

ภาคผนวก ง

ใบรับรองเอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0485	5-Jan-22	5-Jul-22	6
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	16-Dec-21	16-Dec-22	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Stand	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Stand	-	-	-	-
Ambient	Total Suspended Particulate	High Volume	BKK_FS0367	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0358	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0359	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0372	-	-	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_FS1063	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0374	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0375	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0387	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS1092	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0785	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0741	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS1090	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKK_FS1091	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKK_FS0784	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKK_FS0740	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKK_FS1089	4-Jan-22	4-Jul-22	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0039	7-Dec-20	7-Jun-22	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	10-Dec-20	10-Jun-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0909	31-Mar-21	29-Sep-22	18
Ambient	Temperature	Temperature Sensor	SGK_FS0039	7-Dec-20	7-Jun-22	18
Ambient	Temperature	Temperature Sensor	RYG_FS0436	6-Jan-22	7-Jul-23	18
Ambient	Temperature	Temperature Sensor	BKK_FS0975	10-Dec-20	10-Jun-22	18
Ambient	Temperature	Temperature Sensor	BKK_FS0909	31-Mar-21	29-Sep-22	18
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0633	14-Jan-22	14-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0996	6-Aug-21	6-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0995	6-Aug-21	6-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0971	12-Jan-22	12-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0994	6-Aug-21	6-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0998	7-Sep-21	7-Sep-22	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0993	12-Oct-21	12-Oct-22	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0633	14-Jan-22	14-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0031	12-Jan-22	12-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0107	15-Oct-21	15-Oct-22	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0115	14-Dec-21	14-Dec-22	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0633	14-Jan-22	14-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0030	12-Jan-22	12-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0106	15-Oct-21	15-Oct-22	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0924	12-Oct-21	12-Oct-22	12
Noise	Leq 5 min	Sound Calibrator	BKK_FS0633	14-Jan-22	14-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0031	12-Jan-22	12-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0107	15-Oct-21	15-Oct-22	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0115	14-Dec-21	14-Dec-22	12
Noise	Leq 5 min	Sound Calibrator	BKK_FS0633	14-Jan-22	14-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0030	12-Jan-22	12-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0106	15-Oct-21	15-Oct-22	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0924	12-Oct-21	12-Oct-22	12
Noise	Noise Contour	Sound Calibrator	BKK_FS0631	26-Oct-21	26-Oct-22	12
Noise	Noise Contour	Sound Level Meter	BKK_FS1001	7-Sep-21	7-Sep-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0671	30-Sep-21	30-Sep-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0675	4-Aug-21	4-Aug-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0680	15-Feb-22	15-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0682	1-Oct-21	1-Oct-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0642	14-Feb-22	14-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0653	2-Nov-21	2-Nov-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0671	30-Sep-21	30-Sep-22	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0672	17-Mar-22	17-Mar-23	12
Illuminance	Illuminance	Lux Meter	BKK_FS1146	8-Sep-21	8-Sep-22	12
Illuminance	Illuminance	Lux Meter	BKK_FS1145	8-Sep-21	8-Sep-22	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Anionic Surfactant	Spectrophotometer	BKK_EN0018	15-Oct-21	15-Oct-22	12
Water Lab	Anionic Surfactant	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Cyanide	Discrete analyzer	BKK_EN0037	28-Jun-21	28-Jun-22	12
Water Lab	Cyanide	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Formaldehyde	Spectrophotometer	BKK_EN0018	15-Oct-21	15-Oct-22	12
Water Lab	Formaldehyde	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Phenol	Discrete analyzer	BKK_EN0037	28-Jun-21	28-Jun-22	12
Water Lab	Phenol	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	pH at 25 °C	pH meter	BKK_EN0072	26-Mar-21	24-Sep-22	18
Water Lab	Sulfide	Burette	BKK_EN0171	30-Mar-21	28-Sep-22	18
Water Lab	Sulfide	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Dissolved Oxygen	Burette	BKK_EN0171	30-Mar-21	28-Sep-22	18
Water Lab	Dissolved Oxygen	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	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	Residual Free Chlorine	Chlorine Meter	BKK_LG0032	23-Feb-22	23-Feb-23	12
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	28-Jun-21	28-Jun-22	12
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_EN0007	1-Dec-21	1-Jun-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_EN0007	1-Dec-21	1-Jun-23	18
Water Lab	BOD (5 days at 20°C)	DO Meter	BKK_EN0205	19-Jan-21	20-Jul-22	18
Water Lab	BOD (5 days at 20°C)	Incubator	BKK_EN0005	4-Oct-21	4-Apr-23	18
Water Lab	COD	Hot Block	BKK_EN0222	21-Mar-22	21-Mar-23	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	15-Oct-21	15-Oct-22	12
Water Lab	Temperature	pH Meter	BKK_LG0011	29-Nov-21	29-Nov-22	12
Water Lab	Color	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Organochlorine Pesticide	Gas Chromatography (ECD)	BKK_EN0284	23-Nov-21	22-May-23	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	15-Oct-21	15-Oct-22	12
Water Lab	Conductivity	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Water Lab	Conductivity (On site)	Conductivity meter	BKK_LG0033	10-Feb-22	10-Feb-23	12
Water Lab	Total Trihalomethane	Gas Chromatography (MSD)	BKK_EN0059	24-Dec-20	24-Jun-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	18
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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	18





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### รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	18
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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	18
Water Lab	Mercury	CVAFS	BKK_EL0011	7-Jun-21	7-Jun-22	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	26-Mar-21	24-Sep-22	18
Sludge	Conductivity aqueous phase 10% (w/v)	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Sludge	Residual Chlorine	Chlorine Meter	BKK_LG0032	23-Feb-22	23-Feb-23	12
Sludge	Trihalomethane	Gas Chromatography (MSD)	BKK_EN0059	24-Dec-20	24-Jun-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	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	18-May-21	16-Nov-22	18





## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 5 Jan 22  
Next Calibration of Date : 5 Jul 22

Barometric Pressure (mm.Hg) : 759  
Relative Humidity (%) : 61.0  
Temperature ( °C ) : 30.0

### Console Control Meter Data

Calibration No. : C-050122-BKK\_FS0485  
Dry Gas Meter No. : BKK\_FS0485  
Serial No. : 1310055  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID.: BKK\_FS1122  
Serial No. : A2003240  
Correction Factor (Yr) : 1.0000  
Next Calibration Date : 1 Mar 22

$\Delta H$  (mm.H <sub>2</sub> O)	$\ominus$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter Correction Factor  (Y)	Orifice Calibration Factor  $\Delta H@$
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Tm (°C)		
		Final	Initial	Total		Final	Initial	Total					
15	12.29	150.00	0.00	150.00	29.0	273149.0	272994.0	155.00	30.0	30.0	30.0	0.9695	45.9639
25	9.30	150.00	0.00	150.00	30.0	273572.0	273415.0	157.00	31.0	31.0	31.0	0.9563	44.0117
50	6.34	150.00	0.00	150.00	31.0	273743.0	273588.0	155.00	33.0	33.0	33.0	0.9694	40.9096
80	5.10	150.00	0.00	150.00	31.0	273917.0	273762.0	155.00	33.0	33.0	33.0	0.9666	42.3552
120	4.10	150.00	0.00	150.00	31.0	274120.0	273966.0	154.00	34.0	34.0	34.0	0.9723	40.9269
											Avg.	0.9668	42.8335

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

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

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

Calibrated by:

*Chawalit*

( Mr.Chawalit Wongchan )

Field Scientist(2)

Approved by:

*Samart*

( Mr.Samart Roo-ngan)

Specialist(1)



## Stopwatch Calibration Test Report

Calibration Date : 5 Jan 22

Next Cal. Date : 5 Jul 22

Barometric Pressure (mmHg) : 759

Temperature (°C) : 31.0

Relative Humidity (%) : 61.0

### 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\_FS0485

Model : XC-572-V

Serial No. : 1310055

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:11	5:00	11	0.00018
2	5:00:08	5:00	8	0.00013
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:10	5:00	10	0.00017
6	5:00:08	5:00	8	0.00013
7	5:00:08	5:00	8	0.00013
8	5:00:12	5:00	12	0.00020
9	5:00:08	5:00	8	0.00013
10	5:00:08	5:00	8	0.00013
			Average	0.00016
			SD	0.00003

Calibrate by :

Chawalit

Mr.Chawalit Wongchan

Field Scientist (2)

Approved by :

712

Mr. Samart Roo-ngan

Specialist (1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	5 Jan 22	Ambient Temperature (°C) :	32
Calibration sheet No. :	C-050122-BKK_FS0486	Relative Humidity (%) :	66

Digital Temperature ID	BKK_FS0486	Reference Temperature ID	BKK_FS0609
Serial No. :	1310055	Serial No. :	7688004
Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	13 Jan 22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	24	-1	
	50	49	-1	
	100	99	-1	
	150	149	-1	
	200	199	-1	
	250	249	-1	
	300	298	-2	
	500	498	-2	
	1000	998	-2	
	1200	1198	-2	
Probe	100	98	-2	
	125	123	-2	
	150	148	-2	
Oven	100	99	-1	
	125	124	-1	
	150	150	0	
Filter	100	100	0	
	125	124	-1	
	150	149	-1	
Exit	0	-1	-1	
	10	9	-1	
	20	19	-1	
Meter	0	0	0	
	25	25	0	
	50	50	0	
AUX	0	-1	-1	
	25	25	0	
	50	50	0	

Calibrated by : \_\_\_\_\_

( Mr.Chawalit Wongchan )

Field Scientist (2)

Approved by : \_\_\_\_\_

( Mr.Samart Roo-ngan )

Specialist (1)





## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0489

Calibration Date : 5 Jan 22

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

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-050122-BKK\_FS0489

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> 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 : Chawalit

( Mr.Chawalit Wongchan )

Field Scientist (2)

Approved by : [Signature]

( Mr.Samart Roo-ngan)

Specialist (1)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0490

Calibration Date : 5 Jan 22

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

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-050122-BKK\_FS0490

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> 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

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

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

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

Calibrated by : Chawalit

( Mr.Chawalit Wongchan )

Field Scientist (2)

Approved by : [Signature]

( Mr.Samart Roo-ngan)

Specialist (1)



## PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	5 Jan 22	Nozzle Set ID.:	BKK_FS0491
Calibration Sheet No. :	C-050122-BKK_FS0491	Vernier Caliper ID.:	BKK_FS0626

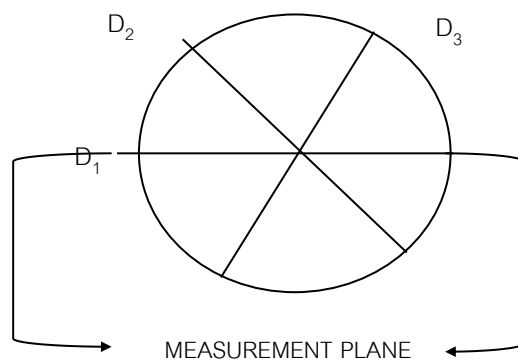
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo $\Delta D$	$(D_1 + D_2 + D_3) / 3$ $D_{avg}$
	$D_1$	$D_2$	$D_3$		
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.955	0.955	0.955	0.000	0.955
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.600	0.000	1.600

Where :

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

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

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



Calibrated by : Chawalit

( Mr.Chawalit Wongchan )

Field Scientist (2)

Approved by : [Signature]

Mr.Samart Roo-ngan

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/m<sup>3</sup>

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

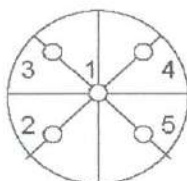
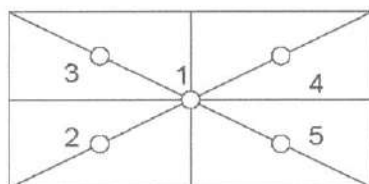
Page: 2 of 2

## 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. 2242910-1

## ANALYZER CALIBRATION DATA

Client : Gulf BP Co., Ltd. Location : HRSG 11  
Date : 10 May 22 Test Operator : Ussaree N.

O<sub>2</sub> ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.02	0.00
Low-Level Gas	8.05	8.08	8.08	0.00
Span Gas	16.06	16.11	16.11	0.00

NO<sub>x</sub> ANALYZER

Model : TELEDYNE API 200EH Serial No. : 774  
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.04	0.00
Low-Level Gas	50.32	50.05	49.97	0.04
Span Gas	158.20	157.58	157.65	0.03

SO<sub>2</sub> ANALYZER

Model : TELEDYNE API 100EH Serial No. : 410  
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.04	0.00
Low-Level Gas	50.27	49.36	49.31	0.02
Span Gas	161.60	159.53	159.64	0.05

Calibrated by

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)

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

ALS Laboratory Group





Lot No. 2242910-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co., Ltd. Location : HRSG 11  
Date : 10 May 22 Test Operator : Ussaree N.

O<sub>2</sub> ANALYZER

Cylinder Conc. (%) : 16.06 Span (%) : 25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.02	0.00	0.02	0.00	0.00
Upscale Gas	16.11	16.12	0.04	16.12	0.04	0.00

NO<sub>x</sub> ANALYZER

Cylinder Conc. (ppm) : 158.20 Span (ppm) : 200

	NO <sub>x</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.05	0.01	0.05	0.01	0.00
Upscale Gas	157.58	157.07	0.26	157.14	0.22	0.03

SO<sub>2</sub> ANALYZER

Cylinder Conc. (ppm) : 161.60 Span (ppm) : 200

	SO <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.04	0.00	0.04	0.00	0.00
Upscale Gas	159.53	158.16	0.69	158.21	0.66	0.03

Calibrated by

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)

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	10 May 22	Location	HRSG 11
Start Time	10:20	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	10:40
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
10:20	14.68	3.80	20.37	0.38	-	
10:21	14.67	3.80	20.50	0.35	-	
10:22	14.66	3.88	21.00	0.34	-	
10:23	14.64	3.90	21.47	0.39	-	
10:24	14.64	3.91	21.73	0.31	-	
10:25	14.65	3.90	21.84	0.35	-	
10:26	14.65	3.90	21.74	0.34	-	
10:27	14.66	3.91	21.56	0.34	-	
10:28	14.67	3.89	21.45	0.29	-	
10:29	14.67	3.89	21.40	0.31	-	
10:30	14.68	3.86	21.36	0.31	-	
10:31	14.69	3.88	21.26	0.30	-	
10:32	14.70	3.87	21.12	0.30	-	
10:33	14.70	3.87	21.10	0.30	-	
10:34	14.69	3.87	21.10	0.31	-	
10:35	14.69	3.91	21.10	0.28	-	
10:36	14.68	3.90	21.12	0.28	-	
10:37	14.68	3.88	21.15	0.28	-	
10:38	14.70	3.86	21.14	0.28	-	
10:39	14.70	3.88	21.14	0.25	-	
10:40	14.69	3.86	21.23	0.26	-	
Average	14.68	3.87	21.23	0.31	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)



## EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	2
Date	10 May 22	Location	HRSG 11
Start Time	10:41	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	11:01
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
10:41	14.68	3.89	21.56	0.22	-	
10:42	14.68	3.90	21.73	0.26	-	
10:43	14.68	3.88	21.79	0.21	-	
10:44	14.69	3.88	21.74	0.20	-	
10:45	14.69	3.85	21.72	0.21	-	
10:46	14.68	3.89	21.71	0.17	-	
10:47	14.65	3.89	21.77	0.19	-	
10:48	14.62	3.94	21.95	0.20	-	
10:49	14.62	3.95	21.95	0.18	-	
10:50	14.62	3.95	21.98	0.17	-	
10:51	14.65	3.88	21.99	0.18	-	
10:52	14.64	3.93	21.93	0.19	-	
10:53	14.60	3.92	21.86	0.18	-	
10:54	14.59	3.98	22.05	0.17	-	
10:55	14.59	3.98	22.18	0.16	-	
10:56	14.58	3.94	22.17	0.14	-	
10:57	14.56	3.92	22.23	0.18	-	
10:58	14.53	4.03	22.34	0.16	-	
10:59	14.53	4.01	22.49	0.17	-	
11:00	14.55	3.98	22.46	0.14	-	
11:01	14.53	3.97	22.33	0.14	-	
Average	14.62	3.93	22.00	0.19	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)





# EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	3
Date	10 May 22	Location	HRSG 11
Start Time	11:02	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	11:22
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
11:02	14.50	3.98	22.36	0.17	-	
11:03	14.50	4.02	22.47	0.11	-	
11:04	14.49	3.99	22.57	0.13	-	
11:05	14.48	4.04	22.54	0.12	-	
11:06	14.49	3.99	22.55	0.16	-	
11:07	14.50	4.01	22.49	0.14	-	
11:08	14.50	4.02	22.52	0.16	-	
11:09	14.50	3.96	22.59	0.12	-	
11:10	14.51	3.98	22.61	0.13	-	
11:11	14.50	4.01	22.67	0.16	-	
11:12	14.49	4.00	22.72	0.15	-	
11:13	14.50	3.93	22.74	0.15	-	
11:14	14.50	4.00	22.71	0.16	-	
11:15	14.52	3.96	22.63	0.17	-	
11:16	14.52	3.98	22.49	0.14	-	
11:17	14.46	4.04	22.53	0.13	-	
11:18	14.46	4.03	22.71	0.16	-	
11:19	14.49	3.99	22.83	0.14	-	
11:20	14.51	4.00	22.66	0.12	-	
11:21	14.51	3.97	22.52	0.15	-	
11:22	14.50	3.98	22.44	0.14	-	
Average	14.50	3.99	22.59	0.15	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)



Lot No. 2242913-1

## ANALYZER CALIBRATION DATA

Client : Gulf BP Co., Ltd. Location : HRSG 12  
Date : 10 May 22 Test Operator : Ussaree N.

O<sub>2</sub> ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.02	0.00
Low-Level Gas	8.05	8.08	8.08	0.00
Span Gas	16.06	16.11	16.11	0.00

NO<sub>x</sub> ANALYZER

Model : TELEDYNE API 200EH Serial No. : 774  
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.04	0.00
Low-Level Gas	50.32	50.05	49.97	0.04
Span Gas	158.20	157.58	157.65	0.03

SO<sub>2</sub> ANALYZER

Model : TELEDYNE API 100EH Serial No. : 410  
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.04	0.00
Low-Level Gas	50.27	49.36	49.31	0.02
Span Gas	161.60	159.53	159.64	0.05

Calibrated by

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)

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

ALS Laboratory Group



Lot No. 2242913-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf BP Co., Ltd. Location : HRSG 12  
Date : 10 May 22 Test Operator : Ussaree N.

O<sub>2</sub> ANALYZER

Cylinder Conc. (%) : 16.06

Span (%) : 25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.02	0.00	0.02	0.00	0.00
Upscale Gas	16.11	16.12	0.04	16.12	0.04	0.00

NO<sub>x</sub> ANALYZER

Cylinder Conc. (ppm) : 158.20

Span (ppm) : 200

	NO <sub>x</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.05	0.01	0.05	0.01	0.00
Upscale Gas	157.58	157.07	0.26	157.14	0.22	0.03

SO<sub>2</sub> ANALYZER

Cylinder Conc. (ppm) : 161.60

Span (ppm) : 200

	SO <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.04	0.00	0.04	0.00	0.00
Upscale Gas	159.53	158.16	0.69	158.21	0.66	0.03

Calibrated by

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)

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	10 May 22	Location	HRSG 12
Start Time	12:20	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	12:40
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:20	14.28	4.15	15.03	0.10	-	
12:21	14.31	4.11	14.99	0.08	-	
12:22	14.30	4.15	14.90	0.09	-	
12:23	14.25	4.16	14.90	0.10	-	
12:24	14.23	4.15	14.96	0.10	-	
12:25	14.23	4.16	14.97	0.11	-	
12:26	14.25	4.15	14.98	0.09	-	
12:27	14.24	4.17	15.02	0.10	-	
12:28	14.27	4.12	15.01	0.10	-	
12:29	14.26	4.14	14.95	0.06	-	
12:30	14.24	4.18	14.94	0.07	-	
12:31	14.23	4.19	15.03	0.08	-	
12:32	14.23	4.17	15.07	0.09	-	
12:33	14.23	4.19	15.02	0.10	-	
12:34	14.23	4.16	14.97	0.09	-	
12:35	14.23	4.16	14.96	0.11	-	
12:36	14.23	4.24	14.97	0.09	-	
12:37	14.25	4.21	14.95	0.13	-	
12:38	14.26	4.14	14.94	0.13	-	
12:39	14.23	4.16	14.92	0.11	-	
12:40	14.22	4.18	14.87	0.17	-	
Average	14.25	4.16	14.97	0.10	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)



## EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	2
Date	10 May 22	Location	HRSG 12
Start Time	12:41	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:01
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:41	14.21	4.15	14.94	0.16	-	
12:42	14.23	4.20	14.99	0.13	-	
12:43	14.23	4.15	15.04	0.08	-	
12:44	14.24	4.18	15.01	0.04	-	
12:45	14.26	4.14	14.95	0.04	-	
12:46	14.24	4.16	14.99	0.04	-	
12:47	14.23	4.13	15.04	0.08	-	
12:48	14.24	4.25	15.07	0.07	-	
12:49	14.23	4.19	15.07	0.06	-	
12:50	14.23	4.14	15.03	0.07	-	
12:51	14.26	4.17	15.02	0.07	-	
12:52	14.27	4.13	15.02	0.04	-	
12:53	14.27	4.13	15.02	0.09	-	
12:54	14.28	4.16	14.95	0.03	-	
12:55	14.27	4.16	14.86	0.06	-	
12:56	14.27	4.13	14.87	0.06	-	
12:57	14.28	4.14	14.90	0.09	-	
12:58	14.29	4.13	14.92	0.06	-	
12:59	14.28	4.16	14.88	0.12	-	
13:00	14.28	4.15	14.94	0.08	-	
13:01	14.28	4.13	14.97	0.07	-	
Average	14.26	4.15	14.97	0.07	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)





# EMISSION TEST RESULT

Client	Gulf BP Co., Ltd.	Run #	3
Date	10 May 22	Location	HRSG 12
Start Time	13:02	Test Operator	Ussaree N.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:22
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:02	14.28	4.10	14.99	0.09	-	
13:03	14.28	4.14	14.88	0.11	-	
13:04	14.28	4.11	14.83	0.10	-	
13:05	14.27	4.11	14.84	0.08	-	
13:06	14.27	4.11	14.84	0.10	-	
13:07	14.28	4.13	14.82	0.10	-	
13:08	14.28	4.13	14.85	0.11	-	
13:09	14.28	4.13	14.90	0.10	-	
13:10	14.27	4.10	14.90	0.08	-	
13:11	14.28	4.11	14.91	0.08	-	
13:12	14.28	4.14	14.93	0.09	-	
13:13	14.28	4.13	14.93	0.06	-	
13:14	14.28	4.11	14.91	0.08	-	
13:15	14.28	4.17	14.88	0.10	-	
13:16	14.29	4.12	14.90	0.14	-	
13:17	14.28	4.16	14.91	0.10	-	
13:18	14.28	4.14	14.91	0.12	-	
13:19	14.29	4.12	14.89	0.10	-	
13:20	14.29	4.16	14.88	0.13	-	
13:21	14.26	4.11	14.90	0.12	-	
13:22	14.27	4.15	14.93	0.10	-	
Average	14.28	4.12	14.89	0.10	-	

( Mr.Ussaree Namburee )

Environmental Field Scientist (4)

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number:	E04NI99E15A0617	Reference Number:	160-401977168-1
Cylinder Number:	EB0140265	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:	Dec 22, 2020

**Expiration Date: Dec 22, 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	160.0 PPM	158.2 PPM	G1	+/- 0.7% NIST Traceable	12/14/2020, 12/22/2020
CARBON MONOXIDE	160.0 PPM	157.5 PPM	G1	+/- 0.5% NIST Traceable	12/14/2020
NITRIC OXIDE	160.0 PPM	158.1 PPM	G1	+/- 0.7% NIST Traceable	12/14/2020, 12/22/2020
SULFUR DIOXIDE	160.0 PPM	161.6 PPM	G1	+/- 1.0% NIST Traceable	12/14/2020, 12/22/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13010210	KAL003128	246.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.2%	Oct 16, 2024
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	13010302	KAL003022	243.4 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	May 04, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	10010212	AAL072873	255.3 PPM SULFUR DIOXIDE/NITROGEN	+/-0.8%	Apr 25, 2022

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 6700 APW1100391 CO	FTIR	Nov 30, 2020
Nicolet 6700 APW1100391 NO	FTIR	Dec 02, 2020
Nicolet 6700 APW1100391 NO2	FTIR	Dec 02, 2020
Nicolet 6700 APW1100391 SO2	FTIR	Dec 10, 2020

Triad Data Available Upon Request

**NOTES:**

Gross Weight: 27.7 Kg  
Net Weight: 4.7 Kg



*Michael A. Fisher*  
Approved for Release

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number:	E04NI99E3HA0023	Reference Number:	160-401754137-1
Cylinder Number:	GN0024388	Cylinder Volume:	247.2 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2215 PSIG
PGVP Number:	A12020	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Mar 26, 2020

**Expiration Date: Mar 26, 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	50.00 PPM	50.32 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
CARBON MONOXIDE	50.00 PPM	49.99 PPM	G1	+/- 0.5% NIST Traceable	03/19/2020
NITRIC OXIDE	50.00 PPM	50.32 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
SULFUR DIOXIDE	50.00 PPM	50.27 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
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
NTRM	13010405	KAL003984	97.60 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	13010405	KAL003984	97.60 PPM NOx/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CO - 000928781	FTIR	Mar 12, 2020
MKS FTIR - NO - 000928781	FTIR	Mar 05, 2020
MKS FTIR - NOx - 000928781	FTIR	Mar 05, 2020
MKS FTIR - SO2 - 000928781	FTIR	Mar 19, 2020

Triad Data Available Upon Request


NOTES: Gross Weight: 47.7 Kg, Net Weight: 7.5 Kg.



