/h or 0.833 NL/min	0.83 NL/min
	Valve 3	5 NI/h or 0.083 NL/min	0.083 NL/min
	Valve 4	10 NI/h or 0.166 NL/min	0.166 NL/min
Check liquid flow			
	Acid	2.5ml/min ± 1 ml	2.5 ml/min
	Red.-agent	2.5ml/min ± 1 ml	2.5 ml/min
	Sample	10ml/min ± 2 ml	10 ml/min
Adventitious light - values		(V)	from file
	100	0	0
	200	0	0
	300	0	0
	350	0	0
	400	1	1
	450	2	2
	500	6	6
	550	13	14
	575	19	20
	600	27	28

Device parameter	nominal value	actual value
Analytical parameters		
Conditions.: max.conc.: 10µg/L PMT-voltage:V		
Blank-solution		Int 0.0005
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int ₁ 0.0026 RSD 1.12 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage:V		
Blank-solution		Int 0.0018
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int ₂ 0.0104 RSD 0.59 %
Fok.- factor (Int ₂ / Int ₁)	> 3,5	4
Comments		

Mr. Srichai Fak-on -

Signature Technician

Bangkok., 2/06/2022.

Place, Date (DD/MM/YYYY)

ก้องเกียรติ งามยิ่งธรรม

Signature Customer

06/06/2022

Place, Date (DD/MM/YYYY)

Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY	<i>Nant Som</i>
APPROVED BY	<i>KLAL</i>
CAL. DATE	22/05/23

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Patthanakarn 40, Patthanakarn Rd., Kwang Suan Luang, Khet Suan Luang, Bangkok 10250
Date: November 23, 2021 1:12:35 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.52, GCMS.02.51
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Nanthawadee.Somboon

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front MMI

Setpoint Status: Pass

	Setpoint	Actual
Inlet Pressure:	25.0 psi	24.9 psi
Accuracy:		0.1 psi
Agilent Recommended:	<=	1.2

Date: November 23, 2021 1:12:35 PM
System ID: GM-10

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 229.8 °C

Accuracy: -0.2 °C

Agilent Recommended: \geq -1.0 % setpoint in K (-5.0 °C) \leq 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 99.8 °C

Accuracy: -0.2 °C

Agilent Recommended: \geq -1.0 % setpoint in K (-3.7 °C) \leq 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 99.78333 °C

Stability: 0.1 °C

Agilent Recommended: \leq 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: November 23, 2021 1:12:35 PM

System ID: GM-10

Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	7000D			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			

Overall Tune EI Test Status

Pass

Scouting Run

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

Overall Scouting Run Status

Completed

Instrument Detection Limit

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

Setpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Minimum RSD:

5.79 %

Agilent Recommended:

<= 12.00

Status:

Pass

Retention Time

0.05 %

<= 1.00

Pass

Instrument Detection Limit:

1.94800 fg

Agilent Recommended:

<= 4.03800

Status:

Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1

Front

MMI

/ External

TQ

Injection Tower

Name:

7693A

Source:

EI - Extractor

Setpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Area Mass 1

Abundance*s

RSD:

4.07 %

Agilent Recommended:

<= 5.00

Pass

Mass Ratio

2.66 %

<= 5.00

Pass

Overall Mass Ratio Precision Test Status

Pass

Date: November 23, 2021 1:12:35 PM

System ID: GM-10

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	GM-10
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Injection Tower
Inlet	Front
Detector	External
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN18180003
Firmware Revision	A.11.03
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN18170137
Firmware Revision	A.11.03
Vial Heater	Not installed

Mainframe 1

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

Inlet 1

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

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	TQ
Name	7000D
Serial Number	US1826U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

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

Electronic Signature

Purpose

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Details

Full Name of Signer:	Jaruwat Channarong
Logged On User Name:	jaruwat.channarong@agilent.com
Signature Creation Date:	November 23, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:13:35 AM	Audit	SessionCreated	Session	None
November 23, 2021 10:13:35 AM	Start	Configuration	Session	None
November 23, 2021 10:13:35 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
November 23, 2021 10:20:27 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.52/Gc.02.52.eqp], EQP File Name: [Gc.02.52.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.51/GcMs.02.51.eqp], EQP File Name: [GcMs.02.51.eqp], EQP Name: [AgilentRecommended]
November 23, 2021 10:20:37 AM	End	Configuration	Session	None
November 23, 2021 10:21:34 AM	End	Configuration	Session	None
November 23, 2021 10:21:52 AM	Start	Qualification	Session	OQ
November 23, 2021 10:21:54 AM	Start	Execution	CDS Logon Verification - GC : - Qualitative test	None
November 23, 2021 10:26:40 AM	End	Execution	CDS Logon Verification - GC : - Qualitative test	Run Count : 1

Page 1 / 7

User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:26:42 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
November 23, 2021 10:26:54 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
November 23, 2021 10:26:56 AM	Start	Execution	Inlet Pressure Accuracy - Front MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
November 23, 2021 10:27:01 AM	End	Execution	Inlet Pressure Accuracy - Front MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
November 23, 2021 10:27:05 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
November 23, 2021 10:27:28 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
November 23, 2021 10:27:31 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
November 23, 2021 10:27:33 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
November 23, 2021 10:27:44 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

User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:27:45 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
November 23, 2021 10:28:26 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:35:24 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:35:29 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:37:44 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
November 23, 2021 10:39:20 AM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
November 23, 2021 10:39:23 AM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
November 23, 2021 10:39:26 AM	Start	Execution	Tune EI - 7000D TQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
November 23, 2021 10:41:10 AM	End	Execution	Tune EI - 7000D TQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count : 1

User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:41:13 AM	Start	Execution	Tune EI - 7000D TQ: - Source: - None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
November 23, 2021 10:41:34 AM	End	Execution	Tune EI - 7000D TQ: - Source: - Run Count : 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
November 23, 2021 10:43:42 AM	Start	Execution	Scouting Run - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor- Part of GCMS System Preparation	None
November 23, 2021 10:44:20 AM	Audit	Data	Scouting Run - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor- Part of GCMS System Preparation	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\SQ_001.D
November 23, 2021 10:45:10 AM	End	Execution	Scouting Run - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor- Part of GCMS System Preparation	Run Count : 1
November 23, 2021 10:45:14 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	None
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_003.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_004.D

Page 4 / 7

User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_005.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_006.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_007.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_008.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_009.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_010.D
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_011.D

User Name: jaruwat.channarong
 Hostname: ASBKKWX265

System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM

ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:45:39 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\IDL_012.D
November 23, 2021 10:46:50 AM	End	Execution	Instrument Detection Limit - Injection Tower, Front MMI, TQ: - Source: - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Ret. Time): <= 1.00%	Run Count : 1
November 23, 2021 10:47:03 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\MRP_001.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\MRP_002.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\MRP_003.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\MRP_004.D
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data Agilent\OQ2021\MRP_005.D