*Michael A. Miller*  
Approved for Release



## CERTIFICATE OF ANALYSIS

<b>Customer Detail:</b> <b>ALS Laboratory Group (Thailand)</b>		<b>Production Order Number:</b> 90145553 <b>Material Number:</b> 478100-J-44 <b>Certification Date:</b> 07-Dec-2017 <b>Expiry Date:</b> 07-Dec-2025	
<b>Cylinder Description:</b> <b>STEEL 47 L</b>		The measurement of this reference material is traceable to SI through the reference standard which is traceable to Swiss National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/531 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.	
<b>Certificate Number:</b> 3983/17	<b>Analyst:</b>  Arissara T. ARISSARA THONGNURL		
<b>Cylinder Number:</b> 40233			
<b>Nominal Cylinder Content:</b> 6.520 M <sup>3</sup>	<b>Approve:</b>   SUKANYA KAMUTHARAT		
<b>Nominal Pressure:</b> 145.0 Bar			
<b>Valve Outlet:</b> CGA 590 BRASS	<b>To Re-Order Please Quote:</b> 478100-J-44		
<b>Comment:</b>	<ul style="list-style-type: none"> <li>● It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig.</li> <li>● Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component.</li> <li>● Keep and use in well-ventilated and secure area.</li> </ul>		

## CERTIFICATE OF ANALYSIS

*Analytical Result*

<u>Component</u>	<u>Request Concentration</u>	<u>Certified Concentration</u>	<u>Certified Uncertainty</u>	<u>Method</u>	<u>Assay Date</u>
Oxygen In Nitrogen	8.00 %	8.05 %	± 1% relative	(2) I-PB-354	04-Dec-2017

*Reference Standard used in Assay*

<u>Reference Standard</u>	<u>Cylinder No.</u>	<u>Concentration</u>	<u>Expired Date</u>
Oxygen In Nitrogen	113553SG	9.976± 0.02 %	26-Mar-2018

*Analytical Instruments used in Assay*

<u>Instrument/Make/Model</u>	<u>Analytical Principle</u>	<u>Last Multipoint Calibration</u>
Servomex 4100 O2 Analyzer	Paramagnetic	04-Dec-2017

## Method of Analysis

1. Gas Chromatograph
2. Paramagnetic Oxygen Analyser
3. Electrochemical Oxygen Analyser
4. Electrochemical Moisture Analyser
5. Total Hydrocarbon Analyser
6. Other specified

Cylinder Number 40233  
Production Order Number 90145553

Certification Date: 07-Dec-2017  
Expiration Date: 07-Dec-2025



# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number:	E02NI84E15A07B7	Reference Number:	160-401948145-1
Cylinder Number:	CC740033	Cylinder Volume:	145.8 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Nov 11, 2020

**Expiration Date: Nov 11, 2028**

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.06 %	G1	+/- 0.2% NIST Traceable	11/11/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060503	CC109542	23.204 % OXYGEN/NITROGEN	+/- 0.2%	Dec 24, 2021

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: 27.8 Kg  
Net Weight: 4.7 Kg



*Chen*

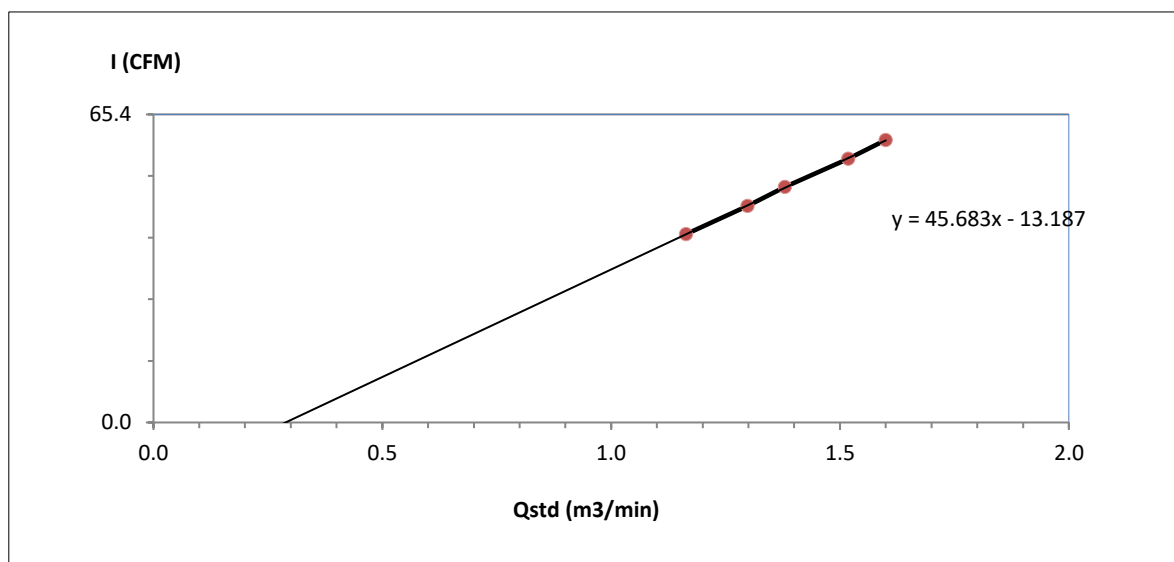
Approved for Release



## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	รพ.สต. บ้านหว้า	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0367
CalibrationSheet No.:	C-050522-BKK_FS0367	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4162
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.6	1.1638	40	Slope : 45.6828 Intercept : -13.1866 Correlation Coefficient : 0.9999
2	4.5	1.2978	46	
3	5.1	1.3797	50	
4	6.2	1.5182	56	
5	6.9	1.6001	60	



Calibrated by \_\_\_\_\_

( Mr. Teeravut Sukdee )  
Field Scientist(1)

Approved by : \_\_\_\_\_

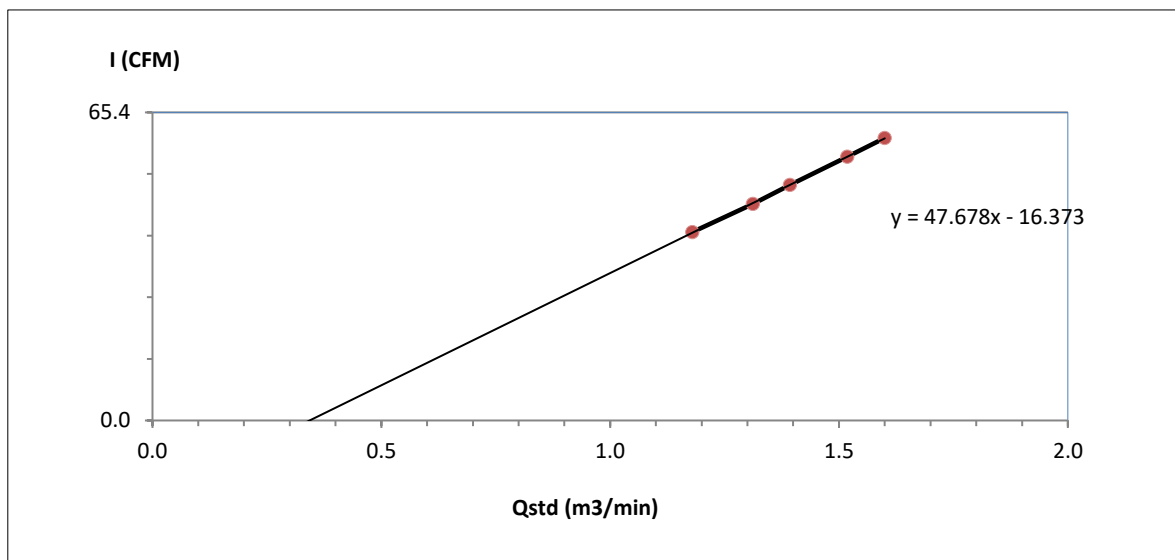
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	โรงเรียนเจ้าฟ้าสร้าง	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0358
CalibrationSheet No.:	C-050522-BKK_FS0358	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5193
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.7	1.1795	40	Slope : 47.6784 Intercept : -16.3729 Correlation Coefficient : 0.9999
2	4.6	1.3118	46	
3	5.2	1.3929	50	
4	6.2	1.5182	56	
5	6.9	1.6001	60	



Calibrated by \_\_\_\_\_

( Mr. Teeravut Sukdee )  
Field Scientist(1)

Approved by : \_\_\_\_\_

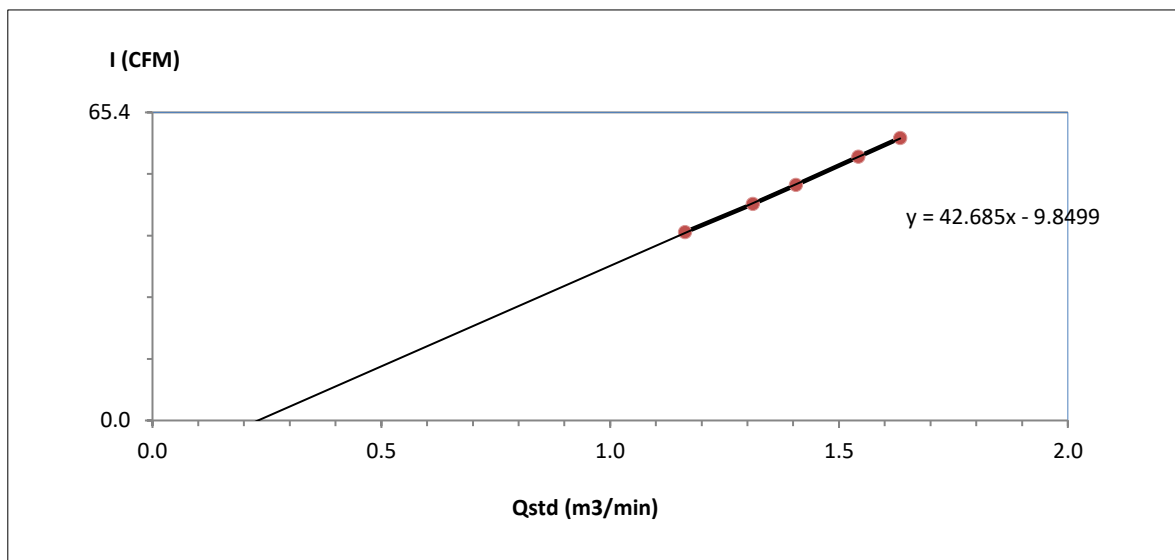
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)






## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	หมู่ที่ 3 ตำบลบ้านเลน	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0359
CalibrationSheet No.:	C-050522-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 <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.6	1.1638	40	Slope : 42.6853 Intercept : -9.8499 Correlation Coefficient : 0.9998
2	4.6	1.3118	46	
3	5.3	1.4059	50	
4	6.4	1.5421	56	
5	7.2	1.6339	60	



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

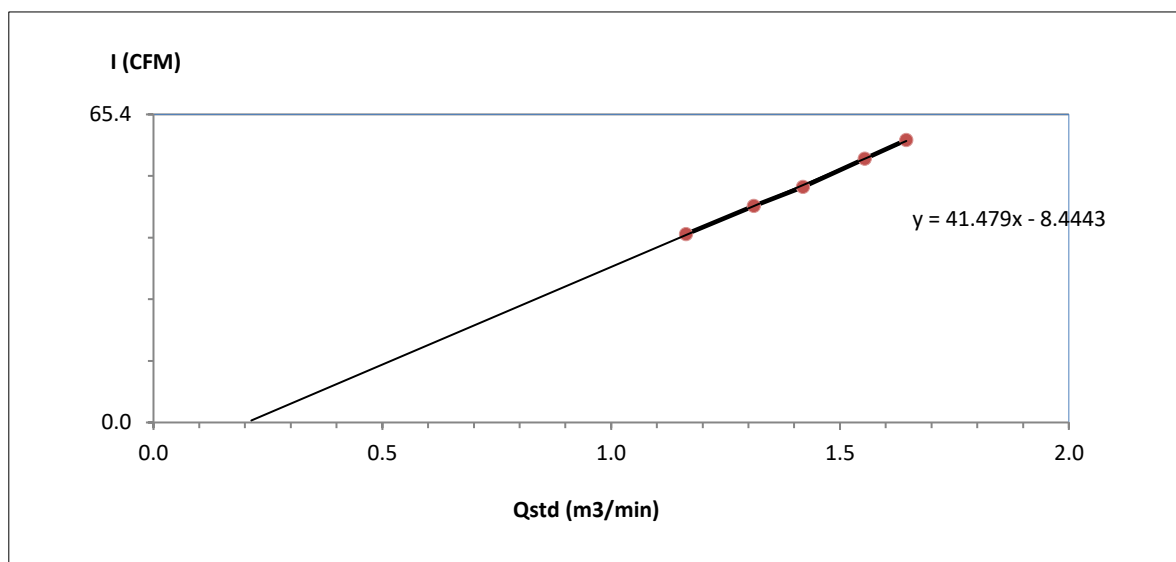
Approved by :   
 (Mr. Noppong Juntarupan)  
 Enviro Field Coordinator Scientist (3)






## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	หมู่ที่ 2 ตำบลบ้านหว้า	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0372
CalibrationSheet No.:	C-050522-BKK_FS0372	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5332
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.6	1.1638	40	Slope : 41.4791 Intercept : -8.4443 Correlation Coefficient : 0.9995
2	4.6	1.3118	46	
3	5.4	1.4189	50	
4	6.5	1.5539	56	
5	7.3	1.6450	60	



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

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





## Certificate of Calibration

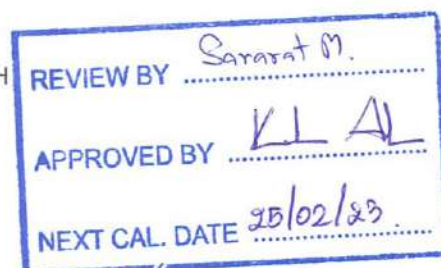
Represent to Certificate of Calibration ,PTC/07/22072

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 ± 0.4 °C  
Humidity 62.8 %RH ± 3.7 %RH  
Air density 1.20 kg/m<sup>3</sup>



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

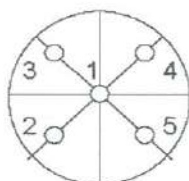
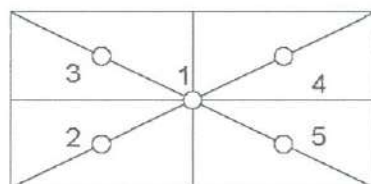
Page: 2 of 3

## 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

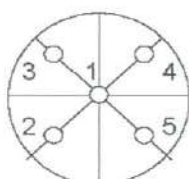
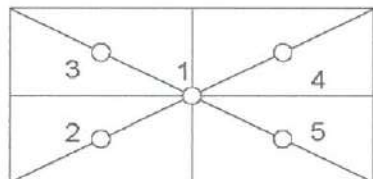
Page: 3 of 3

## 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)

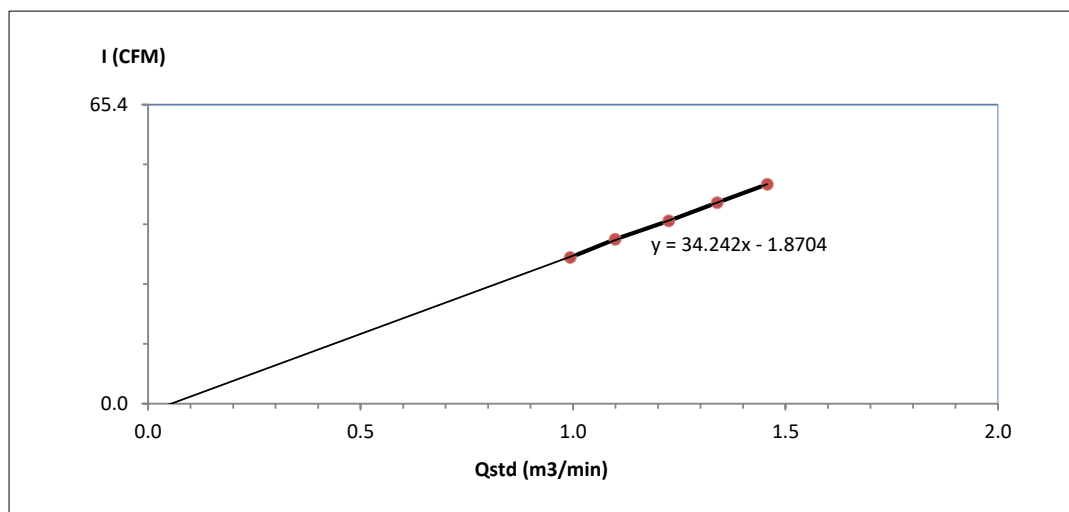
The End of Certificate



## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	รพ.สต. บ้านหว้า	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS1063
Calibration Sheet No.:	C-050522-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 <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.6	0.9934	32	Slope : 34.2424 Intercept : -1.8704 Correlation Coefficient : 0.9997
2	3.2	1.0989	36	
3	4.0	1.2252	40	
4	4.8	1.3394	44	
5	5.7	1.4569	48	



Calibrated by

*Mr. Teeravut Sukdee*

( Mr. Teeravut Sukdee )  
Field Scientist(1)

Approved by :

*Mr. Noppong Juntarupan*

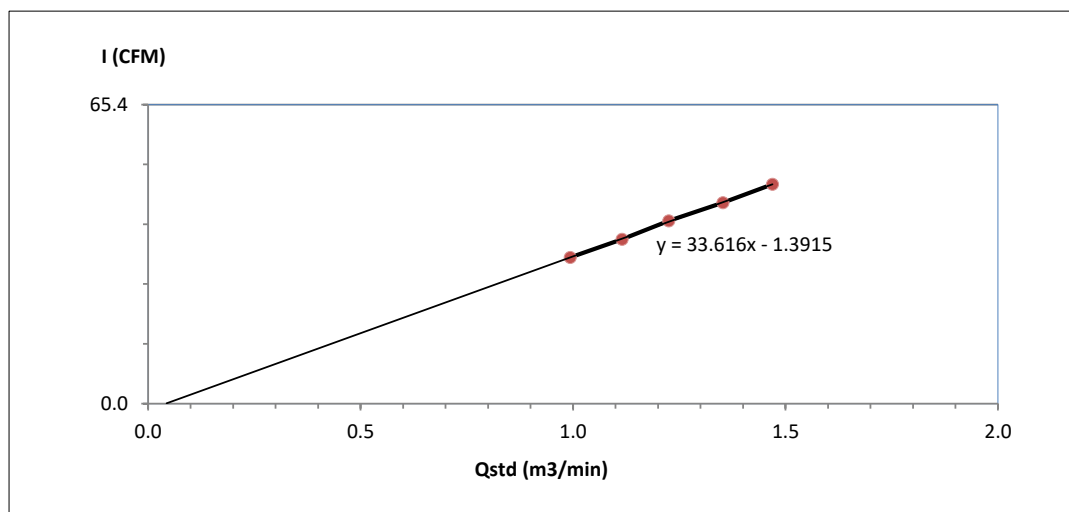
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	โรงเรียนเจ้าฟ้าสร้าง	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0374
Calibration Sheet No.:	C-050522-BKK_FS0374	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	5195
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.6	0.9934	32	Slope : 33.6163 Intercept : -1.3915 Correlation Coefficient : 0.9998
2	3.3	1.1155	36	
3	4.0	1.2252	40	
4	4.9	1.3529	44	
5	5.8	1.4694	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)

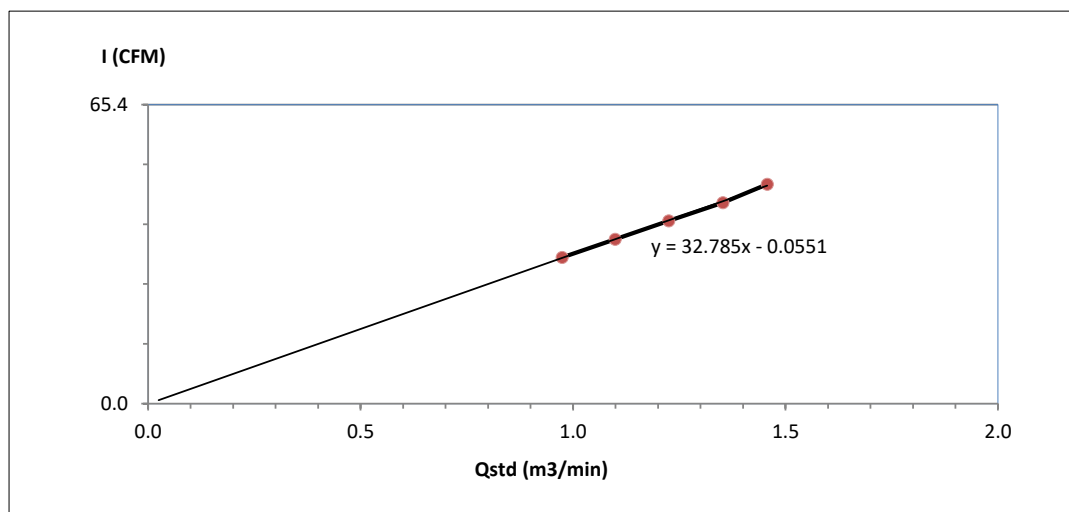




## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	หมู่ที่ 3 ตำบลบ้านเลน	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0375
Calibration Sheet No.:	C-050522-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 <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.5	0.9747	32	Slope : 32.7855 Intercept : -0.0551 Correlation Coefficient : 0.9994
2	3.2	1.0989	36	
3	4.0	1.2252	40	
4	4.9	1.3529	44	
5	5.7	1.4569	48	



Calibrated by

( Mr. Teeravut Sukdee )  
Field Scientist(1)

Approved by :



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

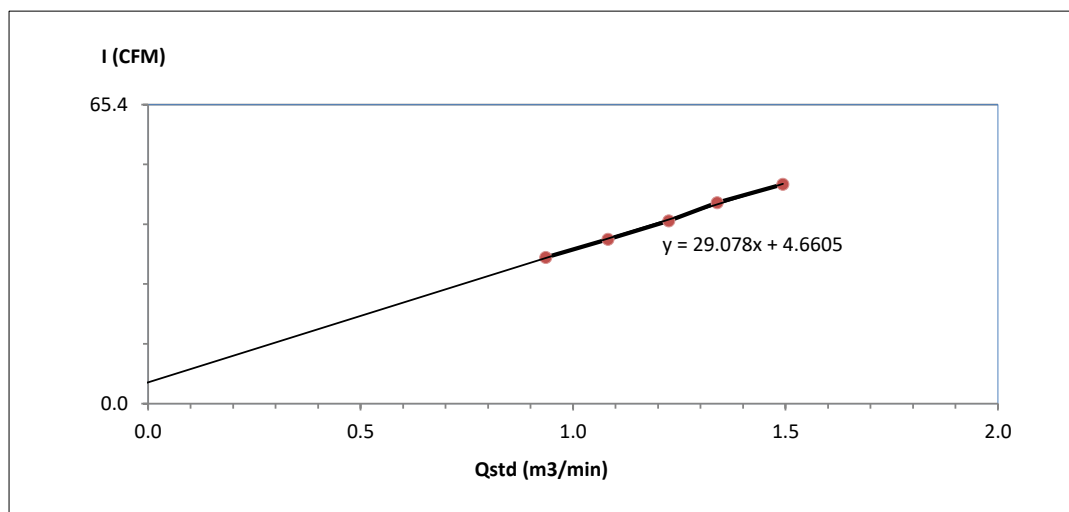




## High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf BP Co., Ltd.	Barometric Pressure (mm Hg) :	757
Calibrate Location :	หมู่ที่ 2 ตำบลบ้านหว้า	Temperature ( °C ) :	32
Calibrate Date :	5-May-22	High Volume ID :	BKK_FS0387
Calibration Sheet No.:	C-050522-BKK_FS0387	High Volume Model :	G1051
Calibrator ID:	BKK_FS0624	High Volume S/N :	1626
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64942
Calibrator S/N :	2584	Calibrator Intercept :	-0.02902

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.3	0.9361	32	Slope : 29.0777 Intercept : 4.6605 Correlation Coefficient : 0.9991
2	3.1	1.0821	36	
3	4.0	1.2252	40	
4	4.8	1.3394	44	
5	6.0	1.4940	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)

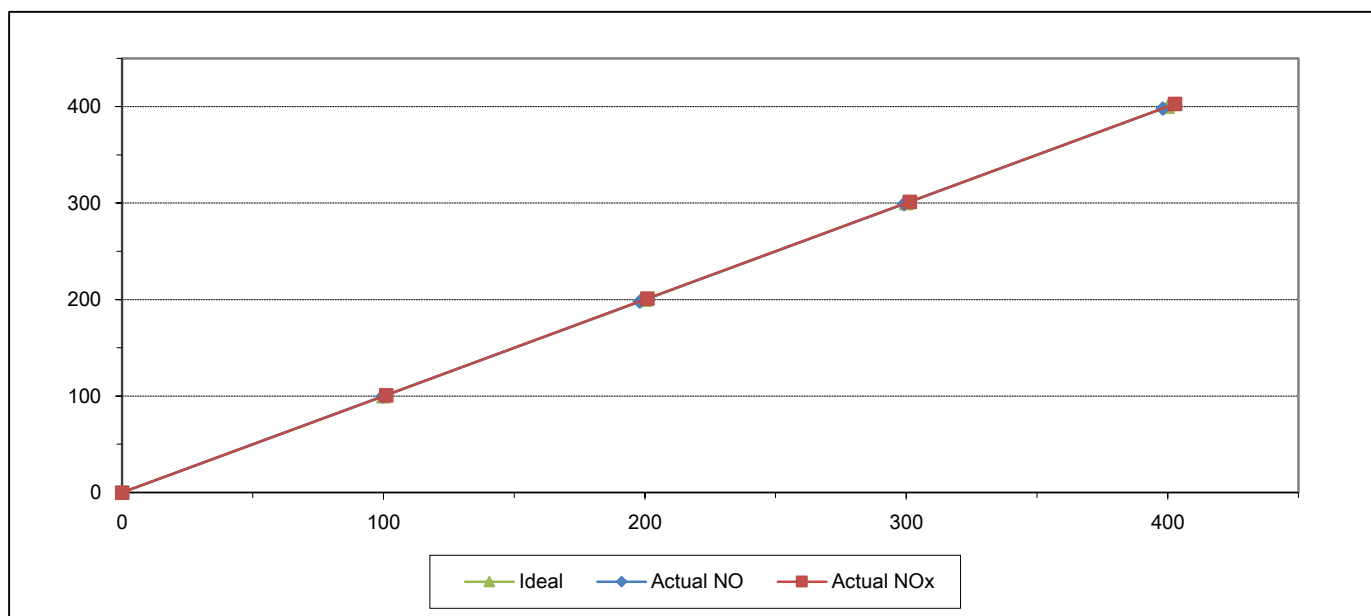


## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22  
Manufacturer HORIBA  
Serial No. XLTWRBSJ  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 51.33  
Cylinder Pressure (psi) 1200  
Certified Date 18-Mar-14

Equipment Name NOx Analyzer  
Model APNA-370  
Equipment ID BKK\_FS1092  
Model 700  
Cylinder No. LL36633  
Certified By Airgas Inc.  
Expired Date 18-Mar-22

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	99.70	-0.30	-0.30	101.00	1.00	1.00
2	200.00	198.10	-1.90	-0.95	201.00	1.00	0.50
3	300.00	299.10	-0.90	-0.30	301.40	1.40	0.47
4	400.00	398.20	-1.80	-0.45	402.80	2.80	0.70
AVERAGE (%)				-0.38			0.55



Calibrated By

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

Approved By

( Mr.Sarayuth Jitranont )  
Assistant General Manager

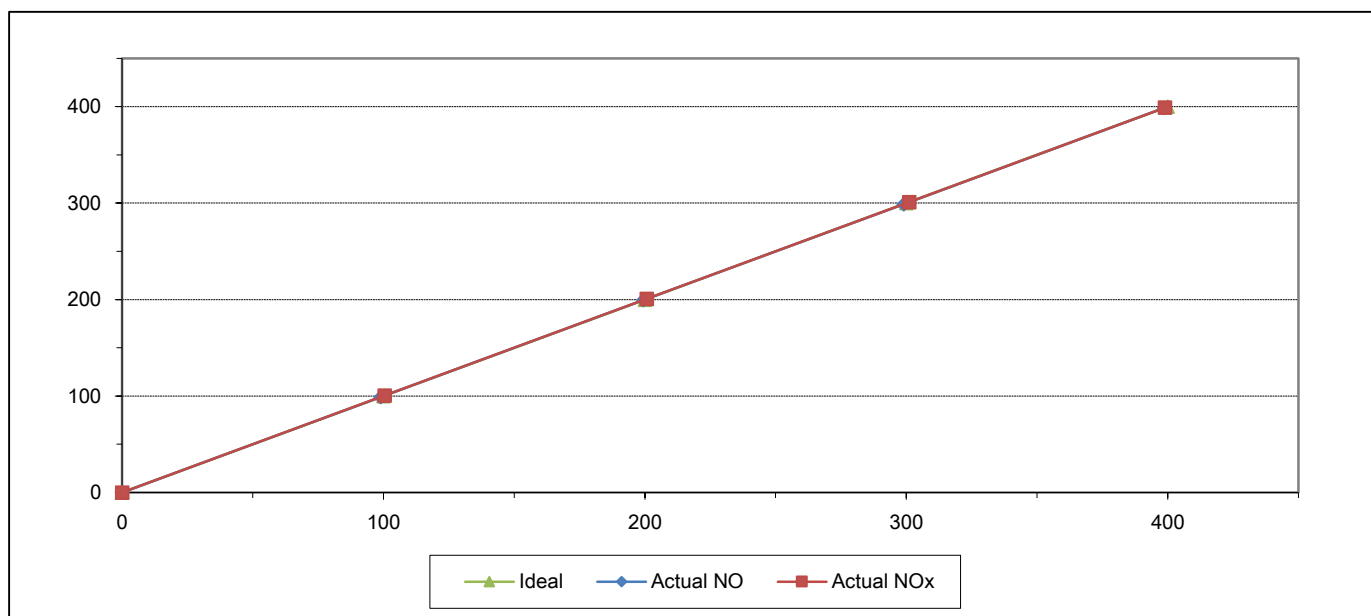


## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22  
Manufacturer HORIBA  
Serial No. TLTATGDW  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 51.33  
Cylinder Pressure (psi) 1200  
Certified Date 18-Mar-14

Equipment Name NOx Analyzer  
Model APNA-370  
Equipment ID BKK\_FS0785  
Model 700  
Cylinder No. LL36633  
Certified By Airgas Inc.  
Expired Date 18-Mar-22

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	199.50	-0.50	-0.25	200.70	0.70	0.35
3	300.00	299.00	-1.00	-0.33	301.10	1.10	0.37
4	400.00	398.70	-1.30	-0.33	399.00	-1.00	-0.25
AVERAGE (%)				-0.36			0.21



Calibrated By

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

Approved By

( Mr.Sarayuth Jitranont )  
Assistant General Manager

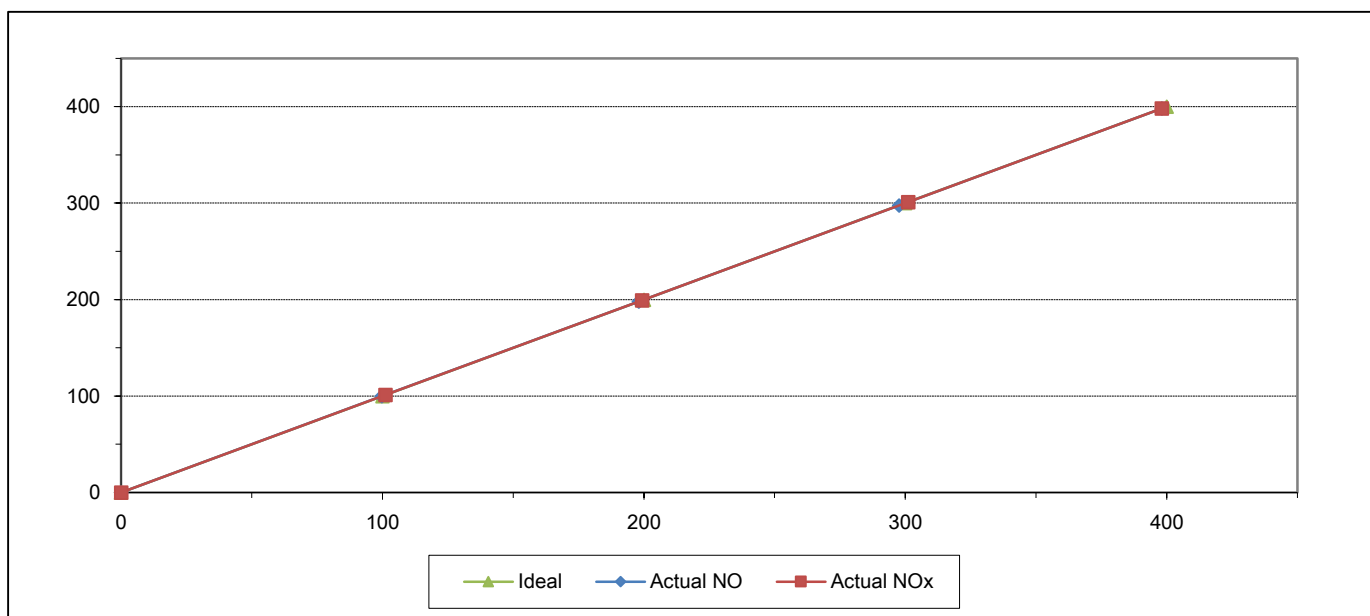


## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22  
Manufacturer Teledyne API  
Serial No. 060  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 51.33  
Cylinder Pressure (psi) 1200  
Certified Date 18-Mar-14

Equipment Name NOx Analyzer  
Model T200  
Equipment ID BKK\_FS0741  
Model 700  
Cylinder No. LL36633  
Certified By Airgas Inc.  
Expired Date 18-Mar-22

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

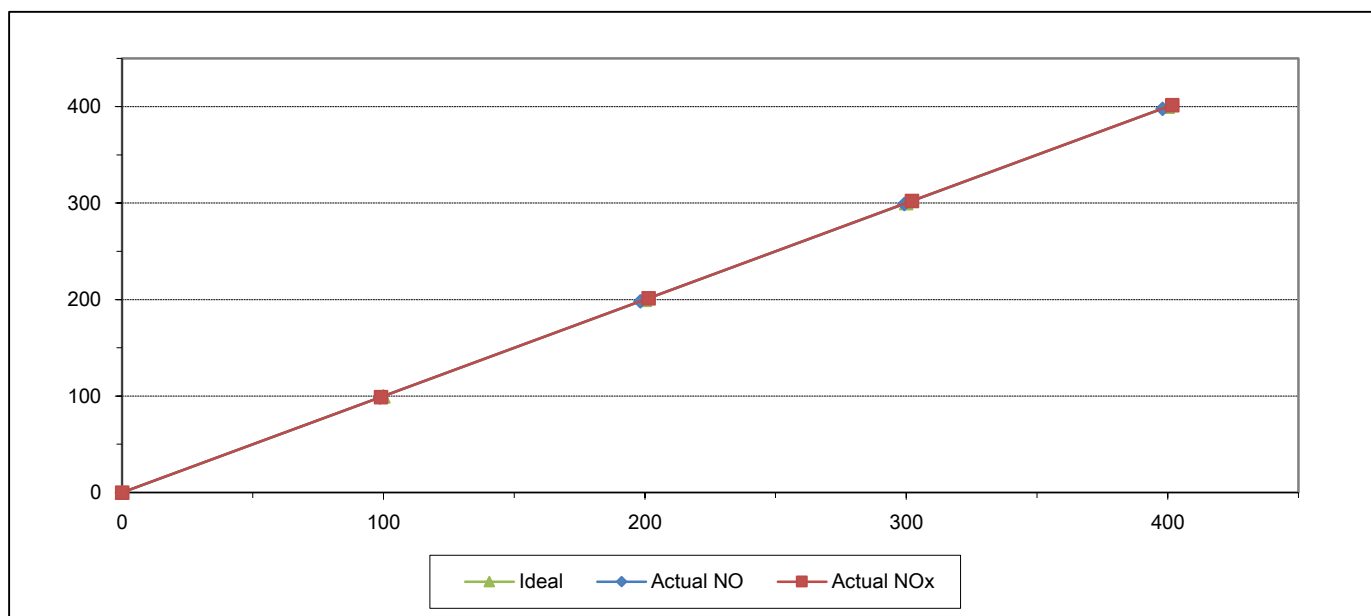


## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22  
Manufacturer HORIBA  
Serial No. SUDL58MU  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 51.33  
Cylinder Pressure (psi) 1200  
Certified Date 18-Mar-14

Equipment Name NOx Analyzer  
Model APNA-370  
Equipment ID BKK\_FS1090  
Model 700  
Cylinder No. LL36633  
Certified By Airgas Inc.  
Expired Date 18-Mar-22

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	99.10	-0.90	-0.90
2	200.00	198.30	-1.70	-0.85	201.50	1.50	0.75
3	300.00	299.30	-0.70	-0.23	302.20	2.20	0.73
4	400.00	398.00	-2.00	-0.50	401.70	1.70	0.42
AVERAGE (%)				-0.56			0.22



Calibrated By

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

Approved By

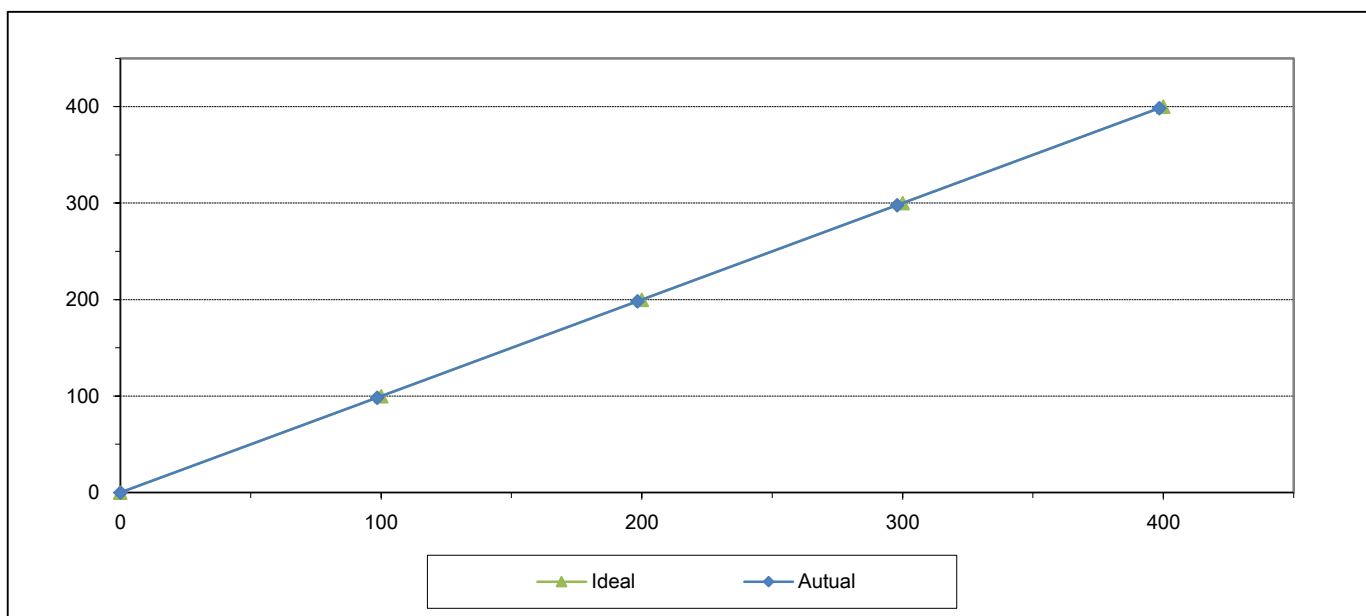
( Mr.Sarayuth Jitranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-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)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

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

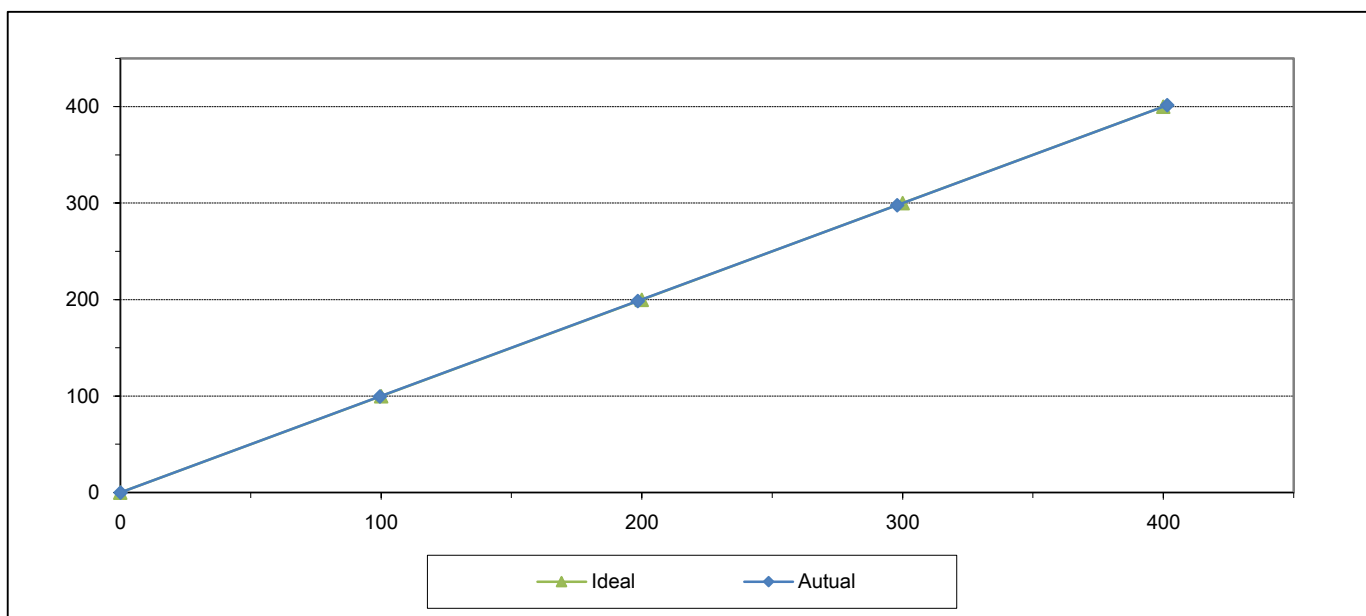
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	3C72K8HB	Equipment ID	BKK_FS0784
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	198.50	-1.50	-0.75
3	300.00	297.90	-2.10	-0.70
4	400.00	401.50	1.50	0.38
AVERAGE (%)				-0.28



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

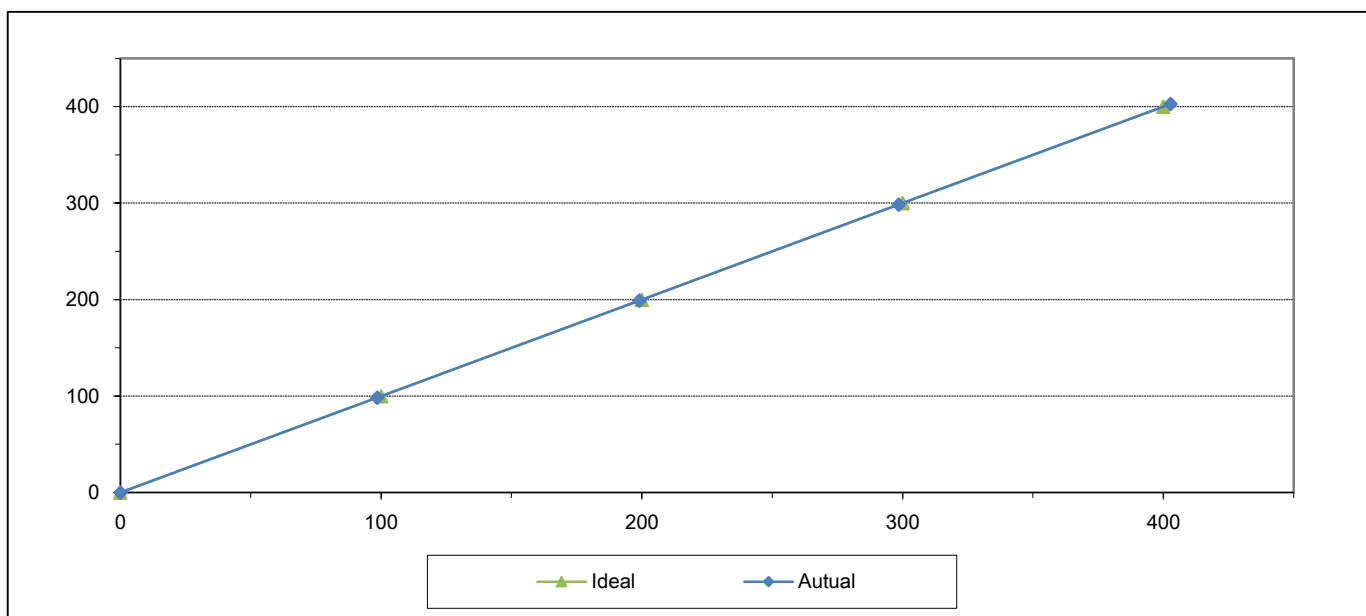




## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-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)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

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

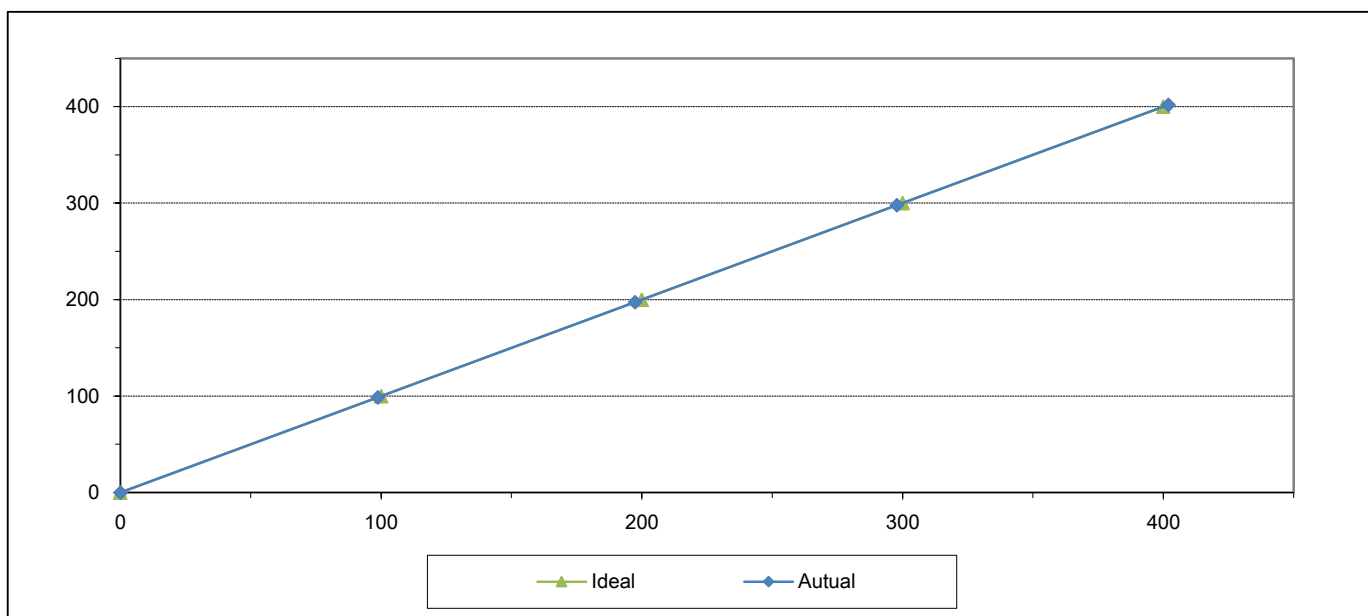
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	XGYV1AU	Equipment ID	BKK_FS1089
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20
2	200.00	197.40	-2.60	-1.30
3	300.00	297.80	-2.20	-0.73
4	400.00	402.00	2.00	0.50
AVERAGE (%)				-0.53



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

## CERTIFICATE OF CALIBRATION

Certificate No. : CL-009AB-63

Page 1 of 2

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

**Manufacturer** : Novalynx

**Model** : 110-WS-25DL-D

**Serial No.** : A5447

**ID No.** :- No. 49 SK 480039

**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** : 26 Nov 2020

**Calibration date** : 2 Dec 2020

**Issue date** : 7 Dec 2020

**Reference Used During Calibration**

1. Standard Temperature Probe Model : STS-100 A500,  
Serial No. : 667682-09, Due date : 22 Apr 2021
2. Digital Temperature Indicator Model : DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date : 20 May 2021

**Calibration Condition**

Temperature : (23±3)°C

Relative Humidity : (55±15)%

REVIEW BY *W. Pookk*

APPROVED BY *[Signature]*

NEXT CAL. DATE *7/6/22*

**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-0025-20, Certificate number : ER-0071-20

*This certificate replaces the issued certificate number  
CL-009-63*

**Calibrated by**

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



**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:**

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	20.059	19.90	-0.16	0.080
60	24.964	24.80	-0.16	0.080
60	29.874	29.70	-0.17	0.080
60	34.865	34.50	-0.36	0.080
60	39.856	39.50	-0.36	0.080

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-0212AB2020

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 110-WS-26DL-D.  
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5447.  
: Relative humidity sensor: R1131114.

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

Measurement Date : Dec 7, 2020  
Issued Date : Dec 14, 2020

### Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC(Reading)	Error
$\text{CH}_3\text{COOK}$ : Potassium Acetate	22.51	22.3	-0.21
$\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate	52.89	52.2	-0.69
$\text{KCl}$ : Potassium Chloride	84.34	83.5	-0.84

This calibration replaces the issued calibration number RH-02122020

### Performed by

- ☒ Mr. Sawit Thachalad  
☐ Mr. Bongkoch Malithong



### Approved Signatory:

*[Signature]*

Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager



## CERTIFICATE OF CALIBRATION

Certificate No. : WS-02122020

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: A5447. Cup anemometer: WSD-005.		
Customer	ALS laboratory group (Thailand) co., ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250.		
Test Conditions	Wind tunnel cross test section area	900	cm <sup>2</sup>
	Anemometer frontal area	100	cm <sup>2</sup>
	Diameter of mounting pipe	-	mm
	Blockage ratio of test object	0.111	[-]
Test Conditions	Air temperature	23.5	±0.2 °C
	Air pressure	1012.0	±0.2 hPa
	Relative air humidity	55.2	±1.1 %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	December 1, 2020.		
Issued Date	December 7, 2020.		

Calibrated by

- ☒ Mr. Sorawit Thachalad  
☐ Mr. Bongkoch Malithong



Approved Signatory: 

Mr. Parinya Booncheroen  
Technical Support  
And Calibration Manager

Certificate No. : WS-02122020

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 <sub>STD</sub> Reading m/s	V <sub>UUC</sub> Reading m/s	Error (m/s)	Uncertainty (%)
1.996	1.9	-0.1	2.8
4.149	4.1	0.0	1.4
5.97	6.0	0.0	1.00
7.96	8.2	0.2	1.34
10.01	10.3	0.3	1.89
12.01	12.5	0.5	1.32
13.98	14.4	0.4	1.26
16.00	16.9	0.9	1.07
15.02	15.6	0.6	0.52
13.00	13.3	0.3	0.94
10.97	11.3	0.3	0.66
8.98	9.2	0.2	0.70
6.99	7.1	0.1	1.05
5.147	5.0	-0.1	0.96
3.035	3.0	0.0	1.7
1.060	0.9	-0.2	5.8

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	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab Microsystem Co.,Ltd.	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 – 5 m/s
4	Temperature	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	-30 – 70°C
5	Relative humidity	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	0 – 100 %RH
6	Atmospheric pressure	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	500 – 1100 hPa
7	Wind tunnel	CSSOM	MP330D	-	-	0 – 50 Hz

\*\*\*End of certificate of calibration\*\*\*

## CERTIFICATE OF CALIBRATION

Certificate No.: WD-02122020

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-02P.

Serial Number : Data logger: A5447.  
: Wind direction sensor: WSD-005.

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  $45^\circ$  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.: CC563-07-0046. Certificate No.: KWS63/0044.

Measurement Date : December 07, 2020  
Issued Date : December 14, 2020

### Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Mr. Bongkoch Malithong



Approved Signatory: .....



Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager



Continuation of Certificate of Calibration Number

Certificate No: WD-02122020

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	2.71
2		45	45	40	-5	2.71
3		90	90	87	-3	2.71
4		135	135	133	-2	2.71
5		180	180	180	0	2.71
6		225	225	228	3	2.71
7		270	270	274	4	2.71
8		315	315	319	4	2.71
9	Counter Clockwise	0/360	360	359	-1	2.71
10		45	45	40	-5	2.71
11		90	90	87	-3	2.71
12		135	135	133	-2	2.71
13		180	180	180	0	2.71
14		225	225	228	3	2.71
15		270	270	274	4	2.71
16		315	315	319	4	2.71

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 Number. : RG-02122020

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novatynx.  
: Rain gauge: Novatynx.

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

Serial Number : Data logger: A5447.  
: Rain gauge: RG-005.