User Name: jaruwat.channarong
 Hostname: ASBKKWX265


System Id: GM-10
 Print Date: November 23, 2021 1:12:38 PM


ALS_GM10 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 23, 2021 10:47:23 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Data files Path : D:\MassHunter\GCMS\1\data \\Agilent\OQ2021\MRP_006.D
November 23, 2021 10:48:02 AM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMI, TQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Run Count : 1
November 23, 2021 10:48:07 AM	End	Qualification	Session	OQ
November 23, 2021 10:48:07 AM	Start	Reporting	Session	None
November 23, 2021 1:01:43 PM	Audit	AceClosed	Session	None
November 23, 2021 1:03:30 PM	Audit	AceRestarted	Session	None
November 23, 2021 1:03:32 PM	Audit	SessionReloaded	Session	None
November 23, 2021 1:03:37 PM	Start	Qualification	Session	OQ
November 23, 2021 1:11:56 PM	Audit	Reporting	Session	Report Generated : Certificate

Certificate No. T220630

Page 1 of 5

Certificate of Calibration**Equipment : HOT BLOCK****Manufacturer : Environmental Express****Model : B3000- 240****Serial No. : 2017CODW116****Customer Code : BKK_EN0222****ID No. : T6769A4****Customer : ALS Laboratory Group (Thailand) Co.,Ltd.**104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250**Customer Location : Wet Chemistry Lab2****Date of Receipt : 21 March 2022****Calibrated By : Watcharapon Sangtong (Technician)****Approved By :  / Sujjar Naknakred (Site Calibration Manager)****Date of Issue : 03 APR 2022**

REVIEW BY	Sararat M.
APPROVED BY	
NEXT CAL. DATE	21/03/23.

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

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



Metrological Center

SCI ECO Services Company Limited

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

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

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T220630

Page 2 of 5

Calibration Report

Equipment : HOT BLOCK
Date of Calibration : 21 March 2022
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.

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	TN51-TN60	T220275	28 February 2023
TC	TYPE T	TN61-TN70	T220275	28 February 2023
DATA LOGGER	34970A	T47	T220275	28 February 2023

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant 1 Hour - Minute At 150 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

Approved By. 

Certificate No. **T220630**

Page **3** of **5**

Calibration Report

R7	49	50	51	52	53	54	55	56
R6	41	42	43	44	45	46	47	48
R5	33	34	35	36	37	38	39	40
R4	25	26	27	28	29	30	31	32
R3	17	18	19	20	21	22	23	24
R2	9	10	11	12	13	14	15	16
R1	1	2	3	4	5	6	7	8
Controller								

○ STANDARD THERMOCOUPLE TYPE T

No.1 = TN51	No.13 = TN63	No.25 = TN55	No.37 = TN67	No.49 = TN59
No.2 = TN52	No.14 = TN64	No.26 = TN56	No.38 = TN68	No.50 = TN60
No.3 = TN53	No.15 = TN65	No.27 = TN57	No.39 = TN69	No.51 = TN61
No.4 = TN54	No.16 = TN66	No.28 = TN58	No.40 = TN70	No.52 = TN62
No.5 = TN55	No.17 = TN67	No.29 = TN59	No.41 = TN51	No.53 = TN63
No.6 = TN56	No.18 = TN68	No.30 = TN60	No.42 = TN52	No.54 = TN64
No.7 = TN57	No.19 = TN69	No.31 = TN61	No.43 = TN53	No.55 = TN65
No.8 = TN58	No.20 = TN70	No.32 = TN62	No.44 = TN54	No.56 = TN66
No.9 = TN59	No.21 = TN51	No.33 = TN63	No.45 = TN55	
No.10 = TN60	No.22 = TN52	No.34 = TN64	No.46 = TN56	
No.11 = TN61	No.23 = TN53	No.35 = TN65	No.47 = TN57	
No.12 = TN62	No.24 = TN54	No.36 = TN66	No.48 = TN58	

Approved By. _____



Measurement Results

Calibration Report

Calibration Point		Average Standard Reading at each position (°C)							
R1		TN51	TN52	TN53	TN54	TN55	TN56	TN57	TN58
CAL POINT	Max	149.42	150.39	149.10	149.91	150.93	150.58	151.54	150.13
150	Min	149.27	150.15	148.51	149.65	150.72	150.39	151.43	149.97
	Average	149.35	150.27	148.81	149.78	150.83	150.48	151.49	150.05
R2		TN59	TN60	TN61	TN62	TN63	TN64	TN65	TN66
	Max	150.66	150.45	151.00	151.76	150.66	150.67	150.73	149.65
	Min	150.46	150.16	150.74	151.51	150.48	150.48	150.56	149.40
	Average	150.56	150.31	150.87	151.63	150.57	150.58	150.65	149.52
R3		TN67	TN68	TN69	TN70	TN51	TN52	TN53	TN54
	Max	150.90	151.18	151.10	151.05	150.16	150.55	149.86	150.39
	Min	150.68	151.00	150.84	150.75	149.36	149.17	148.95	149.17
	Average	150.79	151.09	150.97	150.90	149.76	149.86	149.41	149.78
R4		TN55	TN56	TN57	TN58	TN59	TN60	TN61	TN62
	Max	150.82	150.07	151.63	150.72	150.35	149.78	150.24	150.04
	Min	149.53	149.71	149.57	148.67	148.46	148.86	149.55	148.81
	Average	150.17	149.89	150.60	149.70	149.41	149.32	149.90	149.42
R5		TN63	TN64	TN65	TN66	TN67	TN68	TN69	TN70
	Max	150.00	149.68	150.31	149.66	150.34	150.48	150.09	149.51
	Min	149.81	149.58	149.49	149.42	149.20	149.60	149.69	149.38
	Average	149.90	149.63	149.90	149.54	149.77	150.04	149.89	149.44
R6		TN51	TN52	TN53	TN54	TN55	TN56	TN57	TN58
	Max	149.25	150.37	148.53	149.06	150.91	150.04	151.13	149.83
	Min	149.07	150.18	148.28	148.78	150.69	149.83	150.95	149.65
	Average	149.16	150.28	148.41	148.92	150.80	149.94	151.04	149.74
R7		TN59	TN60	TN61	TN62	TN63	TN64	TN65	TN66
	Max	149.38	149.24	149.88	150.17	149.72	149.45	149.63	149.51
	Min	149.22	149.05	149.68	149.99	149.61	149.34	149.48	149.36
	Average	149.30	149.15	149.78	150.08	149.67	149.40	149.56	149.43

Approved By.



Certificate No. T220630

Page 5 of 5

Calibration Report

Measurement Results:

HOT BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (\pm °C)	Uncertainty (\pm °C)
	Min , Max	Average		
150.0	149.9 , 150.1	150.0	1.04	1.44

* 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.





บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยสุขุมวิท 14, แขวงคลองเตย เขตคลองเตย 10260 โทรศัพท์ (02) 747-7009 โทรสาร (02) 747-7008
4 Soi Udomsui, 14, Bangna, Bangkok 10260 Tel: (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2012

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม						2						

Periodical maintenance check list for Konelab

	6M	12M	Note
1.Diluent-wash tubing change	<input type="checkbox"/>	<input type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3.Syringe check/change		<input checked="" type="checkbox"/>	
4.Dispensing check/ change		<input checked="" type="checkbox"/>	
5.Waste tubing change when necessary		<input checked="" type="checkbox"/>	
6.Lamp check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)		<input checked="" type="checkbox"/>	
8.ISE needles check/change		<input checked="" type="checkbox"/>	
9.Pump tubing check/ chance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10.Broken/worn out part check /change		<input checked="" type="checkbox"/>	
11.Peristaltic pump check /cleaning/ lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
12.Heating check		<input checked="" type="checkbox"/>	
13.Cooling check		<input checked="" type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input type="checkbox"/>	<input type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input type="checkbox"/>	
16.Dispenser movement check/adjustment	<input type="checkbox"/>	<input type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input type="checkbox"/>	<input type="checkbox"/>	
18.Dispensing tubing tightness check	<input type="checkbox"/>	<input type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
22.Instrument cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input type="checkbox"/>	<input type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
25.UPS Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Place: ALS LAB Instrument: Konelab 20

Date/Time: 2012-05-05 Serial no: 3251

Service done by: Install date:

Signature of customer: Date/Time: 2012/12



Applications Chemist

Certificate No. T211711

Page 1 of 5

Certificate of Calibration**Equipment : Digestion Unit****Manufacturer : Environmental Express****Model : AIM 600 Block****Serial No. : 5146000105****Customer Code : BKK_EN0141****ID No. : T5666A3****Customer : ALS Laboratory Group (Thailand) Co.,Ltd.**104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250**Customer Location : Environmental Laboratory****Date of Receipt : 30 July 2021****Calibrated By : Sujjar Naknakred (Site Calibration Manager)****Approved By :  / Boonchai Suriyawong (Site Calibration Manager)****Date of Issue : 09 AUG 2021**

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

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

Certificate No. T211711

Page 2 of 5

Calibration Report

Equipment : Digestion Unit
Date of Calibration : 4-5 August 2021
Environment : Temperature : 21.1 - 21.8 °C
Line Voltage : 221.4 - 225.1 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert four standard thermocouples type S into its chamber , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T10.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	Type S	M20A1-(CH17-CH20)	T210011	14 January 2022
DATA LOGGER	34970A	T149	T210011	14 January 2022

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant - Hour 51 Minute At 380 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment

() after adjustment

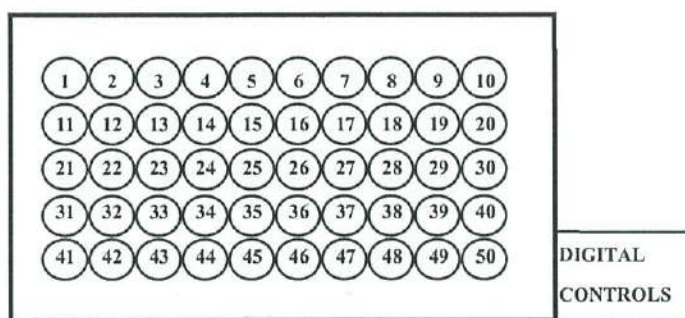
Approved By. _____



Certificate No. T211711

Page 3 of 5

Calibration Report



FRONT

Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole1	Hole2	Hole3	Hole4	Hole5	Hole6	Hole7	Hole8	Hole9	Hole10
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380	374	374	Max °C	378.8	379.5	382.0	383.3	381.8	382.3	383.3	382.8	379.5	381.1
			Min °C	378.2	378.8	381.4	382.7	381.5	382.0	382.9	382.5	379.2	380.6
			Average °C	378.5	379.2	381.7	383.0	381.7	382.1	383.1	382.6	379.3	380.8
			Stability ± °C	0.3	0.3	0.3	0.3	0.1	0.2	0.2	0.1	0.1	0.2

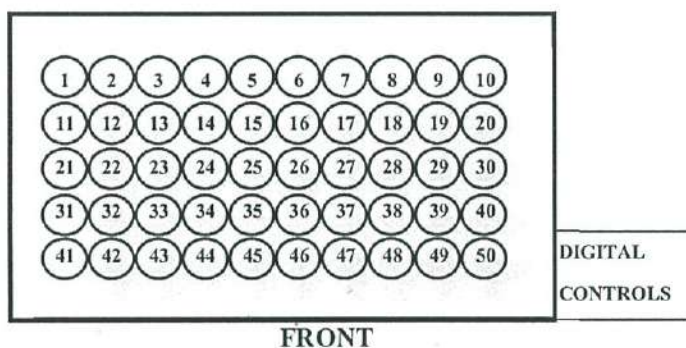
Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole11	Hole12	Hole13	Hole14	Hole15	Hole16	Hole17	Hole18	Hole19	Hole20
				M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20
380	374	374	Max °C	382.9	380.0	382.9	378.7	379.8	380.3	383.0	383.4	383.0	381.6
			Min °C	382.5	379.5	382.7	378.4	379.6	380.1	382.8	383.1	382.7	381.3
			Average °C	382.7	379.7	382.8	378.5	379.7	380.2	382.9	383.3	382.9	381.4
			Stability ± °C	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Approved By. 

Certificate No. T211711

Page 4 of 5

Calibration Report



Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole21	Hole22	Hole23	Hole24	Hole25	Hole26	Hole27	Hole28	Hole29	Hole30
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380	374	374	Max °C	379.0	380.1	383.4	383.4	380.4	380.7	381.9	382.0	380.8	379.7
			Min °C	378.7	379.7	382.6	383.1	380.1	380.5	381.7	381.7	380.5	379.2
			Average °C	378.8	379.9	383.0	383.2	380.3	380.6	381.8	381.9	380.6	379.5
			Stability ± °C	0.1	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.2	0.3

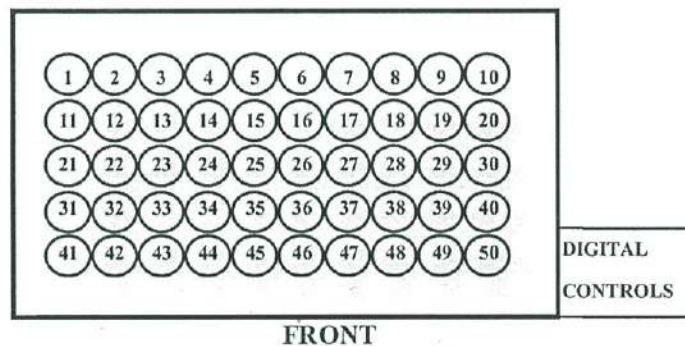
Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole31	Hole32	Hole33	Hole34	Hole35	Hole36	Hole37	Hole38	Hole39	Hole40
				M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20
380	374	374	Max °C	379.3	379.4	380.3	381.7	382.6	383.2	382.6	382.7	383.0	381.6
			Min °C	378.7	378.5	380.1	381.5	382.3	382.9	382.3	382.5	382.8	381.3
			Average °C	379.0	379.0	380.2	381.6	382.4	383.1	382.5	382.6	382.9	381.4
			Stability ± °C	0.3	0.5	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1

Approved By. 