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 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 =  $323.6 \text{ cm}^2$ .
2. Obtain theoretical correct rain gauge answer (number of tippings) using  $323.6 \text{ cm}^2$  inlet area and 0.6 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)  $30.90 \times 0.6 \text{ L volume} = 15.45 \text{ mm}$  (mm of rain over  $1 \text{ m}^2$  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 : Dec 07, 2020  
Issued Date : Dec 14, 2020

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



### Approved Signatory



Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG-02122020

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Quantity of H <sub>2</sub> O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	61	60 - 64
500	62	61	60 - 64
500	62	62	60 - 64
500	62	62	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\*\*\*



## CALIBRATION REPORT

Calibration Number. : BP-02122020

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: A5447.  
: Barometric pressure: A5447.

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 ( $P_{\text{Std}}$ ) at 990 – 1015 hPa was generated by digital pressure generator. The pressure reading of UUC ( $P_{\text{UUC}}$ ) 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 : Dec 07, 2020

Issued Date : Dec 14, 2020

### Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Mr. Bongkoch Malithong



Approved Signatory: \_\_\_\_\_



Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager



Continuation of Calibration of Calibration Number

Calibration Number: BP-02122020

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Calibration Point (hPa)	P <sub>(STD)</sub> reading (hPa)	P <sub>(UUC)</sub> reading (hPa)	Error (hPa)
990	990.002	989.814	0.2
995	995.004	994.641	0.4
1000	1000.001	999.720	0.3
1005	1005.002	1004.462	0.5
1010	1010.010	1009.771	0.2
1015	1015.009	1014.249	0.8

\*\*\*End of calibration report\*\*\*



## 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 cm<sup>2</sup>  
: Anemometer frontal area 100 cm<sup>2</sup>  
: 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.

REVIEW BY	<i>Parinya P.</i>
APPROVED BY	<i>Mr. Ch</i>
NEXT CAL. DATE	7/7/23

**Calibrated by**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



**Approved Signatory:**

*2kay05*  
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 <sub>STD</sub> Reading m/s	V <sub>UUC*</sub> 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  $(23 \pm 3) ^\circ\text{C}$ . 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  $45^\circ$  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±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

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  $\text{CH}_3\text{COOK}$ : Potassium Acetate,  $\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate,  $\text{KCl}$ : 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 <sub>(Reading)</sub>	Error
$\text{CH}_3\text{COOK}$ : Potassium Acetate	22.51	22.4	-0.1
$\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate	52.89	52.5	-0.4
$\text{KCl}$ : 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 ( $P_{\text{STD}}$ ) at 990 – 1015 hPa was generated by digital pressure generator. The pressure reading of UUC ( $P_{\text{UUC}}$ ) 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:.....



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=  $323.6 \text{ cm}^2$ .

2. Obtain theoretical correct rain gauge answer (number of tippings) using  $323.6 \text{ cm}^2$  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  $1 \text{ m}^2$  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 <sub>2</sub> 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. : CL-013-63

Page 1 of 2

Equipment Name : Data Logger with Temperature  
Sensor

Manufacturer : Novalynx

Model : 110-WS-25DL-D

Serial No. : A5443

ID No. : -


### 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 2020

Calibration date : 10 Dec 2020

Issue date : 14 Dec 2020

REVIEW BY	W. Pookkalk
APPROVED BY	
NEXT CAL. DATE	10/6/22

### Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,  
Serial No. : 667682-09, Due date : 22 Apr 2021

2. Digital Temperature Indicator Model : DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date : 20 May 2021

### 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

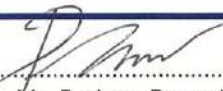
The measurement results are traceable to the  
international system of units (SI) through National  
Institute of Metrology Thailand (NIMT) Certificate  
number : TT-0025-20, Certificate number : ER-0071-  
20

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



### Approved Signatory:

  
Mr. Parinya Booncharoen  
Technical Support  
And Calibration Manager

Certificate No. : CL-013-63

Page 2 of 2

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 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	19.60	-0.45	0.080
60	24.879	24.50	-0.38	0.080
60	29.865	29.50	-0.36	0.080
60	34.851	34.40	-0.45	0.080
60	39.835	39.40	-0.43	0.080

**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. : WS-05122020

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.		
Customer	ALS laboratory group (Thailand) co., ltd.		
	104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250.		
Test Conditions	Wind tunnel cross test section area	900	cm <sup>2</sup>
	Anemometer frontal area	100	cm <sup>2</sup>
	Diameter of mounting pipe	-	mm
	Blockage ratio of test object	0.111	[-]
Test Conditions	Air temperature	24.1	±0.2 °C
	Air pressure	1014.4	±0.2 hPa
	Relative air humidity	60.1	±1.1 %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	December 11, 2020.		
Issued Date	December 14, 2020.		

Calibrated by

- ☒ Mr. Sorawit Thachalad  
☐ Mr. Bongkoch Malithong



Approved Signatory: \_\_\_\_\_

Mr. Parinya Booncharoen  
Technical Support  
And Calibration Manager

Certificate No. : WS-05122020

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 <sub>STD</sub> Reading m/s	V <sub>UUC</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.035	1.9	-0.1	2.5
4.098	4.0	-0.1	1.3
6.04	6.1	0.1	1.00
7.97	8.1	0.1	0.79
10.01	10.2	0.2	0.67
12.00	12.3	0.3	0.65
14.02	14.5	0.5	0.42
15.98	16.7	0.7	1.20
15.01	15.6	0.6	1.09
13.00	13.3	0.3	0.75
11.01	11.3	0.3	0.66
8.97	9.1	0.1	0.66
6.98	7.1	0.1	0.98
5.137	5.1	0.0	0.94
2.990	3.0	0.0	1.7
1.038	0.9	-0.1	5.4

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	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab Microsystem Co.,Ltd.	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	-30 - 70°C
5	Relative humidity	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	0 – 100 %RH
6	Atmospheric pressure	Zoglab Microsystem Co.,Ltd.	DSR-THP	March 3, 2020	HZ202003301001	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

\*\*\*End of certificate of calibration\*\*\*

## CALIBRATION REPORT

Calibration No. : RH-05122020

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.

**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 display, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution  $\text{CH}_3\text{COOK}$ : Potassium Acetate,  $\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate,  $\text{KCl}$ : Potassium Chloride to determine the errors.

**Measurement Date** : Dec 14, 2020

**Issued Date** : Dec 14, 2020

### Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC <sub>(Reading)</sub>	Error
$\text{CH}_3\text{COOK}$ : Potassium Acetate	22.51	22.5	-0.01
$\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate	52.89	52.4	-0.49
$\text{KCl}$ : Potassium Chloride	84.34	84.2	-0.14

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



Approved Signatory: \_\_\_\_\_

Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager



## CERTIFICATE OF CALIBRATION

Certificate No.: WD-05122020

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.

**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  $45^{\circ}$  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.: CC563-07-0045, Certificate No.: KWS63/0044.

**Measurement Date** : December 09, 2020

**Issued Date** : December 14, 2020

**Performed by**

- ☒ Mr. Sorawit Thachalad  
☐ Mr. Bongkoch Malithong



**Approved Signatory:**

Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-05122020

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	2.71
2		45	45	41	-4	2.71
3		90	90	88	-2	2.71
4		135	135	133	-2	2.71
5		180	180	179	-1	2.71
6		225	225	226	1	2.71
7		270	270	272	2	2.71
8		315	315	317	2	2.71
9	Counter Clockwise	0/360	360	359	-1	2.71
10		45	45	41	-4	2.71
11		90	90	88	-2	2.71
12		135	135	133	-2	2.71
13		180	180	179	-1	2.71
14		225	225	226	1	2.71
15		270	270	272	2	2.71
16		315	315	317	2	2.71

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 Number. : RG-06122020

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.  
: Relative gauge: 110-WS-25RG.

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

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 =  $323.6 \text{ cm}^2$ .
2. Obtain theoretical correct rain gauge answer (number of tippings) using  $323.6 \text{ cm}^2$  inlet area and 0.5 L of rain.
  - a)  $10,000 \text{ cm}^3 / 323.6 \text{ cm}^2 \text{ inlet area} = 30.90$  (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  $1 \text{ m}^2$  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 : Dec 14, 2020

Issued Date : Dec 14, 2020

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



Approved Signatory: \_\_\_\_\_



Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG05122020

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Quantity of H <sub>2</sub> 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	60	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\*\*\*



## CALIBRATION REPORT

Calibration Number. : BP-06122020

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-26DL-D.  
: Barometric pressure: 110-WS-26BP.

Serial Number : Data logger: A5443.  
: Barometric pressure: A5443.

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  $(25\pm3)^{\circ}\text{C}$ , and relative humidity of  $(50\pm15)\%$ .

### Measurement Method:

The Barometric pressure sensor, Unit Under Calibration (UUC) was calibrated in the pressure conditioning chamber. The standard pressure ( $P_{\text{STD}}$ ) at 990 – 1015 hPa was generated by digital pressure generator. The pressure reading of UUC ( $P_{\text{UUC}}$ ) 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 : Dec 11, 2020  
Issued Date : Dec 14, 2020

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



Approved Signatory.....



Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager

Continuation of Calibration of Calibration Number

Calibration Number: BP-05122020

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Calibration Point (hPa)	P <sub>(STD)</sub> reading (hPa)	P <sub>(UUC)</sub> reading (hPa)	Error (hPa)
990	990.008	990.104	0.1
995	995.002	995.241	0.2
1000	1000.007	1000.300	0.3
1005	1005.001	1005.431	0.4
1010	1010.004	1010.392	0.4
1015	1015.011	1015.412	0.4

\*\*\*End of calibration report\*\*\*





## CERTIFICATE OF CALIBRATION

Certificate No: WS-01042021

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: A5262.  
: 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<sup>2</sup>  
: Anemometer frontal area 100 cm<sup>2</sup>  
: Diameter of mounting pipe - mm  
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.1 ±0.8 °C  
: Air pressure 1014.4 ±0.4 hPa  
: Relative air humidity 60.1 ±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;  
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 : Mar 31, 2021.

Issued Date : Apr 01, 2021.

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong

Approved Signatory: 

Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager



Continuation of Certificate of Calibration Number

Certificate No. : WS-01042021

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 <sub>STD</sub> Reading m/s	V <sub>UUC</sub> * Reading m/s	Error (m/s)	Uncertainty (%)
2.032	1.8	-0.2	2.7
4.107	3.9	-0.2	1.5
6.03	6.0	0.0	1.01
8.03	8.0	0.0	0.76
10.02	10.0	0.0	0.80
12.02	12.1	0.1	0.50
14.01	14.1	0.1	0.53
15.98	16.2	0.2	0.61
15.00	15.2	0.2	0.67
13.00	13.0	0.0	0.65
10.97	11.0	0.0	0.82
9.03	9.0	0.0	0.76
7.02	7.0	0.0	1.0
5.093	5.0	-0.1	0.9
3.042	2.9	-0.1	1.8
1.039	0.7	-0.3	7.0

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%

#### Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2600	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2020	HZ202003301001	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2020	HZ202003301001	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2020	HZ202003301001	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

\*\*\*End of certificate of calibration\*\*\*

## CERTIFICATE OF CALIBRATION

Certificate No.: WD-01042021

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: A5262.  
: 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  $(23\pm3)^{\circ}\text{C}$ , and relative humidity of  $(40\pm10)\%$ .

### 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  $45^{\circ}$  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.: CC563-07-0045,  
Certificate No.: KWS63/0044.

Measurement Date : Mar 31, 2021.

Issued Date : Apr 01, 2021.

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



Approved Signatory:.....



Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-01042021

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	134	-1	3.0
5		180	180	180	0	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	134	-1	3.0
13		180	180	180	0	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.026-64

Page 1 of 2

Equipment Name : Data Logger with Temperature  
Sensor

Manufacturer : Novalynx  
Model : 200-WS-25LB  
Serial No. : A5262  
ID No. : -

### 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 : 26 Mar 2021  
Calibration date : 30 Mar 2021  
Issue date : 01 Apr 2021

### Reference Used During Calibration

1.Standard Temperature Probe Model : STS-100 A500,  
Serial No. : 667682-09, Due date : 22 Apr 2021  
2.Digital Temperature Indicator Model : DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date : 20 May 2021

### 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-0025-20, Certificate number : ER-0071-  
20

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong

### Approved Signatory:

Mr. Parinya Booncharoen  
Technical Support  
And Calibration Manager



Certificate No. : CL-025-64  
Page 2 of 2

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

**Calibration Range:** 20 °C – 40 °C

**Function:**

This equipment was connected with temperature sensor Model : HMP60 S/N : N0330785

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	20.074	19.8	-0.3	0.081
60	25.067	24.8	-0.3	0.081
60	30.057	29.8	-0.3	0.081
60	35.048	34.5	-0.5	0.081
60	40.040	39.5	-0.5	0.081

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-01042021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 200-WS-25LB.  
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5262.  
: Relative humidity sensor: N0330785.

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 display, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution  $\text{CH}_3\text{COOK}$ : Potassium Acetate,  $\text{Mg}(\text{NO}_3)$ : Magnesium Nitrate,  $\text{KCl}$ : Potassium Chloride to determine the errors.

Measurement Date : Mar 30, 2021

Issued Date : Apr 01, 2021

### Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC <sub>(Reading)</sub>	Error
$\text{CH}_3\text{COOK}$ : Potassium Acetate	22.51	23.0	0.5
$\text{Mg}(\text{NO}_3)$ : Magnesium Nitrate	52.89	52.2	-0.7
$\text{KCl}$ : Potassium Chloride	84.34	82.3	-2.0

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Mr. Bongkoch Malithong



Approved Signatory:.....



Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager

# 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. : ACC22004

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178120  
**ID No.:** BKK\_FS0633

**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>Nathakorn P.</i>
NEXT CAL. DATE	14/1/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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Continuation of Calibration Certificate

**Cert. No. : ACC22004**

**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. : ACC22004  
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	94.06	0.06	0.14	0.40

**2. Frequency**

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.3	0.1	0.1	1.0

**3. Total distortion**

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.19	0.10	3.0

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

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



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

Cert. No. : ACL21084

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597161 / 180404 / 88174  
**ID No.:** BKK\_FS0996

**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 :** 05 AUGUST 2021  
**Calibration Date :** 06 -10 AUGUST 2021  
**Date of Issue :** 11 AUGUST 2021

REVIEW BY	Nathakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	6/8/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

[Signature]  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21084  
Job No. : VC64AC0060  
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	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-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. : ACL21084

Job No. : VC64AC0060

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. : ACL21084  
Job No. : VC64AC0060  
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 )
15.8

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	18.0
Flat	23.5

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	0.1	0.1	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL21084

Job No. : VC64AC0060

Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

## Continuation of Calibration Certificate

Cert. No. : ACL21084

Job No. : VC64AC0060

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	$\pm 1.1$
136.0	136.0	0.0	$\pm 1.1$
135.0	135.0	0.0	$\pm 1.1$
134.0	134.0	0.0	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.0	0.0	$\pm 1.1$
114.0	114.0	0.0	$\pm 1.1$
109.0	109.0	0.0	$\pm 1.1$
104.0	104.0	0.0	$\pm 1.1$
99.0	99.0	0.0	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	53.9	-0.1	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	38.9	-0.1	$\pm 1.1$
34.0	33.9	-0.1	$\pm 1.1$
30.0	29.9	-0.1	$\pm 1.1$
29.0	28.9	-0.1	$\pm 1.1$
28.0	27.9	-0.1	$\pm 1.1$
27.0	26.9	-0.1	$\pm 1.1$
26.0	25.9	-0.1	$\pm 1.1$
25.0	24.9	-0.1	$\pm 1.1$



## Continuation of Calibration Certificate

Cert. No. : ACL21084

Job No. : VC64AC0060

Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

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

**Continuation of Calibration Certificate**

**Cert. No. : ACL21084**

**Job No. : VC64AC0060**

**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.,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. : ACL21083

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597159 / 180402 / 88172  
**ID No.:** BKK\_FS0995

**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 :** 05 AUGUST 2021  
**Calibration Date :** 06 -10 AUGUST 2021  
**Date of Issue :** 11 AUGUST 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	6/8/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21083

Job No. : VC64AC0060

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	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-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. : ACL21083

Job No. : VC64AC0060

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. : ACL21083  
Job No. : VC64AC0060  
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 )
15.1

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	18.1
Flat	23.9

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.8	±5.0

**Continuation of Calibration Certificate**

Cert. No. : ACL21083  
 Job No. : VC64AC0060  
 Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

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

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

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

Continuation of Calibration Certificate

Cert. No. : ACL21083

Job No. : VC64AC0060

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	104.1	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	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

## Continuation of Calibration Certificate

Cert. No. : ACL21083

Job No. : VC64AC0060

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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

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

## Continuation of Calibration Certificate

Cert. No. : ACL21083

Job No. : VC64AC0060

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	137.1	-0.1	±0.3

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

End of Calibration Certificate



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.  
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NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACL22038

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00296514 / 179116 / 87523  
**ID No.:** BKK\_FS0971

**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>Worakorn 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. : ACL22038

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. : ACL22038  
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. : ACL22038

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 )
14.4

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	13.7
Flat	24.2

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.5	0.5	-4.5	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.1	-1.0	-1.0	±5.0



## Continuation of Calibration Certificate

Cert. No. : ACL22038

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

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

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

**6. Long - term stability**

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



## Continuation of Calibration Certificate

Cert. No. : ACL22038

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	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

## Continuation of Calibration Certificate

Cert. No. : ACL22038

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	94.0	0.0	±1.1

**9. Tone burst response**

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

**10. Peak C sound level**

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

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



Continuation of Calibration Certificate

Cert. No. : ACL22038  
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	89.7	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

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Cert. No. : ACL21082

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597156 / 180399 / 88169  
**ID No.:** BKK\_FS0994

**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 :** 05 AUGUST 2021  
**Calibration Date :** 06 -10 AUGUST 2021  
**Date of Issue :** 11 AUGUST 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	6/8/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21082

Job No. : VC64AC0060

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	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-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. : ACL21082

Job No. : VC64AC0060

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. : ACL21082  
Job No. : VC64AC0060  
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 )
16.1

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	17.8
Flat	23.6

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

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

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

**Continuation of Calibration Certificate**

**Cert. No. : ACL21082**  
**Job No. : VC64AC0060**  
**Pages : 5 of 8**

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

Weighting network response with relative to 1 kHz.

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

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

**5.1 Frequency weightings at 1 kHz**

Frequency Weighting	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	93.9	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	93.9	0.0	± 0.2

**5.2 Time weighting at 1 kHz**

Frequency Weighting	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	93.9	0.0	-
Slow	93.9	0.0	± 0.1
Leq	93.9	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. : ACL21082

Job No. : VC64AC0060

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	$\pm 1.1$
136.0	136.1	0.1	$\pm 1.1$
135.0	135.1	0.1	$\pm 1.1$
134.0	134.1	0.1	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.1	0.1	$\pm 1.1$
114.0	114.1	0.1	$\pm 1.1$
109.0	109.1	0.1	$\pm 1.1$
104.0	104.1	0.1	$\pm 1.1$
99.0	99.1	0.1	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	54.0	0.0	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	39.0	0.0	$\pm 1.1$
34.0	34.0	0.0	$\pm 1.1$
30.0	29.9	-0.1	$\pm 1.1$
29.0	28.9	-0.1	$\pm 1.1$
28.0	27.9	-0.1	$\pm 1.1$
27.0	27.0	0.0	$\pm 1.1$
26.0	26.0	0.0	$\pm 1.1$
25.0	24.9	-0.1	$\pm 1.1$

## Continuation of Calibration Certificate

Cert. No. : ACL21082

Job No. : VC64AC0060

Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

**Continuation of Calibration Certificate**

**Cert. No. : ACL21082**

**Job No. : VC64AC0060**

**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.,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. : ACL21090

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597163 / 180406 / 88176  
**ID No.:** BKK\_FS0998

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 26 AUGUST 2021  
**Calibration Date :** 07-08 SEPTEMBER 2021  
**Date of Issue :** 08 SEPTEMBER 2021

REVIEW BY	<i>Nathakorn R</i>
APPROVED BY	<i>Nathakorn</i>
NEXT CAL. DATE	31/9/22

**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. : ACL21090

Job No. : VC64AC0062

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	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-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. : ACL21090  
Job No. : VC64AC0062  
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. : ACL21090

Job No. : VC64AC0062

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	11.2
C - weight	17.3
Flat	23.0

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	-0.1	± 1.0
8000	-0.3	-0.2	-0.2	±5.0



Continuation of Calibration Certificate

**Cert. No. : ACL21090**  
**Job No. : VC64AC0062**  
**Pages : 5 of 8**

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

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±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. : ACL21090

Job No. : VC64AC0062

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	$\pm 1.1$
136.0	136.0	0.0	$\pm 1.1$
135.0	135.0	0.0	$\pm 1.1$
134.0	134.0	0.0	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.0	0.0	$\pm 1.1$
114.0	114.0	0.0	$\pm 1.1$
109.0	109.0	0.0	$\pm 1.1$
104.0	104.1	0.1	$\pm 1.1$
99.0	99.0	0.0	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	54.0	0.0	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	39.0	0.0	$\pm 1.1$
34.0	34.0	0.0	$\pm 1.1$
30.0	29.9	-0.1	$\pm 1.1$
29.0	28.9	-0.1	$\pm 1.1$
28.0	28.0	0.0	$\pm 1.1$
27.0	26.9	-0.1	$\pm 1.1$
26.0	25.9	-0.1	$\pm 1.1$
25.0	24.9	-0.1	$\pm 1.1$



Continuation of Calibration Certificate

**Cert. No. : ACL21090**

**Job No. : VC64AC0062**

**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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

**10. Peak C sound level**

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
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. : ACL21090**

**Job No. : VC64AC0062**

**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	137.1	137.0	0.1	±0.3

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

**End of Calibration Certificate**

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACL21124

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597155 / 180398 / 88168  
**ID No.:** BKK\_FS0993

**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 :** 29 SEPTEMBER 2021  
**Calibration Date :** 12-14 OCTOBER 2021  
**Date of Issue :** 15 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	12/10/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21124  
Job No. : VC64AC0071  
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. : ACL21124  
 Job No. : VC64AC0071  
 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. : ACL21124  
Job No. : VC64AC0071  
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 )
15.8

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	17.7
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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.4	1.5	1.5	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL21124

Job No. : VC64AC0071

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

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

Frequency Weighting	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. : ACL21124

Job No. : VC64AC0071

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	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.1	0.1	± 1.1



## Continuation of Calibration Certificate

Cert. No. : ACL21124

Job No. : VC64AC0071

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	136.4	0.0	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21124  
Job No. : VC64AC0071  
Pages : 8 of 8

**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.  
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NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACL22045

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01022262 / 142975 / 22310  
**ID No.:** BKK\_FS0031

**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>Nathakorn 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. : ACL22045

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. : ACL22045  
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. : ACL22045

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 )
15.4

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

Frequency Weighting	Measured value ( dB )
A - weight	13.1
C - weight	19.5
Flat	25.0

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			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	-2.0	-1.9	-1.9	±5.0



## Continuation of Calibration Certificate

Cert. No. : ACL22045

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	-0.1	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. : ACL22045  
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	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1



## Continuation of Calibration Certificate

Cert. No. : ACL22045

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	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, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.5	-0.9	±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. : ACL22045

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		
89.7	89.6	-0.1	±1.5

**12. High level stability**

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

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

End of Calibration Certificate



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Cert. No. : ACL21127

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,  
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 :** 06 OCTOBER 2021  
**Calibration Date :** 15-18 OCTOBER 2021  
**Date of Issue :** 19 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	19/10/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21127

Job No. : VC65AC0002

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. : ACL21127  
Job No. : VC65AC0002  
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. : ACL21127  
Job No. : VC65AC0002  
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 )
17.2

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

Frequency Weighting	Measured value ( dB )
A - weight	12.6
C - weight	18.9
Flat	24.7

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			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	-1.3	-1.3	-1.3	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL21127  
 Job No. : VC65AC0002  
 Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

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

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

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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



## Continuation of Calibration Certificate

Cert. No. : ACL21127  
Job No. : VC65AC0002  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.2	0.2	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 1.1



## Continuation of Calibration Certificate

Cert. No. : ACL21127

Job No. : VC65AC0002

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	128.1	0.1	±1.0

**10. Peak C sound level**

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
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. : ACL21127**

**Job No. : VC65AC0002**

**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	89.8	0.3	±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

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Cert. No. : ACL21171

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00858525 / 158776 / 58777  
**ID No.:** BKK\_FS0115

**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	Nathakorn P.
APPROVED BY	[Signature]
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. : ACL21171

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. : ACL21171  
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. : ACL21171**  
**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 )
13.4

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

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

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.4	0.4	0.5	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.8	-2.7	-2.7	±5.0



Continuation of Calibration Certificate

Cert. No. : ACL21171  
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	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

**6. Long - term stability**

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

Continuation of Calibration Certificate

Cert. No. : ACL21171

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	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. : ACL21171**

**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, L <sub>peak</sub> ( 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. : ACL21171**

**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		
89.6	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

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. : ACL22044

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01022261 / 180399 / 88169  
**ID No.:** BKK\_FS0030

**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	Narakorn P.
APPROVED BY	Narakorn P.
NEXT CAL. DATE	12/1/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACL22044

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. : ACL22044  
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. : ACL22044

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 )
16.5

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

Frequency Weighting	Measured value ( dB )
A - weight	13.4
C - weight	19.9
Flat	25.4

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.1	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.8	0.9	0.9	±5.0



Continuation of Calibration Certificate

Cert. No. : ACL22044  
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	0.0	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	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. : ACL22044

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	104.1	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	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1



Continuation of Calibration Certificate

**Cert. No. : ACL22044**

**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	94.0	0.0	±1.1

**9. Tone burst response**

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

**10. Peak C sound level**

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
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. : ACL22044

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	89.7	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	137.1	-0.1	±0.3

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

**End of Calibration Certificate**



# 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



Cert. No. : ACL21126

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00858516 / 158777 / 58778  
**ID No.:** BKK\_FS0106

**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 :** 06 OCTOBER 2021  
**Calibration Date :** 15-18 OCTOBER 2021  
**Date of Issue :** 19 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	15/10/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21126  
Job No. : VC65AC0002  
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. : ACL21126  
Job No. : VC65AC0002  
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. : ACL21126**  
**Job No. : VC65AC0002**  
**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 )
13.8

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

Frequency Weighting	Measured value ( dB )
A - weight	10.8
C - weight	17.1
Flat	22.9

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.0	-1.9	-1.9	±5.0

## Continuation of Calibration Certificate

 Cert. No. : ACL21126  
 Job No. : VC65AC0002  
 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	-0.1	0.1	0.0	±1.5
1000	-0.1	0.0	0.0	±1.0
2000	-0.1	0.1	0.1	±2.0
4000	-0.1	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. : ACL21126