Certificate No. T211711

Page 5 of 5

Calibration Report



Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole41	Hole42	Hole43	Hole44	Hole45	Hole46	Hole47	Hole48	Hole49	Hole50
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380	374	374	Max °C	378.9	378.6	381.0	382.3	381.8	383.2	382.4	382.2	383.0	382.4
			Min °C	378.6	378.4	380.7	382.1	381.5	383.0	382.2	382.0	382.7	382.0
			Average °C	378.8	378.5	380.8	382.2	381.6	383.1	382.3	382.1	382.8	382.2
			Stability ± °C	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2

The expanded uncertainty of temperature measurement was $\pm 1.73^{\circ}\text{C}$

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 $k=2$, 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. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH202

Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go S3
Serial No. :	B908260825
ID No. :	BKK_LG0035
Condition As-Received:	Used Item
Received Date :	08 February 2022
Calibration Date :	10 February 2022
Reference :	2202-0244DSC-9
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 \pm 2.5) °C
Relative Humidity :	(50 \pm 15) %
Calibration Procedure:	In -house method : - CP-CH6 : based on direct measurement by using certified reference material (CRM)

REVIEW BY	<i>Chayathorn P.</i>
APPROVED BY	<i>Warakorn P.</i>
NEXT CAL. DATE	<i>10/2/23</i>

Calibrated by : Uthen Kankawi

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 14 February 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0037253



Cert.No.: 22CH202

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	211451	15 Apr 2022

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

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

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

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
84.000 $\mu\text{S/cm}$	CPA Chem	754034	28 June 2022
1413.0 $\mu\text{S/cm}$	CPA Chem	766815	04 Sep 2022
12.880 mS/cm	CPA Chem	761022	02 Aug 2022

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) $^{\circ}\text{C}$

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

Calibration results**Function : Conductivity Measurement****(*) After Adjustment at 1413.0 $\mu\text{S/cm}$** **Conductivity Electrode Serial No.: 5821360533**

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
84.000 $\mu\text{S/cm}$	85.52 $\mu\text{S/cm}$	84.47 $\mu\text{S/cm}$	0.62 $\mu\text{S/cm}$	2.00
1413.0 $\mu\text{S/cm}$	1426 $\mu\text{S/cm}$	1414 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12.880 mS/cm	12.92 mS/cm	12.77 mS/cm	0.086 mS/cm	2.00

Remark

- UUC* = Unit Under Calibration

- Cell constant = 0.549 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-

Maha.

HACH COMPANY

C/O AB Sciex (Thailand) Limited, Building D Room No. D3 11, 3rd Floor, No. 735/4, Srinakarin Road, Pattanakarn, Suanluang, Bangkok
 | Phone +66 (02) 026-3529 Ext. 0 | Fax +66(02) 026-3572 | www.sea.hach.com |

LABX 2200107

Test Report

Customers	:	ALS Laboratory Group (Thailand) Co., Ltd.			
Equipment	:	Chlorine Meter	Manufacturer	:	HACH
Controller Model	:	DR300	ID No.	:	BKK_LG0042
Controller Serial No.	:	20040A001722	Sensor Serial No.	:	-
Date of test	:	28/01/2022	Period	:	-
Environment temperature	:	25.0 °C	Humidity	:	58.0 %RH

Results

Instrument Checked

Item	Characteristic	Before	After	Remark
1	Visual Inspect	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
2	Power Supply (4.5 – 6.5 VDC)	6.0 VDC	6.0 VDC	
3	Display Check	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
4	Keyboard Check	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
5	Function System Program	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	

Warning and Error Checked

Item	Event	Before	After
6	Error list	<input checked="" type="checkbox"/> None <input type="checkbox"/> Appear	<input checked="" type="checkbox"/> None <input type="checkbox"/> Appear

Check with Standard

Item	Characteristic	Before	After	Remark
	DPD-CHLORINE-LR			
7	Blank (0.00 mg/l)	0.00 mg/l	0.00 mg/l	
8	Standard Cl2 No. 1 (0.25 ± 0.09 mg/l)	0.22 mg/l	0.24 mg/l	
9	Standard Cl2 No. 2 (0.94 ± 0.10 mg/l)	0.89 mg/l	0.90 mg/l	
10	Standard Cl2 No. 3 (1.72 ± 0.14 mg/l)	1.63 mg/l	1.67 mg/l	
	DPD-CHLORINE-HR			
11	Blank (0.0 mg/l)	0.0 mg/l	0.0 mg/l	
12	Standard Cl2 No. 1 (2.2 ± 0.2 mg/l)	2.1 mg/l	2.2 mg/l	
13	Standard Cl2 No. 2 (4.1 ± 0.3 mg/l)	3.9 mg/l	4.0 mg/l	
14	Standard Cl2 No. 3 (7.0 ± 0.6 mg/l)	6.9 mg/l	7.0 mg/l	

REVIEW BY Chayathron P.

APPROVED BY [Signature]

NEXT CAL. DATE 28/1/23



HACH COMPANY

C/O AB Sciex (Thailand) Limited, Building D Room No. D3 11, 3rd Floor, No. 735/4, Srinakarin Road, Pattanakarn, Suanluang, Bangkok
| Phone +66 (02) 026-3529 Ext. 0 | Fax +66(02) 026-3572 | www.sea.hach.com

LABX 2200107

Summary of checked

- ☒ 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:

Standard Equipment Used

Equipment	Equipment I.D.		
Standard Chlorine DPD-CHLORINE-LR	Lot No.	A0197	Exp date : Jul-22
Standard Chlorine DPD-CHLORINE-HR	Lot No.	A0164	Exp date : Jun-22
Digital multi meter	S/N :	21190066	Due date : 19-Mar-22
Thermo hygrometer	S/N :	45146347	Due date : 30-Jul-22

Test By :

WILAILAK S.

(Miss Wilailak Sawangpun)

Service Engineer

Approved by :

S. Suanun

(Mr. Suanun Sartyangkool)

Position :

Assistant Service Division Manager



Be Right™

ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙



กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ เขตราชเทวี
กรุงเทพมหานคร ๑๐๔๐๐

๒๙ มกราคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๓๐ กรกฎาคม ๒๕๖๓

- สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น
๓. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุ
หนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๕ สถานที่ตั้งเลขที่ ๑๐๔
ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร
ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย)
จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

- ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย ตามสิ่งที่ส่งมาด้วย ๒
ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๕๙ รายการ น้ำได้ดิน
จำนวน ๑๒๖ รายการ อากาศเสีย ๑๖ รายการ สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน ๓๕ รายการ และดิน
จำนวน ๑๒๕ รายการ รวมทั้งสิ้นจำนวน ๓๖๑ รายการ ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๖ หากประสงค์จะต่ออายุหนังสือ
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอ
ต่อกรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์
เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายศิริะ จันทรเจต)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน

ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเตือนภัยมลพิษโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๒๐๒ ๔๑๔๖ ๐ ๒๒๐๒ ๔๐๐๒

โทรสาร ๐ ๒๓๕๔ ๓๒๐๘ ๐ ๒๓๕๔ ๓๔๑๕

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย

๑) นางสาวยุพาพร จันทร์เปล่ง

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๐

๒) นางสาวชนัญ โกลมารกุล ณ นคร

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๑

๓) นายศรายุทธ จิตรานนท์

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๒

๔) นางสาวกนกกร เอนก

ทะเบียนเลขที่ ว-๒๐๔-ค-๖๑๑๑

๕) นายสุริยา สอนแก้ว

ทะเบียนเลขที่ ว-๒๐๔-ค-๖๑๑๒

๖) นายวิชาญ ชูณหรัศ

ทะเบียนเลขที่ ว-๒๐๔-ค-๖๑๑๓



(นายศิริระ จันทรเลิศ)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและพัฒนามลพิษโรงงาน

ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑๐๖๕

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย

๑) นางสาวจินดา ไชจุลธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๘
๒) นางสาวสาวิตรี น้อยเสงี่ยม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๙
๓) นางสาวชนัญญาญจน์ อัมขม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๐
๔) นางสาวนรินทร์ สายเส็ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๕
๕) นางสาวนันทวดี สมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๖
๖) นางสาวศรียา เฉลิมธำรงค์	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๗
๗) นางสาวสรารัตน์ มงคลจิรวดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๙
๘) นางสาวศิริลักษณ์ พึ่งแพง	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๒๐
๙) นายณพพงศ์ จันทรพันธุ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๐๘
๑๐) นายนรเศรษฐ์ โกมลาลัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๑
๑๑) นายธินว จริยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๔
๑๒) นางสาวเกศรินทร์ แก้วมัน	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๖
๑๓) นางสาวสุวิมล ชัยเรืองวุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๗
๑๔) นางสาวสุชาดา ธรรมถาวร	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๑
๑๕) นางสาวเปมิกา ชัยเดชธนกุล	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๓
๑๖) นางสาวศศิธร หมูสวัสดิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๔
๑๗) นางสาวเสาวลักษณ์ ภู่นาอำพร	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๕
๑๘) นายอภิสิทธิ์ สิงหา	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๖
๑๙) นายศักดิ์สิทธิ์ ไพศาลพิสุทธิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๗
๒๐) ว่าที่ร้อยตรีหญิง พรรณิภา ขำเจริญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๒๘
๒๑) นางจิตดา คำภูแก้ว	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๓๑
๒๒) นางสาวอรรพรรณ รักษย	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๑๕
๒๓) นางสาวนพรัตน์ แยมกรานต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๑๙
๒๔) นายจุลเดช วารินทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๐
๒๕) นางสาวดาญรัตน์ ร้องคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๑
๒๖) นายนคร สุขเจริญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๒
๒๗) นายบัญชา นามเขตต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๓
๒๘) นายพรมมี ศรีปัดเนตร	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๕
๒๙) นายอุทิศ อุ่นสิม	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๖
๓๐) ว่าที่ร้อยตรี เฉลิมเกียรติ อมรศรีเสริม	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๘
๓๑) นางสาววริยา สร้างนา	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๙
๓๒) นายอนุพงศ์ รัตนศรีประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๓๐
๓๓) นางสาวจุฑารัตน์ โอนสันเทียะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๔๒
๓๔) นางสาวจารุวรรณ พิมพ์อภิกฤติยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๗๖

(นายศิริ จันทร์เจ็ด)

๓๕) นางสาวปรางค์ทิพย์...

มหาวิทยาลัยราชภัฏวชิรเวศน์ วิทยาลัยการแพทย์

ผู้อำนวยการกองวิจัยและพัฒนาระบบสุขภาพ

วิทยาลัยการแพทย์และสาธารณสุข มหาวิทยาลัยราชภัฏวชิรเวศน์

๓๕) นางสาวปรางค์ทิพย์ กิจไพศาลศักดิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๗๙
๓๖) นางสาวเตือนใจ ทางกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๐
๓๗) นางสาวจิราพร ศิริเวช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๑
๓๘) นายวรกร ผูกרך	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๓
๓๙) นายทง วิริยะสหกิจ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๔
๔๐) นายธนิศ เจนจบ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๕
๔๑) นายคณิศร ขำเพชร	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๖
๔๒) นายอรรคพล นิยมวิทยาพันธ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๗
๔๓) นายภูวิช พรหมสะอาด	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๘
๔๔) นายธนเดช โกคาพิพัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๙
๔๕) นายชวฤทธิ์ วงษ์จันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๐
๔๖) นายอาทิตย์ ศรีแสน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๑
๔๗) นายเจษดินทร์ คงศักดิ์ไทย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๒
๔๘) นายจรัส บุญยั้ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๕
๔๙) นายธนาณัติ เอนก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๖
๕๐) นายอภิวัฒน์ ทุมหนู	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๗
๕๑) นางสาวสุภาขวัญ มาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๘
๕๒) นางสาวหัตพร ขวาลสมบุรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๐
๕๓) นางสาวธิดิมา บุญเพ็ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๑
๕๔) นางสาวกนกอร เข้มเพ็ชร	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๒
๕๕) นางสาวพัชรียา หงษ์สมดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๓
๕๖) นางสาวภาวนิดา สุรวงศ์ตระกูล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๔
๕๗) นางสาวภาณุมาศ นามวัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๕
๕๘) นางสาวอุไรรัตน์ ทิงสร้างแป้น	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๖
๕๙) นายธีรวัฒน์ ปวงสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๗
๖๐) นายอิทธิพล ยะโส	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๘
๖๑) นายประพนธ์ วรรณขุชัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๙
๖๒) นายชยธร พวงทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๐
๖๓) นางสาวกนกวรรณ จันทบาล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๑
๖๔) นางสาวเกษร หลักบุญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๒
๖๕) นายสิทธิโชค ธงเงิน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๓
๖๖) นางศิวารรณ ใจบุญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๕
๖๗) นางสาวพรรณธิดา พุ่มคง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๘
๖๘) นางสาวศรณีย์ ยิ่งดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๙
๖๙) นายนวกัทร ศรีวิริยะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๐
๗๐) นายสุวิชา ทองอ่อน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๑
๗๑) นายวิญญู บุญตะนัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๓

(นายศิระ จันทรเกิด)

นักวิทยาศาสตร์ชำนาญการพิเศษ วิชาการการแพ

ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน

๗๒) นายสมบุรณ์...