Job No. : VC65AC0002

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	$\pm 1.1$
136.0	136.0	0.0	$\pm 1.1$
135.0	135.0	0.0	$\pm 1.1$
134.0	134.0	0.0	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.0	0.0	$\pm 1.1$
114.0	114.0	0.0	$\pm 1.1$
109.0	109.0	0.0	$\pm 1.1$
104.0	104.1	0.1	$\pm 1.1$
99.0	99.0	0.0	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	54.0	0.0	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	39.0	0.0	$\pm 1.1$
34.0	34.0	0.0	$\pm 1.1$
30.0	30.0	0.0	$\pm 1.1$
29.0	29.0	0.0	$\pm 1.1$
28.0	28.0	0.0	$\pm 1.1$
27.0	27.0	0.0	$\pm 1.1$
26.0	26.1	0.1	$\pm 1.1$
25.0	25.1	0.1	$\pm 1.1$



## Continuation of Calibration Certificate

Cert. No. : ACL21126  
 Job No. : VC65AC0002  
 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	135.7	-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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

Continuation of Calibration Certificate

**Cert. No. : ACL21126**

**Job No. : VC65AC0002**

**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



Cert. No. : ACL21123

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00572609 / 157781 / 48096  
**ID No.:** BKK\_FS0924

**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 :** 29 SEPTEMBER 2021  
**Calibration Date :** 12-14 OCTOBER 2021  
**Date of Issue :** 15 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	12/10/22

**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. : ACL21123  
Job No. : VC64AC0071  
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. : ACL21123  
 Job No. : VC64AC0071  
 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. : ACL21123  
Job No. : VC64AC0071  
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 )
17.2

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	24.6

**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)			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	-1.0	-0.9	-0.9	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL21123  
Job No. : VC64AC0071  
Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

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

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

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

Frequency Weighting	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. : ACL21123  
Job No. : VC64AC0071  
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.2	0.2	± 1.1



Continuation of Calibration Certificate

Cert. No. : ACL21123  
Job No. : VC64AC0071  
Pages : 7 of 8

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

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

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
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	136.4	0.0	±3.0

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

Continuation of Calibration Certificate

**Cert. No. : ACL21123**

**Job No. : VC64AC0071**

**Pages : 8 of 8**

**11. Overload indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.8	89.5	-0.3	±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

NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACC21021

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178118  
**ID No.:** BKK\_FS0631

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 08 OCTOBER 2021  
**Calibration Date :** 26 OCTOBER 2021  
**Date of Issue :** 26 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	26/10/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACC21021

Job No. : VC65AC0003

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	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
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. : ACC21021

Job No. : VC65AC0003

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	94.15	0.15	0.14	0.40

**2. Frequency**

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1000	1001.6	0.2	0.1	1.0

**3. Total distortion**

Measured value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1.76	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.,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. : ACL21093

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597166 / 180409 / 88179  
**ID No.:** BKK\_FS1001

**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 :** 26 AUGUST 2021  
**Calibration Date :** 07-08 SEPTEMBER 2021  
**Date of Issue :** 08 SEPTEMBER 2021

REVIEW BY *Narakorn P.*  
APPROVED BY *Nich Ch*  
NEXT CAL. DATE *9/9/22*

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACL21093  
Job No. : VC64AC0062  
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	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-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. : ACL21093  
Job No. : VC64AC0062  
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. : ACL21093  
Job No. : VC64AC0062  
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 )
14.8

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	23.1

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

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21093  
Job No. : VC64AC0062  
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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.1	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. : ACL21093  
Job No. : VC64AC0062  
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	$\pm 1.1$
136.0	136.1	0.1	$\pm 1.1$
135.0	135.1	0.1	$\pm 1.1$
134.0	134.1	0.1	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.1	0.1	$\pm 1.1$
114.0	114.1	0.1	$\pm 1.1$
109.0	109.0	0.0	$\pm 1.1$
104.0	104.1	0.1	$\pm 1.1$
99.0	99.1	0.1	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	54.0	0.0	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	39.0	0.0	$\pm 1.1$
34.0	34.0	0.0	$\pm 1.1$
30.0	29.9	-0.1	$\pm 1.1$
29.0	28.9	-0.1	$\pm 1.1$
28.0	28.0	0.0	$\pm 1.1$
27.0	26.9	-0.1	$\pm 1.1$
26.0	25.9	-0.1	$\pm 1.1$
25.0	24.9	-0.1	$\pm 1.1$



Continuation of Calibration Certificate

**Cert. No. : ACL21093**  
**Job No. : VC64AC0062**  
**Pages : 7 of 8**

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

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, 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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0



## Continuation of Calibration Certificate

Cert. No. : ACL21093

Job No. : VC64AC0062

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

## CERTIFICATE OF CALIBRATION

Certificate No. : CL-070-64  
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor  
Manufacturer. : DeltaOHM  
Model: HD32.2  
Serial No: 15006708  
ID No: BKK\_FS0671

### 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 : 30 SEP 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>Marakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	30/9/22

### 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: 15015843.  
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	20.051	20.1	0.0	0.099
30	25.047	25.1	0.1	0.099
30	30.035	30.1	0.1	0.099
30	35.026	35.1	0.1	0.099
30	40.014	40.1	0.1	0.099

**Table 2:** This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015489.  
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	20.045	20.2	0.2	0.099
70	24.874	25.0	0.1	0.099
70	29.821	29.8	0.0	0.099
70	34.779	34.7	-0.1	0.099
70	39.735	39.6	-0.1	0.099

**Table 3:** This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15015979.  
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	20.050	19.9	-0.2	0.099
110	25.047	24.9	-0.1	0.099
110	30.035	29.9	-0.1	0.099
110	35.026	34.9	-0.1	0.099
110	40.014	39.8	-0.2	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-063-64  
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor  
Manufacturer. : DeltaOHM  
Model: HD32.2  
Serial No: 15036014  
ID No: BKK\_FS0675

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 : 3 AUG 2021  
Calibration date : 4 AUG 2021  
Issue date : 5 AUG 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 *Naratorn P.*  
APPROVED BY *[Signature]*  
NEXT CAL. DATE *4/8/22*

### 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: 16008218.  
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	20.057	20.0	-0.1	0.099
30	25.053	25.0	-0.1	0.099
30	30.045	30.0	0.0	0.099
30	35.038	34.9	-0.1	0.099
30	40.035	39.9	-0.1	0.099

**Table 2:** This equipment was connected with temperature probe Model: TP3207.2 S/N: 16010563.  
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	20.057	20.0	-0.1	0.099
70	24.894	24.9	0.0	0.099
70	29.842	29.8	0.0	0.099
70	34.782	34.7	-0.1	0.099
70	39.740	39.6	-0.1	0.099

**Table 3:** This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008200.  
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	25.053	25.1	0.0	0.099
110	30.045	30.1	0.1	0.099
110	35.038	35.1	0.1	0.099
110	40.035	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-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-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



JIRANATE ASSOCIATES CO.,LTD

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-012-65

Page 1 of 2

Equipment Name: Heat Stress Monitor with Sensor  
Manufacturer.: DeltaOHM  
Model: HD32.2  
Serial No: 13024797  
ID No: BKK\_FS0642

### 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: 14 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±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

*Manakorn P.*

APPROVED BY

*[Signature]*

NEXT CAL. DATE

14 / 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: 13035038.  
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	20.055	20.0	-0.1	0.099
30	25.037	25.0	0.0	0.099
30	30.019	30.0	0.0	0.099
30	35.006	35.0	0.0	0.099
30	40.002	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 13033291.  
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	20.0	-0.1	0.099
70	24.990	24.7	-0.3	0.099
70	29.917	29.5	-0.4	0.099
70	34.873	34.4	-0.5	0.099
70	39.864	39.4	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 13042466.  
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	20.053	20.1	0.0	0.099
110	25.035	25.1	0.1	0.099
110	30.026	30.1	0.1	0.099
110	35.020	35.0	0.0	0.099
110	40.009	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-092-64  
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor  
Manufacturer. : DeltaOHM  
Model: HD32.2  
Serial No: 17020558  
ID No: BKK\_FS0653

### 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: 30 OCT 2021  
Calibration date: 2 NOV 2021  
Issue date: 3 NOV 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	Narakorn P.
APPROVED BY	Wichit Ch
NEXT CAL. DATE	2/11/22

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Orathai Wiwatwittaya



### Approved Signatory:

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: 13035020.  
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	20.064	20.2	0.1	0.099
30	25.051	25.1	0.0	0.099
30	30.038	30.1	0.1	0.099
30	35.030	35.1	0.1	0.099
30	40.018	40.1	0.1	0.099

**Table 2:** This equipment was connected with temperature probe Model: TP3207.2 S/N: 13044778.  
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	20.062	19.9	-0.2	0.099
70	24.880	24.5	-0.4	0.099
70	29.814	29.4	-0.4	0.099
70	34.773	34.3	-0.5	0.099
70	39.723	39.2	-0.5	0.10

**Table 3:** This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 13044156.  
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	20.064	20.2	0.1	0.099
110	25.051	25.1	0.0	0.099
110	30.038	30.1	0.1	0.099
110	35.030	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-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:  $(23 \pm 3)^\circ\text{C}$   
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 *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 \*







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. : 21PH435

Page : 1 of 2

Equipment : Lux Meter  
Manufacturer: PEAKMETER  
Model : PM6612L  
Serial No.: H12A-K20118  
ID No.: BKK\_FS1146

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.

Condition As-Received: New Item

Received Date: 24 August 2021

Calibration Date: 08 September 2021

Reference: 2108-0737WSC

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

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

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

Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against  
luminous-intensity standard lamp (source-based method) According to the inverse square law measurement  
method.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encorder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2022
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1472	TP-1045-20	20 Oct 2021

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

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

4.Test Equipment : Illuminance Meter ( Model : 51002, S/N : 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>Wangkom P.</i>
APPROVED BY	<i>Wich Chan</i>
NEXT CAL. DATE	<i>8/9/22</i>

Calibrated by : Nuntawat Khamchai  
Issue Date : 10 September 2021

Approved Signatory : *Phalinee Prabpaipal*  
[ ] Phalinee Prabpaipal  
[ ] Chatchawan Khunpiluek



Cert. No.: 21PH435

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	0.00	0.00	0.060
15	14.98	-0.02	0.20
100	100.4	0.4	1.3
500	502	2	6.5
1000	1005	5	13
2000	2000	0	27
3000	3000	0	40
4000	4010	10	52
5000	5010	10	65

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

**Light source factor setting :  $L_0 = 1.000$**

**UUC\* = Unit Under Calibration.**

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 21PH434

Page : 1 of 2

Equipment : Lux Meter  
Manufacturer: PEAKMETER  
Model : PM6612L  
Serial No.: H12A-K20117  
ID No.: BKK\_FS1145  
Condition As-Received: New Item  
Received Date: 24 August 2021  
Calibration Date: 08 September 2021

This certificate may not be reproduced other than in full,  
except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2108-0737WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %

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

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

Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against  
luminous-intensity standard lamp (source-based method) According to the inverse square law measurement  
method.

### Condition of this result of calibration

#### 1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encorder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2022
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1472	TP-1045-20	20 Oct 2021

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

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

4. Test Equipment : Illuminance Meter ( Model : 51002, S/N : 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>Naraporn P.</i>
APPROVED BY	<i>Nida Ch.</i>
NEXT CAL. DATE	<i>8/9/23-22</i>

Calibrated by : Nuntawat Khamchai  
Issue Date : 10 September 2021

Approved Signatory :

[ *ay L* ] Phalinee Prabpaipal

[ ] Chatchawan Khunpiluek





Cert. No.: 21PH434

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 )	( $\pm$ lx )
0	0.00	0.00	0.060
15	15.05	0.05	0.20
100	100.6	0.6	1.3
500	503	3	6.5
1000	1008	8	13
2000	2010	10	27
3000	3020	20	40
4000	4030	30	52
5000	5030	30	65

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

**Light source factor setting :  $L0 = 1.000$**

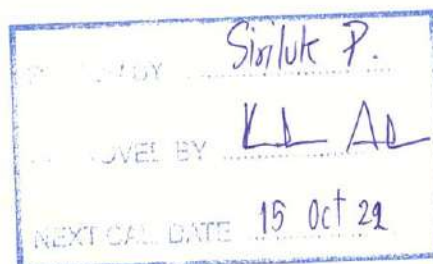
**UUC\* = Unit Under Calibration.**

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# Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-290/21  
Equipment UV/Vis Spectrophotometer  
Model UV-1800  
Manufacturer Shimadzu  
Serial No. A11454908533CD  
ID No. BKK\_EN0018  
Date of receipt 15 October 2021  
Date of calibration 15 October 2021  
Date of issue 25 October 2021



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

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

Temperature (25.0 - 26.4) °C (On site)  
Humidity (49.5 - 53.4) %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. 87839 and 87844  
Photometric Accuracy is traceable to certificate No. 87846 and 87877  
Stray Light is traceable to certificate No. 87825  
The above certificate are traceable to SI unit through Starna Scientific Ltd.  
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr.Wanchana Janloey

Approved by



**Mr.Kanchit Choothep**  
Technical Manager

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

# Certificate of Calibration

Certificate No. BSCC-UV-290/21

Number of Page(s) 2 of 3

## Calibration Results:

### 1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty ( $\pm$ nm)
241.70	241.55	-0.15	0.18
334.02	333.80	-0.22	0.18
418.53	418.40	-0.13	0.18
572.99	572.85	-0.14	0.18
879.41	879.15	-0.26	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
	0.7174	0.7198	0.0024	0.0075
257	0.0000	-0.0001	-0.0001	0.0075
	0.8362	0.8377	0.0015	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2778	0.2803	0.0025	0.0075
350	0.0000	-0.0001	-0.0001	0.0075
	0.6202	0.6221	0.0019	0.0075

\*CNR = Customer not request

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.



# Certificate of Calibration

Certificate No. **BSCC-UV-290/21**

Number of Page(s) **3 of 3**

## 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
	0.5631	0.5570	-0.0061	0.0042
	0.7390	0.7334	-0.0056	0.0042
	1.0863	1.0816	-0.0047	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5524	0.5469	-0.0055	0.0042
	0.7217	0.7166	-0.0051	0.0042
	1.0606	1.0570	-0.0036	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5018	0.4966	-0.0052	0.0042
	0.6657	0.6610	-0.0047	0.0042
	0.9775	0.9740	-0.0035	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5147	0.5113	-0.0034	0.0042
	0.6743	0.6705	-0.0038	0.0042
	0.9909	0.9890	-0.0019	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5427	0.5394	-0.0033	0.0042
	0.7037	0.7001	-0.0036	0.0042
	1.0338	1.0323	-0.0015	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5268	0.5235	-0.0033	0.0042
	0.6720	0.6685	-0.0035	0.0042
	0.9864	0.9847	-0.0017	0.0042

\*CNR = Customer not request

### 4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.91 $\pm$ 0.11nm	200.31	0.9399	2.0274

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.



# 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. T211009

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 : Laboratory

Date of Receipt : 6 May 2021

Calibrated By : Watcharapon Songthong (Technician)

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

Date of Issue : 20 MAY 2021

REVIEW BY	<u>Sinlue P.</u>
APPROVED BY	<u>L. L. A.</u>
NEXT CAL. DATE	<u>16/11/22</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. T211009

Page 2 of 4

## Calibration Report

**Equipment** : Chamber (Cold Room)  
**Date of Calibration** : 18 May 2021  
**Environment** : **Temperature** : 23.4-24.9 °C  
**Line Voltage** : 221.4-230.2 V  
**Relative Humidity** : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	8 January 2022
TC	TYPE T	TN171-TN180	T210009	8 January 2022
DATA LOGGER	34970A	T149	T210009	8 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 1 Hour - Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :

( X ) without adjustment

( ) after adjustment

Approved By. 





Certificate No. T211009

Page 4 of 4

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	3.23	3.38	3.23	3.41	3.36	3.52	3.51	3.11	3.29	3.50
	TN171	TN172	TN173	TN174	TN175	TN176				
	3.36	3.18	3.52	3.22	3.28	3.31				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average					
3.0	2.7 , 3.4	3.0	3.34	1.00	1.10	1.46	2.00

\* The Acuoted 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 multiplled 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.

เลขที่ ๑๐๖ หมู่ ๑๐ ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10110  
Tel. (02) 747-7000 Fax. (02) 747-7005

Maintenance Plan YEAR : 2561

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม												

## Periodical maintenance check list for Konelab

	6M	12M	Notes
1. Fluoro-wash tubing change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2. UF tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3. Dry-type 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 type="checkbox"/>	
7. Rotor paddle/paddle change(not Konelab20)		<input checked="" type="checkbox"/>	
8. FNE needles check/change		<input checked="" type="checkbox"/>	
9. Pump Lubing check/ chance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10. Broken/worn out part check /change		<input 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 checked="" type="checkbox"/>	
15. Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
16. Dispenser movement check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
17. Sample/reagent register check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
18. Dispensing tubing tightness check	<input type="checkbox"/>	<input checked="" 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 checked="" 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 type="checkbox"/>	

Model: Kon Lab Instrument: Konelab 20  
 Date/Time: 25-01-64 Serial no: 22951  
 Installed by: [Signature] Install date: [Signature]  
 Signature of customer: [Signature] Date/Time: 29/1/21





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.: 21CH452  
Page.: 1 of 3

## Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact S220
Serial No. :	B520948426
ID No. :	BKK_EN0072
Condition As-Received:	Used Item
Received Date :	24 March 2021
Calibration Date :	26 March 2021
Reference :	2103-1008DSC-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) - CP-CH8 by comparison with standard thermometer

REVIEW BY	Siriluk P.
APPROVED BY	KL AL
NEXT CAL. DATE	24/9/22

Calibrated by : Warakorn Lernagatrakul

Approved by :

*Malee*

Approved Signatory

- (☒) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lernagatrakul

Issue Date :

31 March 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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0026590



Cert.No.: 21CH452

Page.: 2 of 3

**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	1385032	130RC022	20E4213	24 Nov 2021
2) Ref. Standard Thermometer	4982054	110RC044	20I1233	15 Oct 2021

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	706694	06 Sep 2022
pH 6.985	CPA chem	722285	19 Dec 2021
pH 10.012	CPA chem	722287	19 Dec 2021

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

**Calibration Results**

**Function : mV Measurement**

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor k
			mV	pH		
pH Meter S/N.: B520948426	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

Malu.





Cert.No.: 21CH452

Page.: 3 of 3

**Calibration Results****Function : pH Measurement**

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading ( mV )	Uncertainty of pH measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: 9265091	4.008	4.010	150.3	0.0048	2.05
	6.985	6.989	-22.5	0.0077	2.00
	10.012	10.011	-193.7	0.013	2.00

**Function : Temperature Measurement****( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM

- Serial No. : 9265091

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point ( °C )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of measurement ( $\pm$ °C )	Coverage factor $k$
25.0	25.003	25.2	0.197	0.20	2.00

**Remark : - UUC\* = Unit Under Calibration**

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

-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.: 21CG1446

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 :	755 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Sa-ngeunkam Wongsu



Approved by :

*Malee*

Approved Signatory

- ( ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ) Ponpan Paipim  
( ) Srisuda Khamtha

Issue Date :

31 March 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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0026589



Equipment : Burette  
Received Date : 24 March 2021  
Condition As-Received : Used Item  
Calibration Date : 30 March 2021  
Reference : 2103-1008DSC-5

Cert.No.: 21CG1446  
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	XP205	B134206712	140RC007	21MM181	NIMT	02 Mar 2022
2) Thermo-Hygrograph	TH 803	09153022	140EC004	20H1434	NIST,NIMT	19 June 2021
3) Thermometer		1594592	140EC010	20I1191	NIMT	08 Oct 2021

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	50.0041	0.011	2.00

**Remark** mL = cm<sup>3</sup>

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

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/m<sup>3</sup>



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

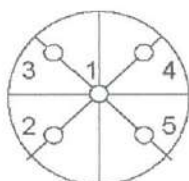
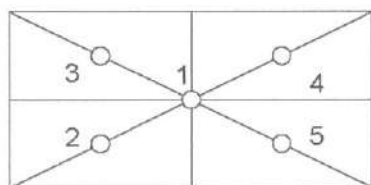
Page: 2 of 2

## 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

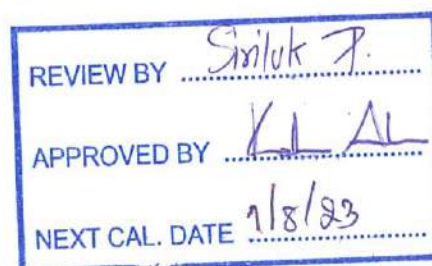


Certificate No. T220139

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

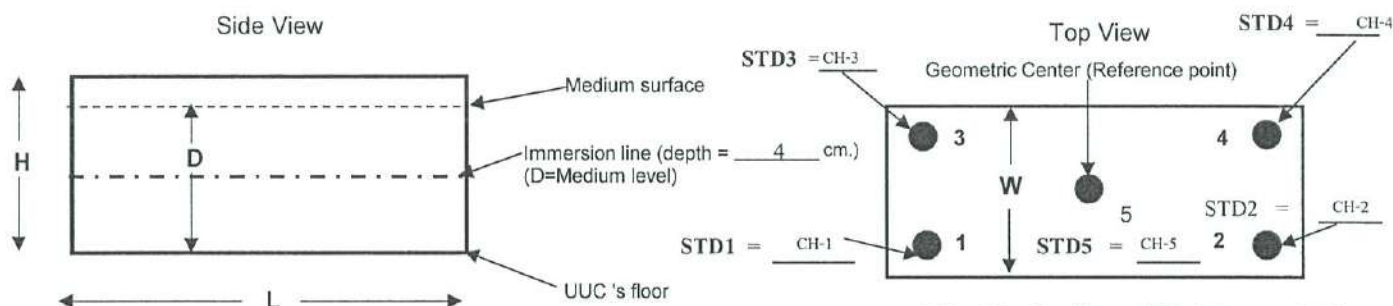
Approved By. 



Certificate No. T220139

Page 3 of 3

## Calibration Report



- 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. 

**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](http://www.sea.hach.com)

LABX 2200441

**Test Report**

Customers	: ALS Laboratory Group (Thailand) Co., Ltd.	Manufacturer	: HACH
Equipment	: Chlorine Meter	ID No.	: BKK_LG0032
Controller Model	: Pocket II Cl2	Sensor Serial No.	: -
Controller Serial No.	: 18110E374141	Period	: -
Date of test	: 23/02/2022	Humidity	: 58.0 %RH
Environment temperature	: 25.0 °C		

**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)	0.90 mg/l	0.91 mg/l	
10	Standard Cl2 No. 3 ( 1.72 ± 0.14 mg/l)	1.66 mg/l	1.68 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 ( 3.9 ± 0.3 mg/l)	4.0 mg/l	3.9 mg/l	
14	Standard Cl2 No. 3 ( 6.8 ± 0.6 mg/l)	7.0 mg/l	6.9 mg/l	

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



## 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](http://www.sea.hach.com) |

LABX 2200441

### 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





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

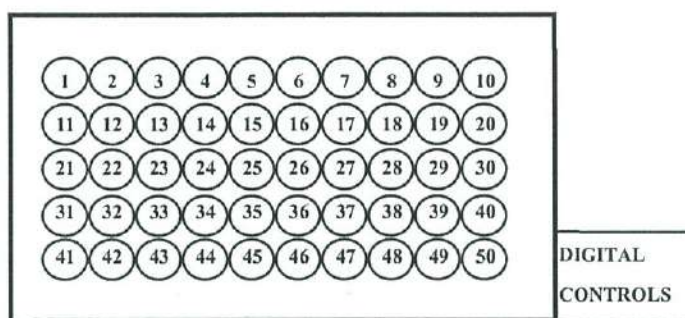
Approved By. \_\_\_\_\_



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

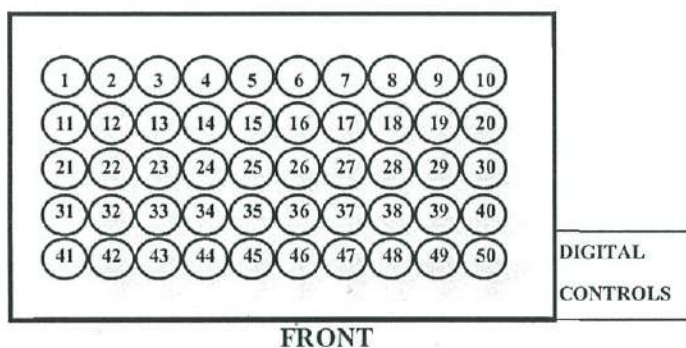
Approved By. 



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

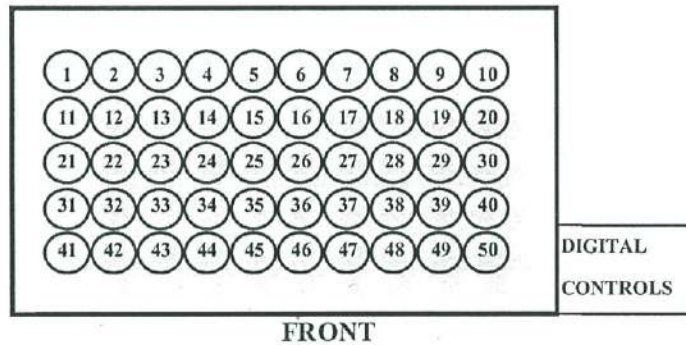
Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole31	Hole32	Hole33	Hole34	Hole35	Hole36	Hole37	Hole38	Hole39	Hole40
				M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20
380	374	374	Max °C	379.3	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.: 21TM2189

Page.: 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UFE 500

Serial No. : G511.1574

ID No. : BKK\_EN0007

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

Location : Oven Room

Received Order : 1 December 2021

Calibration Date : 1 December 2021

Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 30) \%$

Calibrated by : Khit Ruttanaprapachai

Approved by :

*Malee*

Approved Signatory

( ) Pornthippa Tameyakul

( ☒ ) Malee Butkruea

( ) Suwit Imjai

Issue Date : 7 December 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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0032815





Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2112-0002OC-1

Cert. No.: 21TM2189

Page.: 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44060450	21LM4/1	06 Mar 2022

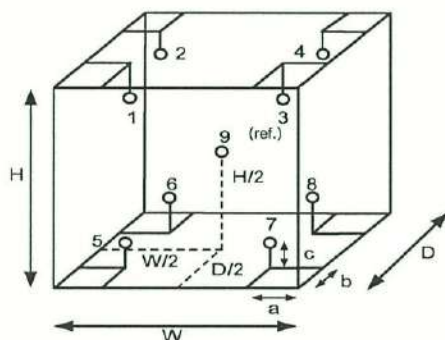
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	51	53
AC Supply ( Volt )	221	222

Ref. Std. ID No.: @ Calibration Point		
Position :	( 104 ) °C	( 121,175,180 ) °C
1	19-14RTD-01	19-14TC-01
2	19-14RTD-02	19-14TC-02
3	19-14RTD-03	19-14TC-03
4	19-14RTD-04	19-14TC-04
5	19-14RTD-05	19-14TC-05
6	19-14RTD-06	19-14TC-06
7	21-14RTD-07	19-14TC-07
8	19-14RTD-08	19-14TC-08
9 (ref.)	19-14RTD-09	19-14TC-09

**Probe Installation Details :** **Dimension of Chamber :**

a =	5.0	cm	D =	0.40	m
b =	5.0	cm	W =	0.56	m
c =	5.0	cm	H =	0.48	m
			Capacity =	0.11	m <sup>3</sup>

*Malu*



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2112-0002OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 21TM2189

Page.: 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
104.0	104.0	104.0	0.059	0.52	0.59	0.45	2
121.0	121.0	121.0	0.11	0.75	1.2	1.1	2
175.0	175.0	175.0	0.13	0.90	1.6	1.1	2
180.0	180.0	180.0	0.13	0.93	1.6	1.1	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	104.265	104.229	104.080	103.922	104.390	104.304	104.284	103.994	103.909
121.0	120.838	120.519	120.661	120.524	121.162	120.855	120.703	120.126	120.726
175.0	175.021	174.603	174.848	174.652	175.830	175.321	175.411	174.440	175.222
180.0	179.792	179.374	179.575	179.376	180.643	180.081	180.174	179.217	180.014

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

-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 FAX. 0-2719-9484

Cert.No.: 21TW6

Page.: 1 of 2

## Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5100
Serial No. :	15L103204
ID No. :	BKK_EN0205
Received Date :	15 January 2021
Test Date :	19 January 2021
Reference :	2101-0428WSC-5
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Laboratory Condition :	Temperature ( $25 \pm 5$ ) °C Humidity ( $50 \pm 20$ ) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Calibrated by :	Walalak Sirithean
Approved by :	 Approved Signatory
<input checked="" type="checkbox"/> Malee Butkruea <input type="checkbox"/> Saithip Meangmai <input type="checkbox"/> Warakorn Lerngagtrakul	
Issue Date :	25 January 2021







Cert.No.: 21TW6

Page.: 2 of 2

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 18C100772

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.10	8.10	0.0055

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

-o0o-

*Maku.*



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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.: 21TM166

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** DO Meter with Sensor

**Manufacturer :** YSI

**Model :** 5100

**Serial No. :** 15L103204

**ID No. :** BKK\_EN0205

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

**Location :** TPA On Site Calibration Laboratory

**Received Order :** 15 January 2021

**Calibrated Date :** 21 January 2021

**Ambient Temperature :** (  $26 \pm 10$  ) °C

**Relative Humidity :** (  $50 \pm 30$  ) %

**AC Line Voltage :** (  $220 \pm 22$  ) V

**Calibrated by :** Kritsada Chaitrong

**Approved by :**

Approved Signatory

- ( ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 28 January 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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0023875



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2101-0428WSC-6

Cert. No.: 21TM166

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	1523	2188080	2011389	20 Nov 2021

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 maintained at:-

- National Institute of Metrology Thailand (NIMT)

**Result of Calibration :-** ( \* ) Without Adjustment

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 18C100772

<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	20.002	19.94	-0.062	0.15	2.00

UUC\* : Unit Under Calibration

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

-o0o-

*Mali*





# 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

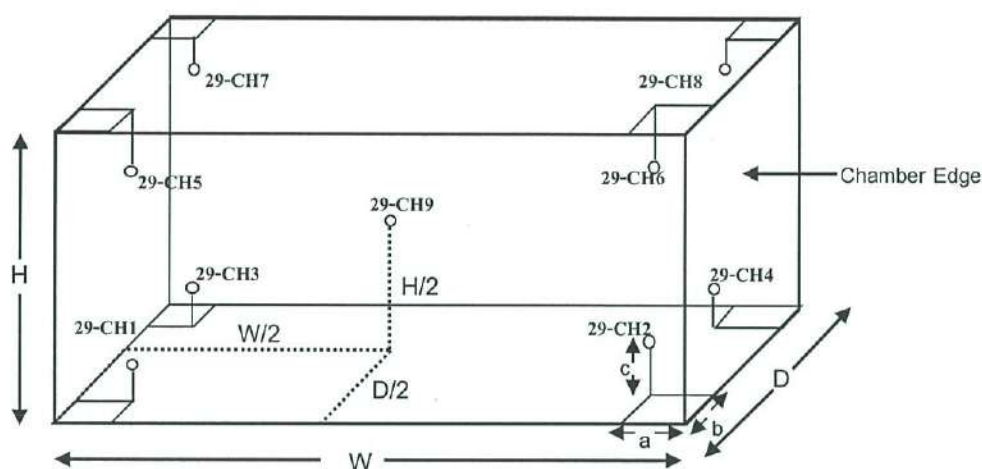
Approved By. \_\_\_\_\_



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 k
	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. 



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.

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. \_\_\_\_\_





## Calibration Report

### Measurement Results

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.






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.: 21CH1650

Page.: 1 of 2

## Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	S2-Field Kit
Serial No. :	B729410583
ID No. :	BKK_LG0011
Condition As-Received:	Used Item
Received Date :	25 November 2021
Calibration Date :	29 November 2021
Reference :	2111-0911DSC-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)
Calibrated by :	Warakorn Lerngagtrakul
Approved by :	 Approved Signatory
( ) Malee Butkruea	
( ) Saithip Meangmai	
( ) Warakorn Lerngagtrakul	
Issue Date :	2 December 2021

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	29/11/22

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 0035374





Cert. No.: 21CH1650

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	21E2682	25 Aug 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.: B729410583	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.: 9291914	4.008	4.01	179	0.0085	2.05
	6.982	6.98	5	0.0099	2.00
	10.015	10.02	-171	0.0095	2.00

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

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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.: 21LM22

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** pH Meter with Sensor

**Manufacturer :** Mettler Toledo

**Model :** S2-Field Kit

**Serial No. :** B729410583

**ID No. :** BKK\_LG0011

**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 :** 25 November 2021

**Calibrated Date :** 29 November 2021


**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**AC Line Voltage :** ( 220 ± 22 ) V

**Calibrated by :** Warakorn Lerngagtrakul

**Approved by :**

  
Approved Signatory

- ( ) Pornthippa Tameyakul  
( ✓ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 1 December 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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0035352





Equipment : pH Meter with Sensor

Condition As-Received : Used Item

Reference : 2111-0911DSC-2

Cert. No.: 21LM22

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	1523	3240076	211193	15 Feb 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 temperature sensor, S/N.: 9291914

<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	120	20.002	20.0	-0.002	0.16	2.00
25.0	120	25.005	25.1	0.095	0.16	2.00
30.0	120	30.006	30.1	0.094	0.16	2.00
35.0	120	35.002	35.1	0.098	0.16	2.00
40.0	120	40.005	40.1	0.095	0.16	2.00
45.0	120	45.002	45.1	0.098	0.16	2.00
50.0	120	50.004	50.1	0.096	0.16	2.00

**UUC\* :** Unit Under Calibration

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

-o0o-

*Mah.*



# Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY	<i>Nant Som</i>
APPROVED BY	<i>KLAL</i>
CAL. DATE <i>22/05/23</i>	

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:

&lt;=

12.00

Status:

Pass

Retention Time

0.05

%

&lt;=

1.00

Pass

Instrument Detection Limit:

1.94800

fg

Agilent Recommended:

&lt;=

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:

&lt;=

5.00

Pass

Mass Ratio

2.66

%

&lt;=

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

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

## Details

Full Name of Signer:	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

## Regulatory Disclaimer

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

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User Name: 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



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





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) °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 $\text{mS/cm}$	Thermo Scientific	230/01	07 June 2023

- Control Conductivity calibration solution temperature by Water bath ( $25 \pm 0.1$ )  $^{\circ}\text{C}$

## 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 $\text{mS/cm}$	12.92 $\text{mS/cm}$	12.79 $\text{mS/cm}$	0.14 $\text{mS/cm}$	2.00

**Remark****- UUC\* = Unit Under Calibration****- Adjustment Cell constant =  $0.559929 \text{ cm}^{-1}$** 

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





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.: 22CH204

Page.: 1 of 2

## Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go S3
Serial No. :	B851971049
ID No. :	BKK_LG0033
Condition As-Received:	Used Item
Received Date :	08 February 2022
Calibration Date :	10 February 2022
Reference :	2202-0244DSC-8
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	$(25 \pm 2.5) ^\circ\text{C}$
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 : Walalak Sirithean

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 0037923





Cert.No.: 22CH204

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	1963878	130RC095	211977	17 Sep 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 $\text{mS/cm}$	CPA Chem	761022	02 Aug 2022

- Control Conductivity calibration solution temperature by Water bath ( $25 \pm 0.1$ )  $^{\circ}\text{C}$

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.: 5818470986

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
84.000 $\mu\text{S/cm}$	82.65 $\mu\text{S/cm}$	85.42 $\mu\text{S/cm}$	0.62 $\mu\text{S/cm}$	2.00
1413.0 $\mu\text{S/cm}$	1367 $\mu\text{S/cm}$	1412 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12.880 $\text{mS/cm}$	12.38 $\text{mS/cm}$	12.68 $\text{mS/cm}$	0.086 $\text{mS/cm}$	2.00

**Remark**

- UUC\* = Unit Under Calibration

- Cell constant =  $0.554 \text{ cm}^{-1}$ 

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



แบบฟอร์มการประเมินเครื่องมือภายหลังทำการสอบเทียบเครื่องมือเทคโนโลยีระดับสูง

ชื่อเครื่องมือ : GC-MSD

ID No. : BKK\_EN0059(GM7)

S/N : CN14133181/US1415M029

Parameter	Set point	Acceptable	Test Results	Pass	Fail	Remark
Inlet Pressure Accuracy	25 psi	23.8 -26.2	25.3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Oven Temp. Accuracy	230°C	225 -235	230.6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Oven Temp. Accuracy	100°C	96.3 -103.7	100.9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Oven Temp. Stability	100°C	99.5 -100.5	100.9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
RFPA Voltage	1050 m/z	≤ 1100 mV	518	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Signal to Noise Filament 1	-	≥ 1200	1472	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Signal to Noise Filament 2	-	≥ 1200	3400	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
				<input type="checkbox"/>	<input type="checkbox"/>	
				<input type="checkbox"/>	<input type="checkbox"/>	
				<input type="checkbox"/>	<input type="checkbox"/>	
				<input type="checkbox"/>	<input type="checkbox"/>	
				<input type="checkbox"/>	<input type="checkbox"/>	

ผู้ตรวจสอบ: *Nant Somb*  
28/12/20  
ว/ด/ป: .....

ผู้อนุมัติ: *Kant Anu*  
28/12/20  
ว/ด/ป: .....

# 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: December 24, 2020 2:51:10 PM  
EQP Name: AgilentRecommended , AgilentRecommended  
EQP Revision: GC.02.50, GCMS.02.50  
Overall Qualification Status: Pass

REVIEW BY	<i>Watt Sank</i>
APPROVED BY	<i>KL AL</i>
NEXT CAL DATE	20/06/22

## 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	25.3	psi
Accuracy:			0.3	psi
Agilent Recommended:			<= 1.2	

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890

Date: December 24, 2020 2:51:10 PM  
System ID: GM-7



Setpoint Status:	Pass			
Zone:	Oven			
	Setpoint/Actual			
Temperature:	230.0	230.6	°C	
Accuracy:		0.6	°C	
Agilent Recommended:	>=	-1.0	% setpoint in K	( -5.0 °C )
	<=	1.0	% setpoint in K	( 5.0 °C )

Data for this setpoint was entered manually.

Reason: Data logging currently not available.

Setpoint Status:	Pass			
Zone:	Oven			
	Setpoint/Actual			
Temperature:	100.0	100.9	°C	
Accuracy:		0.9	°C	
Agilent Recommended:	>=	-1.0	% setpoint in K	( -3.7 °C )
	<=	1.0	% setpoint in K	( 3.7 °C )

Data for this setpoint was entered manually.

Reason: Data logging solution currently not available.

#### Overall GC Oven Temperature Accuracy Test Status

Pass

#### GC Oven Temperature Stability

Name:	7890			
Setpoint Status:	Pass			
	Setpoint/Average			
Temperature:	100.0	100.9	°C	
Stability:		0.0	°C	
Agilent Recommended:	<=	0.5		

Data for this setpoint was entered manually.

Reason: Data logging solution currently not available.

## Overall GC Oven Temperature Stability Test Status

Pass

## Log Amp

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

## Overall Log Amp Test Status

Pass

## RFPA

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

Amu:

1050

m/z

Drift After Five Minutes:

15

mV

RFPA Voltage:

518

mV

Agilent Recommended:

&gt;=

-100

and

&lt;=

100

&lt;=

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

Date:

December 24, 2020 2:51:10 PM

System ID:

GM-7

## Signal to Noise EI

Tested Combination1	Front	SSL	/ External	SQ
---------------------	-------	-----	------------	----

Name:	5977A			
-------	-------	--	--	--

Source:	EI - Extractor	Filament:	1
---------	----------------	-----------	---

Setpoint Status:	Pass
------------------	------

Signal to Noise:	1472
------------------	------

Agilent Recommended:	>= 1200
----------------------	---------

Source:	EI - Extractor	Filament:	2
---------	----------------	-----------	---

Setpoint Status:	Pass
------------------	------

Signal to Noise:	3400
------------------	------

Agilent Recommended:	>= 1200
----------------------	---------

## Overall Signal to Noise EI Test Status

Pass
------



## 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:	December 24, 2020
Reason for Signature:	Executed protocol and published this original version of document

### Regulatory Disclaimer

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

### Warranty

Agilent Technologies makes no warranty of any kind to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.



# 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

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### Spectrometer 1

Manufacturer	Agilent Technologies
Name	5100 SVDV
Model Number	G8010A
Sample Introduction	Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number	MY16010005
Firmware Revision	5395

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Other Unspecified
Other Unspecified Name	Chiller
Model Number	Other Unspecified
Other Unspecified Model Number	G3292-80201
Serial Number	2008-00159

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

#### Switching Valve Accessory 1

Manufacturer	Agilent Technologies
Name	SVS 2+
Model Number	G8485A
Serial Number	AU16040115

# Electronic Signature

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## Details

Full Name of Signer:	Kanyakorn Sukpathrajareem
Logged On User Name:	phimprapha.jeeraphong@agilent.com
Signature Creation Date:	September 13, 2021
Reason for Signature:	Executed protocol and published this original version of document

## Regulatory Disclaimer

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

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Agilent Technologies makes no warranty of any kind to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

User Name: phimpapha.jeeraphong  
 Hostname: ASBKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:49:12 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 8:49:59 AM	Audit	SessionCreated	Session	None
September 8, 2021 8:49:59 AM	Start	Configuration	Session	None
September 8, 2021 8:49:59 AM	Audit	Entitlement	Licensing	User Is FieldEngineer and does not require an unlock code
September 8, 2021 9:07:06 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended]
September 8, 2021 9:07:11 AM	End	Configuration	Session	None
September 8, 2021 9:07:15 AM	Start	Qualification	Session	OQ
September 8, 2021 9:07:15 AM	Start	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:34:35 AM	End	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:34:39 AM	Start	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:27 AM	End	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1

Page 1 / 2

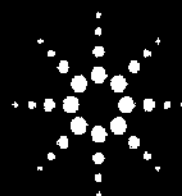


User Name: phimprapha.jeeraphong  
 Hostname: ASBKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:49:12 PM

QCHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:51:30 AM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:36 AM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:51:38 AM	End	Qualification	Session	OQ
September 8, 2021 9:51:38 AM	Start	Reporting	Session	None
September 8, 2021 10:55:40 AM	Audit	AceClosed	Session	None
September 13, 2021 5:01:26 PM	Audit	AceRestarted	Session	None
September 13, 2021 5:01:26 PM	Audit	SessionReloaded	Session	None
September 13, 2021 5:01:28 PM	Start	Qualification	Session	OQ
September 13, 2021 5:47:55 PM	Audit	Reporting	Session	Report Generated : Certificate



Agilent CrossLab Compliance Services

Agilent  
**CrossLab**  
From Insight to Outcome

## EQUIPMENT QUALIFICATION REPORT (EQR)

### Agilent CrossLab Compliance

Qualification Type:	ES-OQ
System ID:	MY16010005
EQP Name:	AgilentRecommended
EQP Details:	Agilent Technologies System
EQP Revision:	ES.02.50
EQP Release Date:	March 2020
Date:	September 13, 2021 5:50:41 PM
Report Type:	Report
Org. Name:	ALS Laboratory Group (Thailand) Co., Ltd.
Org. Location:	104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

## Table of Contents

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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
Preparation : 5100 SVDV	Pass	1
Instrument Tests : 5100 SVDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	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: 6004823273  
EQP Name: AgilentRecommended  
EQP Revision: ES.02.50  
Report Type: Report

### Organization Details

Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

### Local Contact Details

Name: Khun Thitima Boonpeng  
Job Title: Scientist 2, Life Sciences  
Qualification Location: ICP Room

### Operator Details

Name: Kanyakorn sukpathrajarem  
Job Title: Field Service Engineer

### Data Acquisition Details

Acquisition Software Name: ICP Expert  
Acquisition Software Revision: 7.5.3.11953

Customer Data System (CDS): Es: ICP Expert

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### Spectrometer 1

Manufacturer	Agilent Technologies
Name	5100 SVDV
Model Number	G8010A
Sample Introduction	Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number	MY16010005
Firmware Revision	5395

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Other Unspecified
Other Unspecified Name	Chiller
Model Number	Other Unspecified
Other Unspecified Model Number	G3292-80201
Serial Number	2008-00159

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

#### Switching Valve Accessory 1

Manufacturer	Agilent Technologies
Name	SVS 2+
Model Number	G8485A
Serial Number	AU16040115

## 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
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

## Preparation

### Purpose

This test records a status for each preparation task for the Agilent ICP-OES.

### Configuration Details

Model/Serial No.:

G8010A

MY16010005

### Results

Criteria

Observed Result

Expected Result

Status

Does the plasma ignite successfully in the first three attempts?

Yes

Yes

Pass

Was the detector calibration performed and completed successfully?

Yes

Yes

Pass

Was the Instrument calibration performed and completed successfully?

Yes

Yes

Pass



## Test Evidence

Image Details:

Was the detector calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:07:42 AM

Host Name:

ASBKKWX328

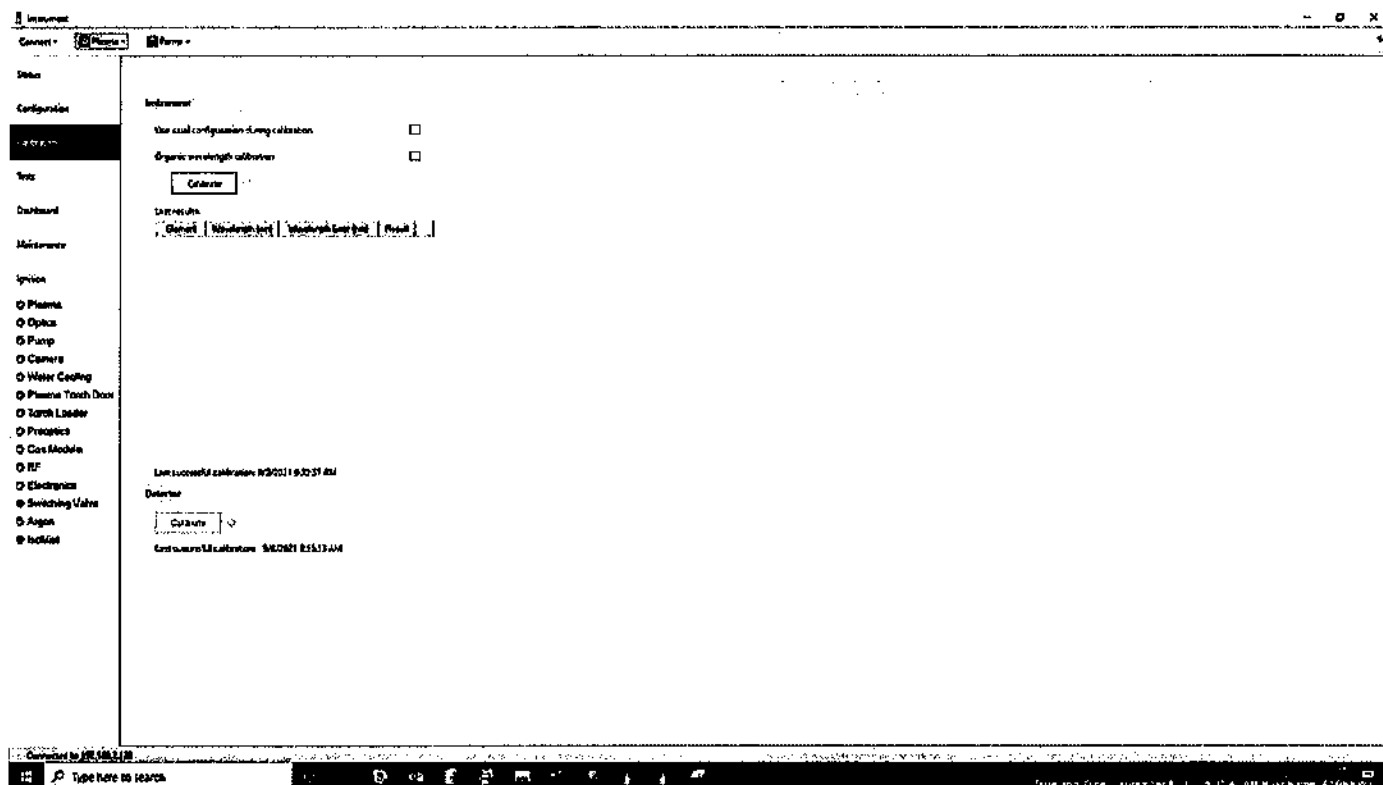


Image Details:

Was the instrument calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:33:30 AM

Host Name:

ASBKWX328

Instrument

Configuration

Test

Dashboard

Measurements

System

Detector

Flaming / Cooling

Pumps

Gas Module

Sweeping Valve

Diagnostic Log Config

☐ Plasma

☐ Gases

☐ Pump

☐ Churner

☐ Water Cooling

☐ Plasma Torch Door

☐ Torch Loader

☐ Preheats

☐ Gas Module

☐ IIR

☐ Electrodes

☒ Switching Valve

☐ Argon

☐ Air

Download to 192.168.1.134

type here to search

Drop with Time: September 8, 2021 9:33:30 AM

Instrument

Use local configuration during calibration ☒

Organic wavelength calibration ☐

Calibrate

Test results

Element	Wavelength (nm)	Wavelength Error (nm)	Result
Al	187.079	0.000007	Pass
H	121.213	0.001864	Pass
As	196.84	-0.011239	Pass
C	191.027	0.000026	Pass
Ca	191.099	0.000020	Pass
Se	196.026	0.000001	Pass
Be	202.032	-0.000004	Pass
Zn	202.543	-0.000079	Pass
Mo	203.846	0.000004	Pass
Mg	204.598	0.000000	Pass
Cr	205.94	-0.000000	Pass
Zn	203.887	-0.000074	Pass
Cd	214.439	-0.000002	Pass
Pb	228.363	-0.000075	Pass

Last successful calibration: 9/8/2021 9:33:07 AM

Details

Calibrate

Last successful calibration: 9/8/2021 8:55:59 AM

## Overall Test Status

Pass

Runs: 1

## Instrument Tests

### Purpose

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

### Configuration Details

Model/Serial No.:

G8010A

MY16010005

### Results

Observed Result

Expected Result

Status

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Yes

Yes

Pass

Air Flow

Yes

Yes

Pass

Water Flow

Yes

Yes

Pass

Gas Flows

Yes

Yes

Pass

RF Generator

Yes

Yes

Pass

Camera

Yes

Yes

Pass

Optics

Yes

Yes

Pass

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes

Yes

Pass

Sensitivity

Yes

Yes

Pass

Precision

Yes

Yes

Pass

### Overall Test Status

Pass

Runs: 1

# Autosampler Operation

## Purpose

This test verifies that the autosampler operates properly.

## Configuration Details

Model/Serial No.:	G8410A	AU15440764
-------------------	--------	------------

## Results

Criteria	Observed Result	Expected Result	Status
Does the autosampler successfully move to the specified location(s)?	Yes	Yes	Pass

## Overall Test Status

Pass	Runs: 1
------	---------



## 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

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Operator's training certificate and qualifications	1
EQR	Material	Certificate of Analysis Wavelength calibration solution	4
EQR	Comments	General	1
EQR	General	Instrument's Test Report	5
EQR	General	Instrument's Test Report	4

## General

Document Name:

Certificate of Qualification for ACE

**Agilent Compliance Engine Self Qualification**

Date: September 8, 2021 10:10:10 AM

Drive Serial #: EAF04572

Platform Revision:

A.03.01

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
UV-Vis Spectrophotometer	13	Conforms
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Software	6	Conforms
Emission Spectroscopy	3	Conforms
Infrared Spectroscopy	7	Conforms

**Overall Qualification Status**

Conforms

## General

Document Name: Certificate of Qualification for ACE



## Certificate of Completion

Learner Name: Kanyakorn Sukpathrajarn

Title Of Course: AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date: June 25, 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:** Operator's training certificate and qualifications

## Certificate of Completion

**Learner Name:** Kanyakorn Sukpatharajareon**Title Of Course:** ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training**Completion Date:** November 2, 2017**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.