๗๒) นายสมบุรณ์ บุตรจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๔
๗๓) นายวิรัตน์ ไชยชนะรา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๕
๗๔) นายณฤเบศน์ เพิ่มพูน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๖
๗๕) นายจิรณัฐ ขาวละออ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๗
๗๖) นายสมโภช วันสา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๘
๗๗) นายอัสรี นามบุรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๙
๗๘) นายณัฐนันท์ ปานประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๐
๗๙) นายอัครเวศ จ่อสาว	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๑
๘๐) นายประเสริฐ สุระขันธ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๒
๘๑) นายณกุล จันทร์เนียม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๓
๘๒) นายพิรพงษ์ ทองคุณปรีดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๔
๘๓) นายณฤพล ทองนุช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๕
๘๔) นายอนุวัฒน์ ม่วงแพร่	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๖
๘๕) นายเจตศราวุฒิ ปิตตะมะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๗
๘๖) นายกฤษณะ สายวรรณ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๘
๘๗) นายพิชัย บุญยงค์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๒๙
๘๘) นายภาณุพงศ์ โหมวงศ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๐
๘๙) นายสามารถ คุ่มปลี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๑
๙๐) นายสัญญาชัย โกศรีนาม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๒
๙๑) นายณัฐวุฒิ ศรีประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๓
๙๒) นายขวัลรัช นาคพนม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๔
๙๓) นายพงศธร ชัยทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๕
๙๔) ว่าที่ร้อยตรี ภาณุพงศ์ แสนศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๖
๙๕) นายสิทธิโชค ทาสีดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๗
๙๖) นายธนากร อินสุตา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๘
๙๗) นางสาววรรณิษา ขาติวันชัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๓๙
๙๘) นางสาวพิมพ์ตะวัน มินากุล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๐
๙๙) นางสาวเพชรรัตน์ สิงห์สมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๑
๑๐๐) นางสาวชญาณิน พรหมจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๒
๑๐๑) นายกীরติ ทวีราช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๓
๑๐๒) นายจักริน หมั่นวิชา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๔
๑๐๓) นายฉัตรชัย สุขเปีย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๕
๑๐๔) นายณรนนท์ ต๊ะทองคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๖
๑๐๕) นายตุลยพล สมนอก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๗
๑๐๖) นายทักษ์ดนัย อุบลศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๘
๑๐๗) นายธนศร นามะภูณนา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๙
๑๐๘) นายธิตพิงศ์ บัวแดง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๕๐

(นายธีระ จันทร์เจิด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและพัฒนากยผลพืชโรงงาน

บริษัท การเกษตรและเทคโนโลยีการเกษตร จำกัด

๑๐๙) นายณนทชัย...

๑๐๙) นายพนนทชัย อุปถัมภ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๔
๑๑๐) นายนิรุฒ พลสุทธิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๕
๑๑๑) นายนิพนธ์วัฒน์ สาริน	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๖
๑๑๒) นายปิยะนัฐ พลมะศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๗
๑๑๓) นายพงศ์สิริ โสมเขียว	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๘
๑๑๔) นายพีรพัฒน์ กำคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๕๙
๑๑๕) นายภาณุพงศ์ มานิตย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๐
๑๑๖) นายมงคล ผลาทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๑
๑๑๗) นายมนินทร์ พูลศิริ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๒
๑๑๘) นายสิรินันท์ ทองอิน	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๓
๑๑๙) นายอเนชา ทันสมัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๔
๑๒๐) นายอดิศักดิ์ ผมไผ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๕
๑๒๑) นายอนันตชัย วิสม	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๖
๑๒๒) นายณัฐดนัย เจือละออง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๗
๑๒๓) นายวรวิธ ดินัก	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๘
๑๒๔) นายแสงตะวัน นตะสัต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๙
๑๒๕) นายยุทธพงศ์ รัตนะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๐
๑๒๖) นายชัยณวุฒิ ไชยชนะิจ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๑
๑๒๗) นายวิศรุต ศรีธรรมมา	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๒
๑๒๘) นายพนนทกร เผือกผ่อง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๓
๑๒๙) นายกำชัย สุทธะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๔
๑๓๐) นางสาวณัฐภรณ์ รักทะเล	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๕
๑๓๑) นางสาวประภาภรณ์ บุตรพรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๖
๑๓๒) นางสาวนิลาวัลย์ นามพรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๗
๑๓๓) นางสาวพัชรินทร์ แสนสร้อย	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๘
๑๓๔) นายไพโรจน์ เปี่ยมพิมาย	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๙
๑๓๕) นางสาวศุภมาศ ทองมาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๐
๑๓๖) นางสาวลลิตา จิตรสว่าง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๑
๑๓๗) นางสาวชไมพร เสิกภูเขียว	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๒
๑๓๘) นางสาวกฤติมาพร คำมีแก่น	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๓
๑๓๙) นางสาวสกุลรัตน์ ภาควุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๔
๑๔๐) นางสาวกาญจนา คงคุณ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๕
๑๔๑) นางสาวไพรินทร์ ศรีรูปี	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๖
๑๔๒) นางสาวทิพนันดา ฝอยปัญญา	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๗
๑๔๓) นางสาวสาธิตา ปานทอง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๘
๑๔๔) นางสาวอริสา ทองนวล	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๒๙
๑๔๕) นางสาวอรยา คำคล่อง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๓๐

(นายศิระ จันทร์เจิด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและพัฒนากยผลพืชโรงงาน

๑๔๖) นางสาวชุตติภรณ์...

๑๔๖) นางสาวชุตากรณ์ สุนทรสนาน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๕
๑๔๗) นางสาวสุตารัตน์ นนทประสาท	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๖
๑๔๘) นางสาวรัชนิกร เนียมกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๗
๑๔๙) นางสาวกัญญารัตน์ ศรีนิลทา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๘
๑๕๐) นางสาวอัญชลี คำจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๙
๑๕๑) นายบุญฤทธิ์ เอี่ยมเทศ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๐
๑๕๒) นายศิริวัฒน์ พานิชย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๑
๑๕๓) นางสาวศุภรดา ปันมยุรา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๒
๑๕๔) นางสาวพาฤดี คุณนาน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๓
๑๕๕) นางสาวจิราเจต ฟองดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๔
๑๕๖) นางสาวกนกภรณ์ อุระ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๕
๑๕๗) นางสาวอารยา มีชัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๖
๑๕๘) นางสาวจิตสุภา ประเทืองสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๗
๑๕๙) นางสาวอริสา วิริยขันติธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๘
๑๖๐) นางสาววิษชุดา นาคผจญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๙
๑๖๑) นางสาวพนิดา ยอดอินทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๐
๑๖๒) นางสาวนันทิยา จันทะลุน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๑



(นายศิริระ จันทรเจ็ด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและพัฒนากิจการโรงงาน

ปฏิบัติการงานทอผ้าไหมและเครื่องทอผ้าไหม

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑๐๖๕

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๖๑ รายการ

น้ำเสีย จำนวน 59 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldicarb	High-Performance Liquid Chromatographic Method ^[4]
2	Aldicarb Sulfone	High-Performance Liquid Chromatographic Method ^[4]
3	Aldicarb Sulfoxide	High-Performance Liquid Chromatographic Method ^[4]
4	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
5	Arsenic	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
6	Barium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
7	α -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
8	β -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
9	δ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
10	γ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
11	Biochemical Oxygen Demand	1) 5-Day BOD Test, Azide Modification Method ^[4] 2) 5-Day BOD Test, Membrane Electrode Method ^[4]
12	Carbaryl	High-Performance Liquid Chromatographic Method ^[4]
13	Carbofuran	High-Performance Liquid Chromatographic Method ^[4]
14	Cadmium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
15	Chemical Oxygen Demand	1) Closed Reflux, Colorimetric Method ^[4] 2) Closed Reflux, Titrimetric Method ^[4]
16	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
17	Chromium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[4]
18	Color	ADMI Weighted-Ordinate Spectrophotometric Method