## Materials

Document Name:

Certificate of Analysis Wavelength calibration solution



# **CERTIFICATE OF ANALYSIS**

**Agilent Product Name:** Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL

**Agilent Part No:** 8810030100

**Lot No:** 0010578941

**Product Specifications**

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO <sub>3</sub> ) <sub>3</sub>	7784-27-2	5.005 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.001 ± 0.025 mg/L
As	As	7440-38-2	5.001 ± 0.025 mg/L	Mo	(NH <sub>4</sub> ) <sub>2</sub> MoO <sub>4</sub>	13106-76-8	5.007 ± 0.025 mg/L
Ba	Ba(NO <sub>3</sub> ) <sub>2</sub>	10022-31-6	5.006 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.004 ± 0.025 mg/L
Cd	Cd	7440-43-8	5.002 ± 0.025 mg/L	Pb	Pb	7439-92-1	5.009 ± 0.025 mg/L
Co	Co	7440-48-4	5.006 ± 0.025 mg/L	Se	Se	7782-49-2	5.004 ± 0.025 mg/L
Cr	Cr(NO <sub>3</sub> ) <sub>3</sub>	13548-38-4	5.002 ± 0.025 mg/L	Sr	Sr(NO <sub>3</sub> ) <sub>2</sub>	10042-75-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.007 ± 0.025 mg/L	Zn	Zn	7440-66-8	5.002 ± 0.025 mg/L
K	KNO <sub>3</sub>	7757-79-1	50.00 ± 0.25 mg/L				

**Matrix:** 5% HNO<sub>3</sub>

**Intended Use:** This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

**Certification & Traceability:** This CRM was manufactured under a quality management system that is registered to ISO 9001, ISO 17034 and ISO/IEC 17025. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid (HNO<sub>3</sub>) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3113, 3112a, 3114, 3141a, 3132, 3134, 3135, 3128, 3149, 3163a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

**Instructions for Use:** Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transference, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 600µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

**Date:**  
**System ID:**

 September 13, 2021 5:50:41 PM  
 MY16010005

Document Name:

Certificate of Analysis Wavelength calibration solution



**Period of Validity:** Agilent ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Date of release: 8 April 2020  
Date of expiration: 8 October 2021

Sample lot approval:

A handwritten signature in black ink, appearing to read "Chuck Goudreau".

Chuck Goudreau, Certifying Officer

Document Name: Certificate of Analysis Wavelength calibration solution



**Hazard Information:** Refer to the Safety Data Sheet (SDS), which can be obtained at [www.agilent.com/chem/sds](http://www.agilent.com/chem/sds).

**Homogeneity:** This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with DSP 6-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

**Further Information:** Please contact Agilent for further information about this CRM.

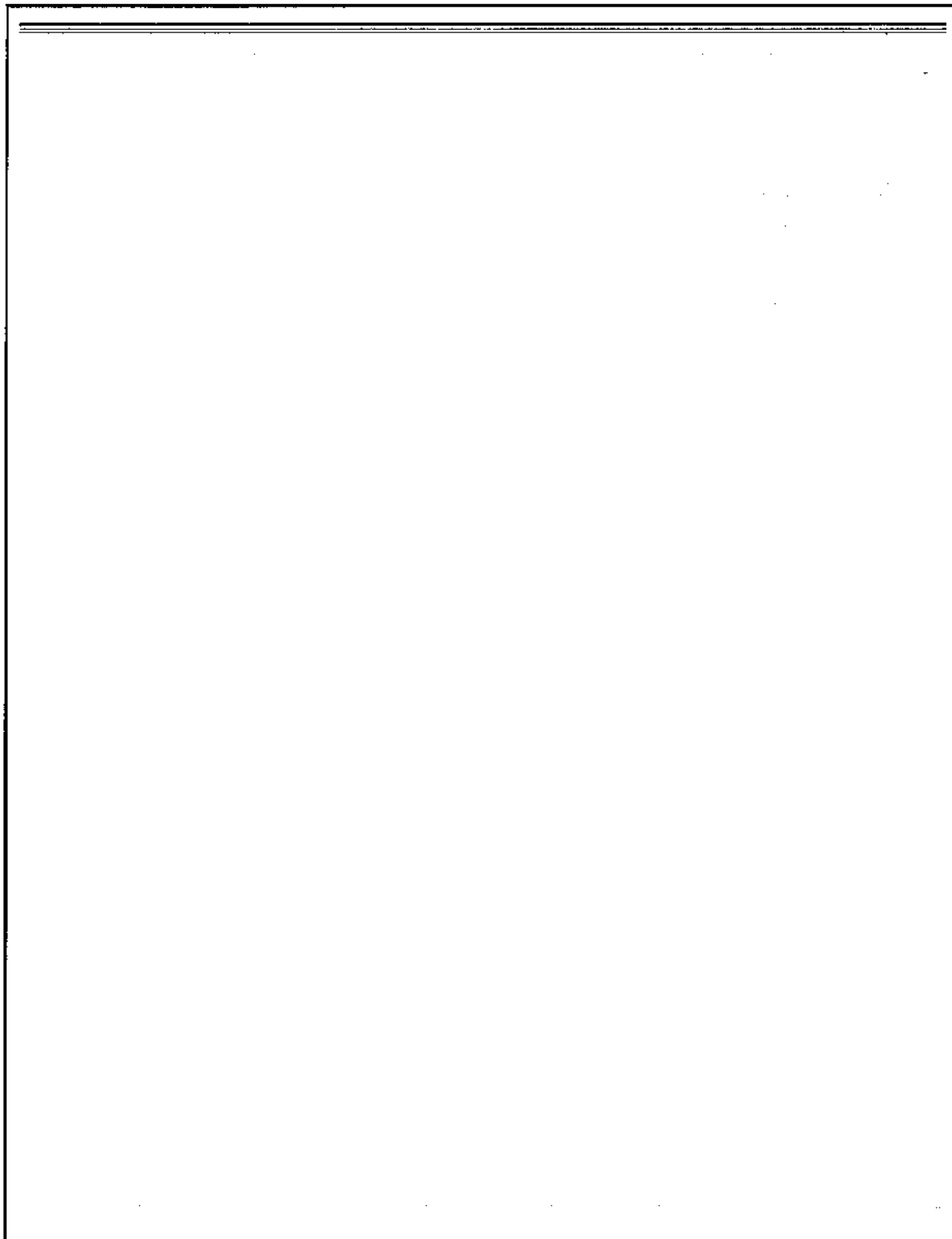
**Quality Certifications:** This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. No. 44 100 16594231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.92)
  - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)



Document Name:

Certificate of Analysis Wavelength calibration solution



## Comments

Date/Time:	September 13, 2021 5:27:56 PM
Test:	General
Comment:	Start OQ on 08 Sep 21 and found water flow fail, So repair job complete for 13 Sep 21 and OQ continue to complete.

## General

Document Name:

Instrument's Test Report

**Report Summary**

Instrument Model Agilent 5100/5110 SVDV ICP-OES  
Instrument ID G8010A/G8014A  
Instrument Serial Number MY16010005  
Software Version 7.5.3.11953  
Firmware Version 5395  
Tested By Kanyakorn S.  
Test started on 9/8/2021 9:51:21 AM  
Test Completed On 9/8/2021 9:56:35 AM

**Result Summary**

Subsystem Communications Test Pass  
Air Flow Test Skipped  
Water Flow Test Skipped  
Gas Flows Test Skipped  
RF Generator Test Skipped  
Camera Test Skipped  
Optics Test Pass  
Advanced Valve System Test Skipped  
Resolution Test Pass  
Sensitivity Test Pass  
Precision Test Pass

**Subsystem Communications Test**

Pass

**Optics Test**

Pass

	Radial	Axial	SVDV
Intensity	3082176	3162050	3419288
Wavelength	737.212	737.212	737.212

Page 1 of 5

Date:  
System ID:

September 13, 2021 5:50:41 PM  
MY16010005

Document Name:

Instrument's Test Report

Resolution Test		Pass
Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.54
As (188.980 nm)	≤ 8.20	8.43
C (193.027 nm)	≤ 11.50	8.89
Mo (202.032 nm)	≤ 8.20	8.50
Cr (206.158 nm)	≤ 13.40	11.05
Zn (213.857 nm)	≤ 8.70	7.27
Pb (220.353 nm)	≤ 9.50	7.52
Co (228.615 nm)	≤ 17.20	12.66
Ba (230.424 nm)	≤ 9.40	7.80
Mn (257.610 nm)	≤ 13.30	9.99
Mn (260.568 nm)	≤ 20.30	16.83
Cr (267.716 nm)	≤ 11.00	8.53
Cu (324.754 nm)	≤ 25.00	19.14
Cu (327.395 nm)	≤ 14.20	11.75
Sr (338.071 nm)	≤ 33.50	26.94
Ba (455.403 nm)	≤ 44.00	33.57
Sr (460.733 nm)	≤ 36.00	22.38
Ba (493.408 nm)	≤ 36.00	25.86
Ba (614.171 nm)	≤ 42.00	28.48
Ar (675.283 nm)	≤ 74.00	60.58
K (766.491 nm)	≤ 80.00	66.42

Page 2 of 5



Document Name:

Instrument's Test Report

**Sensitivity Test****Pass****Radial**

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	88.8	980.1	94.9
Se (196.026 nm)	≥ 41.0	SRBR	55.8	709.4	113.8
Zn (213.857 nm)	≥ 1421.0	SRBR	2095.3	29874.4	197.9
Pb (220.353 nm)	≥ 46.0	SRBR	100.8	1392.6	152.2
Mn (257.610 nm)	≥ 3518.0	SRBR	6641.7	127413.8	365.9
Al (396.152 nm)	≥ 3.4	SBR	6.9	24237.9	3081.8
Ba (493.408 nm)	≥ 34.0	SBR	95.1	1015416.2	10563.7
K (766.491 nm)	≥ 1.8	SBR	4.4	82043.9	15321.8

**Axial**

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	292.4	6108.5	273.5
Se (196.026 nm)	≥ 159.0	SRBR	199.9	3903.2	321.0
Zn (206.200 nm)	≥ 243.0	SRBR	793.6	12455.9	237.0
Zn (213.857 nm)	≥ 1743.0	SRBR	4924.5	130652.8	696.4
Cd (214.439 nm)	≥ 4227.0	SRBR	4508.6	87692.4	375.1
Pb (220.353 nm)	≥ 320.0	SRBR	327.3	7653.1	480.3
Mn (257.610 nm)	≥ 10625.0	SRBR	19008.6	632891.9	1104.7
Cr (267.718 nm)	≥ 1048.0	SRBR	4115.3	173899.6	1751.9
Cu (324.754 nm)	≥ 19.0	SBR	46.6	188303.3	3960.0
Al (396.152 nm)	≥ 6.0	SBR	16.7	156852.5	8877.5
Ba (493.408 nm)	≥ 60.0	SBR	168.0	5374075.7	31797.5
K (766.491 nm)	≥ 24.0	SBR	54.8	2536127.0	38564.9

**Precision Test****Pass****Radial**

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	1.08
Se (196.026 nm)	≤ 2.60	1.38
Zn (213.857 nm)	≤ 1.50	0.62
Pb (220.353 nm)	≤ 2.60	0.72
Mn (257.610 nm)	≤ 1.50	0.44

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September 13, 2021 5:50:41 PM  
MY16010005

Document Name:

Instrument's Test Report

Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.48
K (766.491 nm)	≤ 1.50	0.34

## Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.64
Se (196.026 nm)	≤ 1.50	0.58
Zn (206.200 nm)	≤ 1.50	0.29
Zn (213.857 nm)	≤ 1.50	0.38
Cd (214.439 nm)	≤ 1.50	0.30
Pb (220.353 nm)	≤ 1.50	0.47
Mn (257.610 nm)	≤ 1.50	0.78
Cr (267.716 nm)	≤ 1.50	0.30
Cu (324.754 nm)	≤ 1.50	0.45
Al (396.152 nm)	≤ 1.50	0.35
Ba (493.408 nm)	≤ 1.50	0.50
K (766.491 nm)	≤ 1.50	0.46

## Report Detail

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

SubSystem Status

Mains Power Module - Passed

Gas Control Module - Passed

RF Generator - Passed

pre-optics Module - Passed

Optics/Camera Control Module - Passed

Peristaltic Pump - Passed

Subsystem Communications Test Completed - Passed

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed

Shutter opened - Passed

Peak Intensity Radial mode 3082176.14 - Passed

Shutter closed - Passed

Peak Intensity(closed shutter) Radial mode 55.00 - Passed

Shutter opened - Passed

Optical Argon Ratio: Calculated Value = 2.56, Factory Value = 2.60

Peak Intensity Axial mode 3162050.49 - Passed

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MY16010005

Document Name:

Instrument's Test Report

Radial-Axial Intensity Ratio:(Range 0-100) - 1.03 - Passed  
Peak Intensity Simultaneous mode 3419287.63 - Passed  
Shutter closed - Passed  
Optics Test Completed - Passed

Instrument Performance- Started

Instrument Performance Completed - Passed

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## General

Document Name:

Instrument's Test Report

**Report Summary**

Instrument Model	Agilent 5100/5110 SVDV ICP-OES
Instrument ID	G8010A/G8014A
Instrument Serial Number	MY16010005
Software Version	7.5.3.11953
Firmware Version	5395
Tested By	Kanyakorn S.
Test started on	9/13/2021 5:33:48 PM
Test Completed On	9/13/2021 5:46:50 PM

**Result Summary**

Subsystem Communications Test	Pass
Air Flow Test	Pass
Water Flow Test	Pass
Gas Flows Test	Pass
RF Generator Test	Pass
Camera Test	Pass
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Skipped
Sensitivity Test	Skipped
Precision Test	Skipped

**Subsystem Communications Test**

Pass

**Air Flow Test**

Pass

30% Air Flow (relative speed)	60% Air Flow (relative speed)
11.00	16.00

**Water Flow Test**

Pass

RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.21	1.14	23.01

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System ID:

MY16010005



Document Name:

Instrument's Test Report

**Gas Flows Test** **Pass**

Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.71	276.73	2.00	2.00	108.21

Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	106.63	18.00	17.96	19.78

**RF Generator Test** **Pass**

RF Power Supply Test	Passed
RF Power Supply (V)	130.332

RF Oscillator Test	Passed
RF Oscillator Frequency (MHz)	25.917
Work Coil Current (A)	44.873
RF Power Supply Current (A)	1.996

**Camera Test** **Pass**

Black Level Test	Noise Test	Photo Response Test
Passed	Passed	Passed

**Optics Test** **Pass**

	Radial	Axial	SVDV
Intensity	2965633	3009947	3285038
Wavelength	737.212	737.212	737.212

**Report Detail**

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

**SubSystem Status**

Mains Power Module - Passed  
 Gas Control Module - Passed  
 RF Generator - Passed  
 pre-optics Module - Passed  
 Optics/Camera Control Module - Passed

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Document Name:

Instrument's Test Report

Peristaltic Pump - Passed  
 Subsystem Communications Test Completed - Passed

Air Flow- StartedFan Speed(%) Air Flow(relative speed) Status

30% 11 - Passed  
 60% 16 - Passed  
 Air Flow Completed - Passed

Water Flow- Started

RF Water Flow(L/min) = 1.21  
 Camera Water Flow (L/min) = 1.14  
 Water Inlet Temperature = 23.01  
 RF Water Flow(L/min) (off) = 0.00  
 Water Flow Completed - Passed

Gas Flows- StartedChannel Target Actual Pressure Failure Status

Auxiliary Gas 0.00 0.06 N/A N/A - Passed  
 Auxiliary Gas 2.00 2.00 N/A N/A - Passed  
 Nebulizer Gas 0.00 0.07 0.00 N/A - Passed  
 Nebulizer Gas 0.70 0.71 276.73 N/A - Passed  
 Plasma Gas 0.00 1.18 N/A N/A - Passed  
 Plasma Gas 18.00 17.96 N/A N/A - Passed  
 Makeup Gas 0.00 0.08 N/A N/A - Passed  
 Makeup Gas 2.00 2.00 N/A N/A - Passed  
 Purge Gas 0.70 0.70 N/A N/A - Passed  
 Purge Gas 3.70 3.70 N/A N/A - Passed  
 All Channel flows ON : - Passed  
 All Channel flows OFF : - Passed  
 Gas Flows Completed - Passed

RF Generator- Started

RF generator turned off - Passed  
 RF generator turned on - Passed  
 Bias Control = 0 V - Passed  
 RF Power Supply - Set Value = 150V, Actual Value = 130.33V - Passed  
 RF Oscillator Started - Passed  
 RF Oscillator Frequency(MHz) = 25.92, Workcoil Current(Amps) = 44.87, RF Power Supply  
 Current(Amps) = 2.00 - Passed  
 RF Oscillator stopped - Passed  
 RF generator turned off - Passed  
 RF Generator Completed - Passed

Camera Test- Started

Black level test - PASSED  
 Noise test - PASSED  
 Photo response test - PASSED  
 Camera Test Completed - Passed

Optics Test- StartedTest View Mode Intensities Status

LED Off - Passed

Page 3 of 4

Document Name:

Instrument's Test Report

Plasma ignite Started  
Plasma ignite - Passed  
Waiting 5 min for plasma warm up  
Shutter opened - Passed  
Peak Intensity Radial mode 2985632.60 - Passed  
Shutter closed - Passed  
Peak Intensity(closed shutter) Radial mode 55.48 - Passed  
Shutter opened - Passed  
Optical Argon Ratio: Calculated Value = 2.53, Factory Value = 2.60  
Peak Intensity Axial mode 3009947.39 - Passed  
Radial-Axial Intensity Ratio:(Range 0-100) - 1.01 - Passed  
Peak Intensity Simultaneous mode 3265038.45 - Passed  
Shutter closed - Passed  
Optics Test Completed - Passed

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## Electronic Signature

### Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

### Details

Full Name of Signer:	Kanyakorn Sukpathrajareon
Logged On User Name:	phimprapha.jeeraphong@agilent.com
Signature Creation Date:	September 13, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: phimprapha.jeeraphong  
 Hostname: ASBKKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:50:44 PM

DQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 8:49:59 AM	Audit	SessionCreated	Session	None
September 8, 2021 8:49:59 AM	Start	Configuration	Session	None
September 8, 2021 8:49:59 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
September 8, 2021 9:07:06 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended]
September 8, 2021 9:07:11 AM	End	Configuration	Session	None
September 8, 2021 9:07:15 AM	Start	Qualification	Session	OQ
September 8, 2021 9:07:15 AM	Start	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:34:35 AM	End	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:34:39 AM	Start	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:27 AM	End	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1

User Name: phimprapha.jeeraphong  
 Hostname: ASBKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:50:44 PM

QQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:51:30 AM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:36 AM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:51:38 AM	End	Qualification	Session	OQ
September 8, 2021 9:51:38 AM	Start	Reporting	Session	None
September 8, 2021 10:55:40 AM	Audit	AceClosed	Session	None
September 13, 2021 5:01:28 PM	Audit	AceRestarted	Session	None
September 13, 2021 5:01:28 PM	Audit	SessionReloaded	Session	None
September 13, 2021 5:01:28 PM	Start	Qualification	Session	OQ
September 13, 2021 5:47:55 PM	Audit	Reporting	Session	Report Generated : Certificate

User Name: phimprapha.jeeraphong  
Hostname: ASBKKWX328

System Id: MY16010005  
Print Date: September 13, 2021 5:50:44 PM

## OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 13, 2021 5:49:13 PM	Audit	Reporting	Session	Report Signed : Certificate PDF Name: OQHW 5100 ICPOES ALS 08Sep21_20210913_Certificate_1.pdf User Name: phimprapha.jeeraphong@agilent.com Full Name of Signer: Kanyakorn Sukpathrajarern Reason for signature: Executed protocol and published this original version of document
September 13, 2021 5:49:25 PM	Audit	Reporting	Session	Report Generated : Report



# 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

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## 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 N.
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

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## 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

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

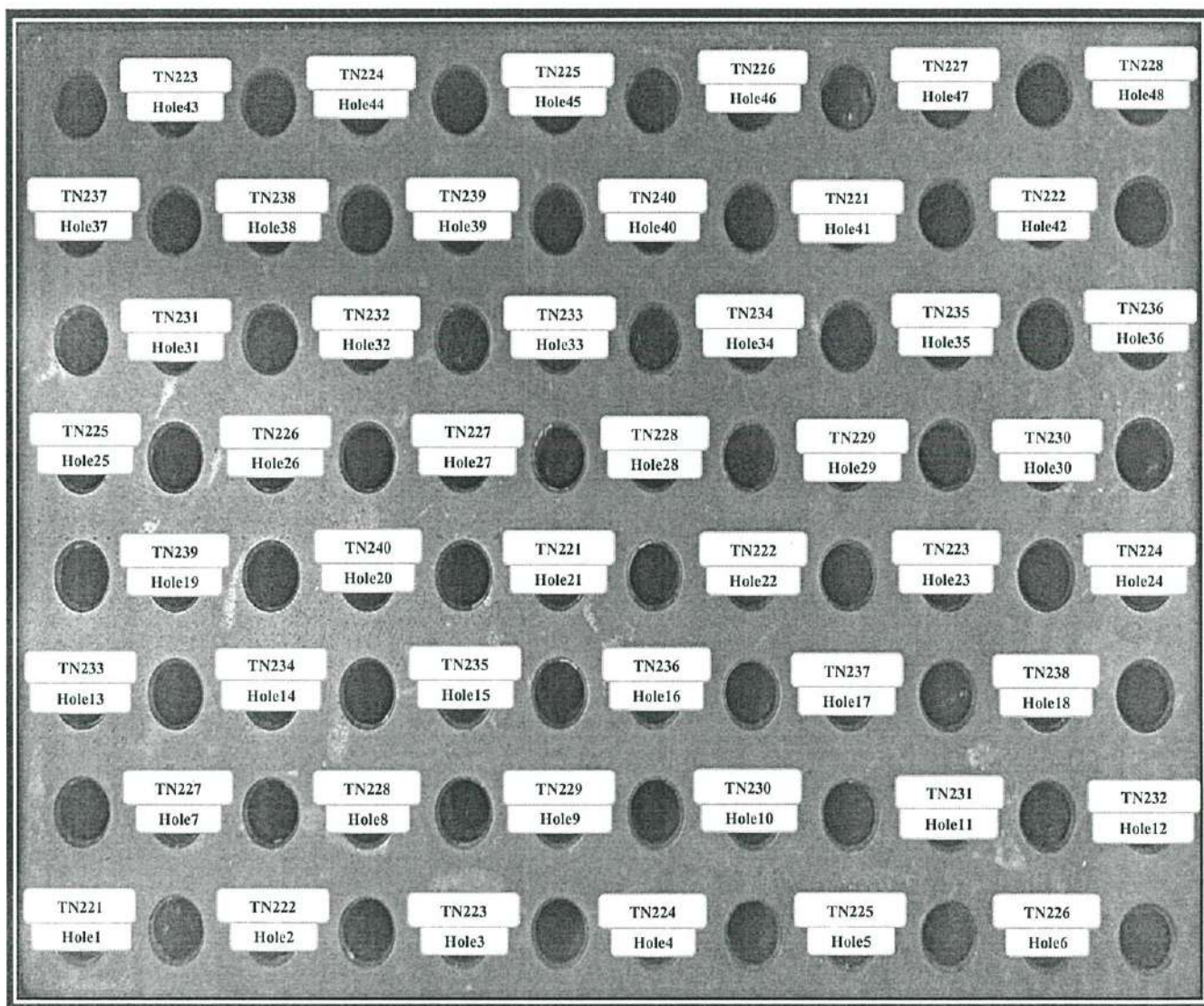
Website : [www.scieco.co.th](http://www.scieco.co.th)

E-Mail : [calibrate@scg.co.th](mailto:calibrate@scg.co.th)

Certificate No. T220730

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## Calibration Report



FRONT CONTROL

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



## Calibration Report

### Measurement Results

Calibration Point		Average Standard Reading at each position ( ° C )					
<b>R1 Hole1-Hole6</b>		<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>
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
<b>R2 Hole7-Hole12</b>		<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>	<b>TN231</b>	<b>TN232</b>
	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
<b>R3 Hole13-Hole18</b>		<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>	<b>TN237</b>	<b>TN238</b>
	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
<b>R4 Hole19-Hole24</b>		<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>
	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
<b>R5 Hole25-Hole30</b>		<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>
	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
<b>R6 Hole31-Hole36</b>		<b>TN231</b>	<b>TN232</b>	<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>
	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
<b>R7 Hole37-Hole42</b>		<b>TN237</b>	<b>TN238</b>	<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>
	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
<b>R8 Hole43-Hole48</b>		<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>
	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)					
<b>R1 Hole1-Hole6</b>		<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>
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
<b>R2 Hole7-Hole12</b>		<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>	<b>TN231</b>	<b>TN232</b>
	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
<b>R3 Hole13-Hole18</b>		<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>	<b>TN237</b>	<b>TN238</b>
	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
<b>R4 Hole19-Hole24</b>		<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>
	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
<b>R5 Hole25-Hole30</b>		<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>
	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
<b>R6 Hole31-Hole36</b>		<b>TN231</b>	<b>TN232</b>	<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>
	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
<b>R7 Hole37-Hole42</b>		<b>TN237</b>	<b>TN238</b>	<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>
	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
<b>R8 Hole43-Hole48</b>		<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>
	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

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## Calibration Report

### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability ( $\pm$ °C)	Uncertainty ( $\pm$ °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

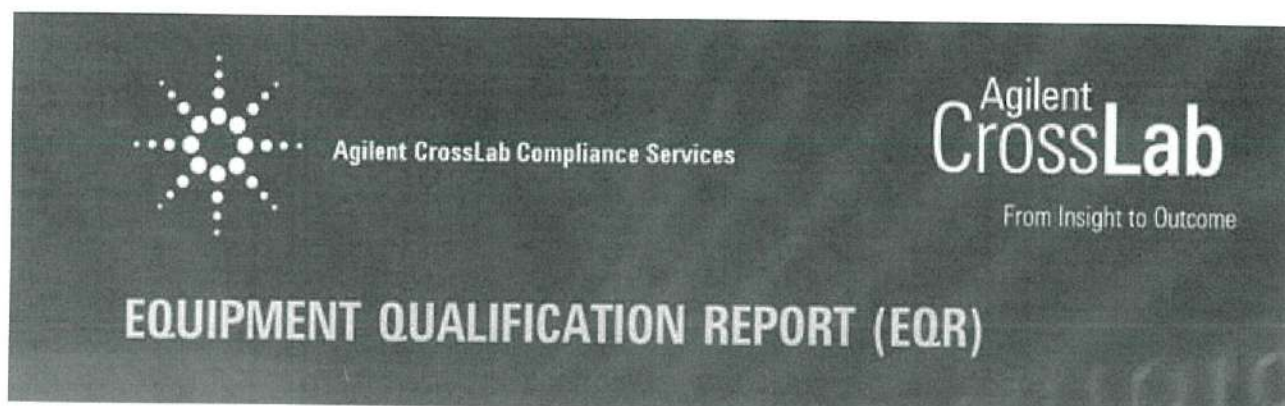
\* The quoted uncertainty exclude " uniformity "