(นางริกาญจน์ จิตรสกุลไชย)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ

19 Copper...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
19	Copper	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
20	Cyanide	Distillation, Colorimetric Method ^[4]
21	2,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
22	4,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
23	2,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
24	4,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
25	2,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
26	4,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
27	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
28	Endosulfan Sulfate	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
29	Endosulfan I	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
30	Endosulfan II	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
31	Endrin	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
32	Endrin Aldehyde	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
33	Formaldehyde	Distillation, Colorimetric Method ^[3]
34	Free Chlorine	1) DPD Ferrous Titrimetric Method ^[4] 2) Iodometric Method ^[4]
35	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
36	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
37	Hexavalent Chromium	Filtration, Colorimetric Method ^[4]
38	3-Hydroxycarbofuran	High-Performance Liquid Chromatographic Method ^[4]
39	Lead	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
40	Manganese	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
41	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[4] 2) Digestion, Inductively Coupled Plasma/Mass spectrometric Method ^[4]
42	Methiocarb	High-Performance Liquid Chromatographic Method ^[4]
43	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]

วิมล

44 Methomyl...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
44	Methomyl	High-Performance Liquid Chromatographic Method ^[4]
45	Nickel	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
46	Oil & Grease	1) Liquid-Liquid, Partition-Gravimetric Method ^[4] 2) Soxhlet Extraction Method ^[4]
47	Oxamyl	High-Performance Liquid Chromatographic Method ^[4]
48	Propoxur	High-Performance Liquid Chromatographic Method ^[4]
49	pH	Electrometric Method ^[4]
50	Phenols	1) Distillation, Chloroform Extraction Method ^[4] 2) Distillation, Direct Photometric Method ^[4]
51	Selenium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
52	Sulfide	Iodometric Method ^[4]
53	Temperature	Laboratory and Field Methods ^[4]
54	Total Dissolved Solids	Dried at 180 °C ^[4]
55	Total Kjeldahl Nitrogen	Semi-Micro Kjeldahl Method ^[4]
56	Total Suspended Solids	Dried at 103-105 °C ^[4]
57	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic Method ^[4]
58	Trivalent Chromium	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ^[4]
59	Zinc	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[4]

น้ำใต้ดิน จำนวน 126 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]

วิภา

3 Aldrin...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
3	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
4	Anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
5	Antimony	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
7	Atrazine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
8	Barium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
9	Benz(a)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
11	Benzo(b)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
12	Benzo(k)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
13	Benzoic Acid	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
14	Benzo(a)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
15	Benzo[g,h,i]perylene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
17	Bis(2-chloroethyl)ether	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]


วิธีทาง)

18 Bis(2-ethylhexyl)phthalate...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และหน่วยงานที่เกี่ยวข้อง

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
18	Bis(2-ethylhexyl)phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
21	Butanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[4]
22	Butyl Benzyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
24	Carbazole	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
27	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
28	p-Chloroaniline	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
32	2-Chlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
33	Chromium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]



34 Chromium (III)...

(นางนงกมล นนงสุกุลไธ)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ^[4]
35	Chromium (VI)	Colorimetric Method ^[4]
36	Chrysene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
37	Cyanide	Distillation, Colorimetric Method ^[4]
38	2,4-D	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
39	DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
40	DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
41	DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
42	Dibenz(a,h)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
43	Di-n-Butyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
47	3,3-Dichlorobenzidine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]

วิมล

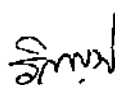
(นางริกาญจน์ ฉัตรสกุลใจ)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กองควบคุมและปฏิบัติการ

51 cis-1,2-Dichloroethylene...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
53	2,4-Dichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
57	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
58	Diethyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
59	2,4-Dimethylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
60	2,4-Dinitrophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
61	2,4-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
62	2,6-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
63	Di-n-Octyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
64	Endosulfan	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
65	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
67	Fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]



(นางริกาญจน์ นัตถกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิชาการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

68 Fluorene...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
68	Fluorene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
69	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
70	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
71	Hexachlorobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
73	n-Hexane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
74	α -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
75	β -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
76	γ -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
77	Hexachlorocyclopentadiene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
78	Hexachloroethane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
79	Indeno(1,2,3-cd)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
80	Isophorone	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
81	Lead	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
82	Manganese	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
83	Mercury	1) Cold Vapor Atomic Absorption Spectrometric Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]

วิมล

84 Methanol...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กรมส่งเสริมการค้าระหว่างประเทศ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[4]
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
89	2-Methylnaphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
91	Naphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
92	Nickel	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
95	N-Nitrosodi-n-Propylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
96	Polychlorinated Biphenyls - PCB 1016 - PCB 1221 - PCB 1232 - PCB 1242 - PCB 1248 - PCB 1254 - PCB 1260	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]

วิมล

97 Pentachlorophenol...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
98	pH	Electrometric Method ^[4]
99	Phenanthrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
100	Phenol	1) Distillation, Direct Photometric Method ^[4] 2) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
101	Pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
102	Selenium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
103	Silver	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
104	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
105	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
106	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
107	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
108	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
109	TPH (C ₅ -C ₈)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[13,24]
110	TPH (C ₈ -C ₁₆)	Solvent Extraction, Gas Chromatographic Method ^[9,21]
111	TPH (C ₁₆ -C ₃₅)	Solvent Extraction, Gas Chromatographic Method ^[9,21]
112	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
113	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]

วิมล

114 1,1,2-Trichloroethane...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
114	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
115	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
116	2,4,5-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
117	2,4,6-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4]
118	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
119	Vanadium	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]
120	Vinyl Acetate	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
121	Vinyl Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
122	m-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
123	o-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
124	p-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
125	Xylene (Total)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4]
126	Zinc	1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4]

อากาศเสีย (ปล่อยระบาย) จำนวน 16 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Antimony	Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5]
2	Arsenic	Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5]

วิมล

3 Carbon Monoxide...

(นางริภาณูจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กรมควบคุมมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
3	Carbon Monoxide	1) Sampling Bag Non-Dispersive Infrared Method ^[5] 2) Non-Dispersive Infrared Method ^[5] 3) Instrumental Analyzer Method ^[5]
4	Chlorine	1) Absorption Sampling, Ion Chromatographic Method ^[5] 2) Isokinetic Sampling, Ion Chromatographic Method ^[5]
5	Copper	Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5]
6	Dioxins	Isokinetic Sampling, Analysis by ISO/IEC 17025 Accredited Laboratory or Analysis by Department of Industrial Works Registered Laboratory (Dioxins/Furans Analysis Approved) ^[5]
7	Hydrogen Chloride	1) Absorption Sampling, Ion Chromatographic Method ^[5] 2) Isokinetic Sampling, Ion Chromatographic Method ^[5]
8	Hydrogen Sulfide	Absorption Sampling, Iodometric Method ^[5]
9	Lead	Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5]
10	Mercury	1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[5] 2) Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5]
11	Opacity	Ringelmann's Method ^[2]
12	Oxides of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method ^[5] 2) Chemiluminescence Method ^[5] 3) Instrumental Analyzer Method ^[5]
13	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Method ^[5] 2) UV Fluorescence Method ^[5] 3) Instrumental Analyzer Method ^[5]
14	Sulfuric Acid	Isokinetic Sampling, Barium-Thorin Titrimetric Method ^[5]
15	Total Suspended Particulate	Isokinetic Sampling, Gravimetric Method ^[5]
16	Xylene	Adsorption Sampling, Gas Chromatographic Method ^[5]

วิมล

สิ่งปลูก...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

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สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน 35 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
2	Antimony	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
3	Arsenic	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]

วิมล

6 Cadmium...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
6	Cadmium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
7	Chlordane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,19,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
8	Chromium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
9	Chromium (III)	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method ^[1,6,15,17] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method ^[1,6,16,17] 3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8,15,17] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8, 16,17]
10	Chromium (VI)	1) Waste Extraction, Colorimetric Method ^[1,6,17] 2) Alkaline Digestion, Colorimetric Method ^[8,17]

วิมล

(นางริกาญจน์ ฉัตรสกุลวิไล)

11 Cobalt...

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

.....เรียนหนังสือภาคีการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
11	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
12	Copper	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
13	2,4-D	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
14	DDD	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
15	DDE	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
16	DDT	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25]

จิรพร

2) Soxhlet...

(นางริภาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และคณะผู้รับผิดชอบปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
17	Dieldrin	2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25]
18	Endrin	2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25]
19	Heptachlor	2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25]
20	Lead	2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
21	Lindane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
22	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[1,6,18]

วิมล

2) Waste Extraction...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
23	Methoxychlor	2) Waste Extraction, Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ^[1,6,19] 3) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^[1,6,20] 4) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[18] 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ^[19] 6) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^[20]
24	Mirex	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
25	Molybdenum	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
26	Nickel	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
		1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]

วิภาดา

27 Polychlorinated...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิชาการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
27	<p>Polychlorinated biphenyls (PCBs)</p> <ul style="list-style-type: none"> - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5',6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl 	<p>1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method^[1,9,23]</p> <p>2) Soxhlet Extraction, Gas Chromatographic Method^[10,23]</p> <p>3) Automated Soxhlet Extraction, Gas Chromatographic Method^[22,31]</p>

วิมล

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

28 Pentachlorophenol...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
28	Pentachlorophenol	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
29	pH	Electrometric Method ^[29,30]
30	Selenium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
31	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16]
32	Thallium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
33	Toxaphene	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31]
34	Vanadium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15]

Signature

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์หกลมลพิษ

4) Digestion...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
35	Zinc	4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] 3) Digestion, Inductively Coupled Plasma Method ^[7,15] 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]

ดิน จำนวน 125 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
3	Aldrin	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
4	Anthracene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
5	Antimony	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
7	Atrazine	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
8	Barium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
9	Benz(a)anthracene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
11	Benzo(b)fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
12	Benzo(k)fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
13	Benzoic acid	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
14	Benzo(a)pyrene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
15	Benzo(g,h,i)perylene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
17	Bis(2-chloroethyl)ether	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
18	Bis(2-ethylhexyl)phthalate	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
21	Butanol	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[12,24]
22	Butyl Benzyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
24	Carbazole	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]

วิกรม

26 Carbon tetrachloride...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
27	Chlordane	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
28	p-Chloroaniline	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
32	2-Chlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
33	Chromium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8,15,17] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8,16,17]
35	Chromium (VI)	Alkaline Digestion, Colorimetric Method ^[8,17]
36	Chrysene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
37	Cyanide	Extraction, Distillation, Colorimetric Method ^[26,27,28]
38	2,4-D	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
39	DDD	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]

Signature

(นางริกาญจน์ จิตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

40 DDE...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
40	DDE	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
41	DDT	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
42	Dibenz(a,h)anthracene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
43	Di-n-Butyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
47	3,3-Dichlorobenzidine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
53	2,4-Dichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]

วิมล

(นางริกาญจน์ อัครสกุลใจ)

57 Dieldrin...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
57	Dieldrin	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
58	Diethyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
59	2,4-Dimethylphenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
60	2,4-Dinitrophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
61	2,4-Dinitrotoluene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
62	2,6-Dinitrotoluene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
63	Di-n-Octyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
64	Endosulfan	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
65	Endrin	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
67	Fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
68	Fluorene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
69	Heptachlor	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
70	Heptachlor Epoxide	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
71	Hexachlorobenzene	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
73	n-Hexane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
74	α -HCH	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
75	β -HCH	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
76	γ -HCH	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
77	Hexachlorocyclopentadiene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
78	Hexachloroethane	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
79	Indeno(1,2,3-cd)pyrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
80	Isophorone	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
81	Lead	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
82	Manganese	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
83	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[18]

วิมล

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กองอนามัยสิ่งแวดล้อม

2) Thermal...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry ^[19] 3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^[20] Equilibrium Headspace, Gas Chromatographic/Mass Spectrometric Method ^[12,24]
85	Methoxychlor	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
88	2-methylphenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
89	2-Methylnaphthalene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^[14,24]
91	Naphthalene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
92	Nickel	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[7,16]
93	Nitrobenzene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
94	N-Nitrosodiphenylamine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
95	N-Nitrosodi-n-propylamine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
96	Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,23] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[23,32]

วิฑูรย์

(นางวิภาณูจน์ ฉัตรสกุลวิไล)

- Aroclor 1242...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
	<ul style="list-style-type: none"> - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5'-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5',6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl 	
97	Pentachlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
98	Phenanthrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
99	Phenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]
100	Pyrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^[25,31]

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
101	Selenium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
102	Silver	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
103	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
106	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
107	Toxaphene	1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
108	TPH (C ₅ -C ₆)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
109	TPH (C ₈ - C ₁₆)	1) Solvent Extraction, Gas Chromatographic Method ^[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[21,31]
110	TPH (C ₁₆ - C ₃₅)	1) Solvent Extraction, Gas Chromatographic Method ^[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[21,31]
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
115	2,4,5-Trichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]

วิมล

116 2,4,6-Trichlorophenol...

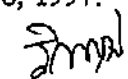
(นางวิภาดาญ์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
116	2,4,6-Trichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31]
117	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
118	Vanadium	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]
119	Vinyl Acetate	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
120	Vinyl Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
121	m-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
122	o-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
123	p-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
124	Xylene (Total)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24]
125	Zinc	1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16]

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ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
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