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	0.719	AMU
Agilent Recommended:	>= 0.65	
	<= 0.80	
Status:	Pass	
Peakwidth Mass 89	0.750	AMU
Agilent Recommended:	>= 0.65	
	<= 0.80	
Status:	Pass	
Peakwidth Mass 205	0.713	AMU
Agilent Recommended:	>= 0.65	
	<= 0.80	
Status:	Pass	
Mass Axis 7	7.05	AMU
Agilent Recommended:	>= 6.9	
	<= 7.1	
Status:	Pass	
Mass Axis 89	88.95	AMU
Agilent Recommended:	>= 88.9	
	<= 89.1	
Status:	Pass	
Mass Axis 205	205.00	AMU
Agilent Recommended:	>= 204.9	
	<= 205.1	
Status:	Pass	



Mass 7 Sensitivity No Gas

94.28

Mcps/ppm

Agilent Recommended:

&gt;= 25.5

Status:

Pass

Mass 89 Sensitivity No Gas

307.15

Mcps/ppm

Agilent Recommended:

&gt;= 127.5

Status:

Pass

Mass 205 Sensitivity No Gas

203.77

Mcps/ppm

Agilent Recommended:

&gt;= 76.5

Status:

Pass

Mass 59 Sensitivity He

28.38

Mcps/ppm

Agilent Recommended:

&gt;= 23.8

Status:

Pass

Mass 89 Sensitivity H2

129.27

Mcps/ppm

Agilent Recommended:

&gt;= 68

Status:

Pass

Oxide Ratio 156/140

1.047

%

Agilent Recommended:

&lt;= 1.38

Status:

Pass

Doubly Charged Species Ratio 70/140

1.482

%

Agilent Recommended:

&lt;= 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
EQR	General	Certificate of System Qualification	18
EQR	General	Operator's training certificate and qualifications	19
EQR	General	Certificate of Qualification for ACE	20
EQR	General	Certificate of Qualification for ACE	21
EQR	General	Tune reports	22
EQR	General	Test Report	25
EQR	General	Test Report	27
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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

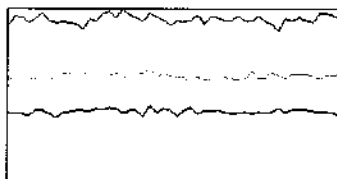
Document Name: Tune reports

## 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



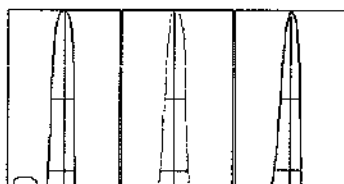
Mass	Range	Count	RSD%	Background
7	10000	9428	2.630	3.200
89	50000	30716	2.825	3.300
205	60000	20377	3.319	3.900

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:

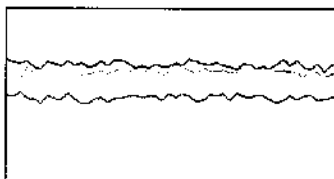
Tune reports

## Tune Report

H2 Flow	0.0 mL/min	OctP RF	190 V		
<b>QP Parameters</b>					
Mass Gain	124	Axis Gain	0.9990	QP Bias	-3.0 V
Mass Offset	125	Axis Offset	0.01		
<b>Hardware Settings</b>					
<b>Torch</b>					
Torch H	-0.3 mm	Torch V	0.1 mm		
<b>EM</b>					
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

<b>Torch</b>					
Torch H	-0.3 mm	Torch V	0.1 mm		

2 of 3

2021-09-30 2:44 PM

Date: September 30, 2021 4:07:18 PM  
System ID: JP15471169



Document Name:

Tune reports

## Tune Report

## EM

Discriminator

4.0 mV

Analog HV

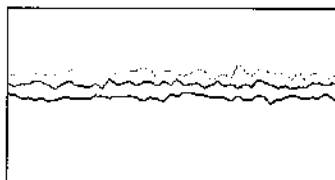
2247 V

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

## 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

	Ret	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

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

### Details

Full Name of Signer:	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

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

### Warranty

Agilent Technologies makes no warranty of any kind to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.



User Name: panthep\_kurasathain  
 Hostname: ASBKKWX315

System Id: JP15471169  
 Print Date: September 30, 2021 4:07:22 PM

ALS CQHW 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	QQ
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	Charatt L.
APPROVED BY	Saunter N.
NEXT CAL. DATE	7/06/2022

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# Maintenance Protocol

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Atomic Fluorescence Spectrometer  
**mercur / mercur plus**

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### 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.: 701 737 (AS52S)

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 checked="" 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"/>
<b>Check gasflow</b>			
	Valve 1	10 NI/h	0.2284 L/min.
	Valve 2	50 NI/h	1.1862 L/min
	Valve 3	5 NI/h	0.1451 L/min
	Valve 4	10 NI/h	0.2284 L/min.
<b>Check liquidflow</b>			
	Acid	2,5ml/min ± 1 ml	2.5 ml
	Red.-agent	2,5ml/min ± 1 ml	2.5 ml
	Sample	10ml/min ± 2 ml	10.0 ml.
<b>Adventitious light - values</b>	<b>(V)</b>	<b>from file</b>	
	100	0	0
	200	0	0
	300	0	0
	350	0	0
	400	1	1
	450	3	2
	500	7	6
	550	15	13
	575	21	19
	600	30	27.

Device parameter	nominal value	actual value
<b>Analytical parameters</b>		
Conditions.: max.conc.: 10µg/L PMT-voltage: <u>414</u> V		
Blank-solution		F <u>0.00083</u>
without enrichment / FBR 30 ng/L	F > 0,0013 RSD < 3 %	F <sub>1</sub> <u>0.00377</u> RSD <u>1.51</u> %
Conditions.: max.conc.: 1,7µg/L PMT-voltage: <u>395</u> V		
Blank-solution		F <u>0.00299</u>
with enrichment / FBR 30 ng/L	F > 0,009 RSD < 3 %	F <sub>2</sub> <u>0.0297</u> RSD <u>0.232</u> %
Fok.- factor ( F <sub>2</sub> / F <sub>1</sub> )	> 4	
<b>Comments</b>		
<u>Reference Material Control.</u>		
<u>Mercury Calibration Std. Part #: 8500-6941</u>		
<u>Lot #: 12-20 HGY2A.</u>		

Srichai Pakorn.  
Signature Technician

7/6/2021.

Place, Date (DD/MM/YYYY)

Patchareeya H.  
Signature Customer

7/6/2021

Place, Date (DD/MM/YYYY)



ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

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ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙



กรมโรงงานอุตสาหกรรม  
ถนนพระรามที่ ๖ เขตราชเทวี  
กรุงเทพมหานคร ๑๐๔๐๐

๒๘ 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 น้ำใต้ดิน  
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

(นายศิริ จันทรจิตร)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน

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) นางสาวชนันย์ โกมารกุล 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 ชูณหะวัณ

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)/ ๑๐๖๙

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 รักษง	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

(นายศิริะ จันทร์เจ็ด)

๓๕) นางสาวปรางค์ทิพย์...

มหาวิทยาลัยราชภัฏวชิรเวศน์ วิทยาลัยการแพทย์

ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน

วิทยาลัยการแพทย์และสาธารณสุขศาสตร์



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 วิริยะสทกิจ	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 โภคาพิพัฒน์	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 ทังสร้างแป้น	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๖
๕๙) นายธีรวัฒน์ ปวงสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๗
๖๐) นายอิทธิพล ยะโส	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๘
๖๑) นายประพนธ์ วรรณชูชัย	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

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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 ปัตตะมะ	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) นายชวัลรัช 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) นางสาวชญานิษฐ์ พรหมจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๒
๑๐๑) นายเกียรติ ทวีราช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๓
๑๐๒) นายจักริน หนัสนิชา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๔
๑๐๓) นายฉัตรชัย สุขเปี้ย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๕
๑๐๔) นายณรนนท์ ต๊ะทองคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๖
๑๐๕) นายตุลพล สมนอก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๗
๑๐๖) นายทักษ์ดนัย อุบลศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๘
๑๐๗) นายธนศร นามะภูณนา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๔๙
๑๐๘) นายธิตีพงศ์ บัวแดง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๕๐

(นายธีระ จันทร์เฑียร)

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 วิสุม	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๖
๑๒๒) นายณัฐดนัย เจือละออง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๗
๑๒๓) นายวรวิธ ดินัก	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๘
๑๒๔) นายแสงตะวัน นະตะສັດ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๙
๑๒๕) นายยุทธพงศ์ รัตนะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๐
๑๒๖) นายชัยณวุฒิ ไชยชนะนิจ	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-๙๒๑๙
๑๓๑) นางสาวประภาภรณ์ บุตรพรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๐
๑๓๒) นางสาวนิลาวัลย์ นามพรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๑
๑๓๓) นางสาวพัชรินทร์ แสนสร้อย	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๒
๑๓๔) นายไพโรจน์ เปี่ยมพิมาย	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๓
๑๓๕) นางสาวศุภมาศ ทองมาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๔
๑๓๖) นางสาวลลิตา จิตรสว่าง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๕
๑๓๗) นางสาวชไมพร เสิกภูเขียว	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๖
๑๓๘) นางสาวกฤติมาพร คำมีแก่น	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๗
๑๓๙) นางสาวสกุลรัตน์ ภาควุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๘
๑๔๐) นางสาวกาญจนา คงคุณ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๙
๑๔๑) นางสาวไพรินทร์ ศรีรูปี	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๐
๑๔๒) นางสาวทิพนันทร ฝูยปัญญา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๑
๑๔๓) นางสาวสาธิตา ปานทอง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๒
๑๔๔) นางสาวอริสา ทองนวล	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๓
๑๔๕) นางสาวอรยา คำคล่อง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๔

(นายศิระ จันทร์เจิด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน

ผู้อำนวยการกองวิจัยและพัฒนากยผลพืชโรงงาน

๑๔๖) นางสาวชุตติภรณ์...

๑๔๖) นางสาวชุตากรณ์ สุนทรสนาน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๕
๑๔๗) นางสาวสุตารัตน์ นนท์ประสาท	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

ปฏิบัติการงานทอผ้าไหมโรงงานอุตสาหกรรม



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 <sup>[4]</sup>
2	Aldicarb Sulfone	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
3	Aldicarb Sulfoxide	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
4	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
5	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
6	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
7	$\alpha$ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
8	$\beta$ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
9	$\delta$ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
10	$\gamma$ -BHC	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
11	Biochemical Oxygen Demand	1) 5-Day BOD Test, Azide Modification Method <sup>[4]</sup> 2) 5-Day BOD Test, Membrane Electrode Method <sup>[4]</sup>
12	Carbaryl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
13	Carbofuran	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
14	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
15	Chemical Oxygen Demand	1) Closed Reflux, Colorimetric Method <sup>[4]</sup> 2) Closed Reflux, Titrimetric Method <sup>[4]</sup>
16	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
17	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[4]</sup>
18	Color	ADMI Weighted-Ordinate Spectrophotometric Method



(นางริกาญจน์ จิตรสกุลไชย)

ผู้อำนวยการกลุ่มมาตรฐานวิชาการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ

19 Copper...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
19	Copper	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
20	Cyanide	Distillation, Colorimetric Method <sup>[4]</sup>
21	2,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
22	4,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
23	2,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
24	4,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
25	2,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
26	4,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
27	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
28	Endosulfan Sulfate	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
29	Endosulfan I	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
30	Endosulfan II	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
31	Endrin	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
32	Endrin Aldehyde	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
33	Formaldehyde	Distillation, Colorimetric Method <sup>[3]</sup>
34	Free Chlorine	1) DPD Ferrous Titrimetric Method <sup>[4]</sup> 2) Iodometric Method <sup>[4]</sup>
35	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
36	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
37	Hexavalent Chromium	Filtration, Colorimetric Method <sup>[4]</sup>
38	3-Hydroxycarbofuran	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
39	Lead	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
40	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
41	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass spectrometric Method <sup>[4]</sup>
42	Methiocarb	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
43	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>

วิมล

44 Methomyl...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
44	Methomyl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
45	Nickel	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
46	Oil & Grease	1) Liquid-Liquid, Partition-Gravimetric Method <sup>[4]</sup> 2) Soxhlet Extraction Method <sup>[4]</sup>
47	Oxamyl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
48	Propoxur	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
49	pH	Electrometric Method <sup>[4]</sup>
50	Phenols	1) Distillation, Chloroform Extraction Method <sup>[4]</sup> 2) Distillation, Direct Photometric Method <sup>[4]</sup>
51	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
52	Sulfide	Iodometric Method <sup>[4]</sup>
53	Temperature	Laboratory and Field Methods <sup>[4]</sup>
54	Total Dissolved Solids	Dried at 180 °C <sup>[4]</sup>
55	Total Kjeldahl Nitrogen	Semi-Micro Kjeldahl Method <sup>[4]</sup>
56	Total Suspended Solids	Dried at 103-105 °C <sup>[4]</sup>
57	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[4]</sup>
58	Trivalent Chromium	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation <sup>[4]</sup>
59	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[4]</sup>

น้ำใต้ดิน จำนวน 126 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

วิภา

3 Aldrin...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ  
และทะเบียนห้องปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
3	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
4	Anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
5	Antimony	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
7	Atrazine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
8	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
9	Benz(a)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
11	Benzo(b)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
12	Benzo(k)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
13	Benzoic Acid	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
14	Benzo(a)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
15	Benzo[g,h,i]perylene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
17	Bis(2-chloroethyl)ether	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

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 <sup>[4]</sup>
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
21	Butanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup> Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
22	Butyl Benzyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
24	Carbazole	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
27	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
28	p-Chloroaniline	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
32	2-Chlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
33	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>



34 Chromium (III)...

(นางวิภาดาญจน์ นิตกรกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation <sup>[4]</sup>
35	Chromium (VI)	Colorimetric Method <sup>[4]</sup>
36	Chrysene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
37	Cyanide	Distillation, Colorimetric Method <sup>[4]</sup>
38	2,4-D	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
39	DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
40	DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
41	DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
42	Dibenz(a,h)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
43	Di-n-Butyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
47	3,3-Dichlorobenzidine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

วิมล

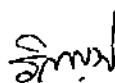
(นางริกาญจน์ ฉัตรสกุลโล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กองควบคุมและปฏิบัติการ

51 cis-1,2-Dichloroethylene...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
53	2,4-Dichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
57	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
58	Diethyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
59	2,4-Dimethylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
60	2,4-Dinitrophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
61	2,4-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
62	2,6-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
63	Di-n-Octyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
64	Endosulfan	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
65	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
67	Fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>



(นางริกาญจน์ นัตถกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิชาการวิเคราะห์ทดสอบมลพิษ  
และทะเบียนห้องปฏิบัติการ

68 Fluorene...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
68	Fluorene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
69	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
70	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
71	Hexachlorobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
73	n-Hexane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
74	$\alpha$ -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
75	$\beta$ -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
76	$\gamma$ -HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
77	Hexachlorocyclopentadiene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
78	Hexachloroethane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
79	Indeno(1,2,3-cd)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
80	Isophorone	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
81	Lead	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
82	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
83	Mercury	1) Cold Vapor Atomic Absorption Spectrometric Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>

วิมล

84 Methanol...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กรมส่งเสริมการค้าระหว่างประเทศ



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup> 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
89	2-Methylnaphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
91	Naphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
92	Nickel	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
95	N-Nitrosodi-n-Propylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
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 <sup>[4]</sup>

วิมล

97 Pentachlorophenol...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
98	pH	Electrometric Method <sup>[4]</sup>
99	Phenanthrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
100	Phenol	1) Distillation, Direct Photometric Method <sup>[4]</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
101	Pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
102	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
103	Silver	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
104	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
105	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
106	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
107	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
108	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
109	TPH (C <sub>5</sub> -C <sub>8</sub> )	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[13,24]</sup>
110	TPH (C <sub>8</sub> -C <sub>16</sub> )	Solvent Extraction, Gas Chromatographic Method <sup>[9,21]</sup>
111	TPH (C <sub>16</sub> -C <sub>35</sub> )	Solvent Extraction, Gas Chromatographic Method <sup>[9,21]</sup>
112	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
113	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

วิมล

114 1,1,2-Trichloroethane...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
114	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
115	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
116	2,4,5-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
117	2,4,6-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
118	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
119	Vanadium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
120	Vinyl Acetate	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
121	Vinyl Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
122	m-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
123	o-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
124	p-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
125	Xylene (Total)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
126	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>

**อากาศเสีย (ปล่อยระบาย) จำนวน 16 รายการ**

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Antimony	Isokinetic, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
2	Arsenic	Isokinetic, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>

*วิมล*

3 Carbon Monoxide...

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ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กรมควบคุมมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
3	Carbon Monoxide	1) Sampling Bag Non-Dispersive Infrared Method <sup>[5]</sup> 2) Non-Dispersive Infrared Method <sup>[5]</sup> 3) Instrumental Analyzer Method <sup>[5]</sup>
4	Chlorine	1) Absorption Sampling, Ion Chromatographic Method <sup>[5]</sup> 2) Isokinetic Sampling, Ion Chromatographic Method <sup>[5]</sup>
5	Copper	Isokinetic, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
6	Dioxins	Isokinetic Sampling, Analysis by ISO/IEC 17025 Accredited Laboratory or Analysis by Department of Industrial Works Registered Laboratory (Dioxins/Furans Analysis Approved) <sup>[5]</sup>
7	Hydrogen Chloride	1) Absorption Sampling, Ion Chromatographic Method <sup>[5]</sup> 2) Isokinetic Sampling, Ion Chromatographic Method <sup>[5]</sup>
8	Hydrogen Sulfide	Absorption Sampling, Iodometric Method <sup>[5]</sup>
9	Lead	Isokinetic, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
10	Mercury	1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[5]</sup> 2) Isokinetic, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
11	Opacity	Ringelmann's Method <sup>[2]</sup>
12	Oxides of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method <sup>[5]</sup> 2) Chemiluminescence Method <sup>[5]</sup> 3) Instrumental Analyzer Method <sup>[5]</sup>
13	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Method <sup>[5]</sup> 2) UV Fluorescence Method <sup>[5]</sup> 3) Instrumental Analyzer Method <sup>[5]</sup>
14	Sulfuric Acid	Isokinetic Sampling, Barium-Thorin Titrimetric Method <sup>[5]</sup>
15	Total Suspended Particulate	Isokinetic Sampling, Gravimetric Method <sup>[5]</sup>
16	Xylene	Adsorption Sampling, Gas Chromatographic Method <sup>[5]</sup>

วิมล

สิ่งปลูก...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

...

สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน 35 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
2	Antimony	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
3	Arsenic	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>

วิมล

6 Cadmium...

(นางริกาญจน์ ดัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และทะเบียนห้องปฏิบัติการ



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
6	Cadmium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
7	Chlordane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,19,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
8	Chromium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
9	Chromium (III)	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method <sup>[1,6,15,17]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method <sup>[1,6,16,17]</sup> 3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,15,17]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8, 16,17]</sup>
10	Chromium (VI)	1) Waste Extraction, Colorimetric Method <sup>[1,6,17]</sup> 2) Alkaline Digestion, Colorimetric Method <sup>[8,17]</sup>



(นางริกาญจน์ ฉัตรสกุลวิไล)

11 Cobalt...

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

.....แผนกปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
11	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
12	Copper	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
13	2,4-D	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
14	DDD	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
15	DDE	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
16	DDT	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup>

จิรพร

2) Soxhlet...

(นางริภาณูจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

และคณะผู้รับผิดชอบปฏิบัติการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
17	Dieldrin	2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup>
18	Endrin	2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup>
19	Heptachlor	2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup>
20	Lead	2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup> 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
21	Lindane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
22	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[1,6,18]</sup>

วิมล

2) Waste Extraction...

(นางริกาญจน์ ฉัตรสกุลวิไล)

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ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
23	Methoxychlor	2) Waste Extraction, Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method <sup>[1,6,19]</sup> 3) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[1,6,20]</sup> 4) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[18]</sup> 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method <sup>[19]</sup> 6) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[20]</sup>
24	Mirex	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
25	Molybdenum	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
26	Nickel	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>

วิภาดา

27 Polychlorinated...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิชาการวิเคราะห์ทดสอบมลพิษ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
27	<p>Polychlorinated biphenyls (PCBs)</p> <ul style="list-style-type: none"> <li>- Aroclor 1016</li> <li>- Aroclor 1221</li> <li>- Aroclor 1232</li> <li>- Aroclor 1242</li> <li>- Aroclor 1248</li> <li>- Aroclor 1254</li> <li>- Aroclor 1260</li> <li>- 2-Chlorobiphenyl</li> <li>- 2,3-Dichlorobiphenyl</li> <li>- 2,2',5-Trichlorobiphenyl</li> <li>- 2,4',5-Trichlorobiphenyl</li> <li>- 2,2',3,5'-Tetrachlorobiphenyl</li> <li>- 2,2',5,5'-Tetrachlorobiphenyl</li> <li>- 2,3',4,4'-Tetrachlorobiphenyl</li> <li>- 2,2',3,4,5'-Pentachlorobiphenyl</li> <li>- 2,2',4,5,5'-Pentachlorobiphenyl</li> <li>- 2,3,3',4',6-Pentachlorobiphenyl</li> <li>- 2,2',3,4,4',5'-Hexachlorobiphenyl</li> <li>- 2,2',3,4,5,5'-Hexachlorobiphenyl</li> <li>- 2,2',3,5,5',6-Hexachlorobiphenyl</li> <li>- 2,2',4,4',5,5'-Hexachlorobiphenyl</li> <li>- 2,2',3,3',4,4',5-Heptachlorobiphenyl</li> <li>- 2,2',3,4,4',5,5'-Heptachlorobiphenyl</li> <li>- 2,2',3,4,4',5',6-Heptachlorobiphenyl</li> <li>- 2,2',3,4',5,5',6-Heptachlorobiphenyl</li> <li>- 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl</li> </ul>	<p>1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method<sup>[1,9,23]</sup></p> <p>2) Soxhlet Extraction, Gas Chromatographic Method<sup>[10,23]</sup></p> <p>3) Automated Soxhlet Extraction, Gas Chromatographic Method<sup>[22,31]</sup></p>



(นางริกาญจน์ จิตรสกุลไชย)

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28 Pentachlorophenol...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
28	Pentachlorophenol	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
29	pH	Electrometric Method <sup>[29,30]</sup>
30	Selenium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
31	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup>
32	Thallium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
33	Toxaphene	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,25]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
34	Vanadium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup>

Signature

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์หกลมลพิษ

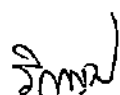
4) Digestion...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
35	Zinc	4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup> 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,15]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,16]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>

ดิน จำนวน 125 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
3	Aldrin	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
4	Anthracene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
5	Antimony	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
7	Atrazine	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
8	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
9	Benz(a)anthracene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
11	Benzo(b)fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
12	Benzo(k)fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
13	Benzoic acid	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
14	Benzo(a)pyrene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
15	Benzo(g,h,i)perylene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
17	Bis(2-chloroethyl)ether	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
18	Bis(2-ethylhexyl)phthalate	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
21	Butanol	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[12,24]</sup>
22	Butyl Benzyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
24	Carbazole	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>



(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

26 Carbon tetrachloride...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
27	Chlordane	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
28	p-Chloroaniline	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
32	2-Chlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
33	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,15,17]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,16,17]</sup>
35	Chromium (VI)	Alkaline Digestion, Colorimetric Method <sup>[8,17]</sup>
36	Chrysene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
37	Cyanide	Extraction, Distillation, Colorimetric Method <sup>[26,27,28]</sup>
38	2,4-D	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
39	DDD	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>

วิฑูรย์

(นางริกาญจน์ จิตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

40 DDE...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
40	DDE	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
41	DDT	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
42	Dibenz(a,h)anthracene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
43	Di-n-Butyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
47	3,3-Dichlorobenzidine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
53	2,4-Dichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>

วิมล

(นางริกาญจน์ อัครสกุลใจ)

57 Dieldrin...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
57	Dieldrin	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
58	Diethyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
59	2,4-Dimethylphenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
60	2,4-Dinitrophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
61	2,4-Dinitrotoluene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
62	2,6-Dinitrotoluene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
63	Di-n-Octyl Phthalate	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
64	Endosulfan	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
65	Endrin	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
67	Fluoranthene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
68	Fluorene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
69	Heptachlor	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
70	Heptachlor Epoxide	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
71	Hexachlorobenzene	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
73	n-Hexane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
74	$\alpha$ -HCH	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
75	$\beta$ -HCH	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
76	$\gamma$ -HCH	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
77	Hexachlorocyclopentadiene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
78	Hexachloroethane	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
79	Indeno(1,2,3-cd)pyrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
80	Isophorone	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
81	Lead	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
82	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
83	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[18]</sup>

วิมล

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กองควบคุมมลพิษ

2) Thermal...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry <sup>[19]</sup> 3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[20]</sup> Equilibrium Headspace, Gas Chromatographic/Mass Spectrometric Method <sup>[12,24]</sup>
85	Methoxychlor	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
88	2-methylphenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
89	2-Methylnaphthalene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[14,24]</sup>
91	Naphthalene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
92	Nickel	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,16]</sup>
93	Nitrobenzene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
94	N-Nitrosodiphenylamine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
95	N-Nitrosodi-n-propylamine	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
96	Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,23]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[23,32]</sup>

วิฑูรย์

(นางวิภาณูจน์ ฉัตรสกุลวิไล)

- Aroclor 1242...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
	<ul style="list-style-type: none"> <li>- Aroclor 1242</li> <li>- Aroclor 1248</li> <li>- Aroclor 1254</li> <li>- Aroclor 1260</li> <li>- 2-Chlorobiphenyl</li> <li>- 2,2',3,5'-Tetrachlorobiphenyl</li> <li>- 2,2',5,5'-Tetrachlorobiphenyl</li> <li>- 2,3',4,4'-Tetrachlorobiphenyl</li> <li>- 2,2',3,4,5'-Pentachlorobiphenyl</li> <li>- 2,2',4,5,5'-Pentachlorobiphenyl</li> <li>- 2,3,3',4',6-Pentachlorobiphenyl</li> <li>- 2,2',3,4,4',5'-Hexachlorobiphenyl</li> <li>- 2,2',3,4,5,5'-Hexachlorobiphenyl</li> <li>- 2,2',3,5,5',6-Hexachlorobiphenyl</li> <li>- 2,2',4,4',5,5'-Hexachlorobiphenyl</li> <li>- 2,2',3,3',4,4',5'-Heptachlorobiphenyl</li> <li>- 2,2',3,4,4',5,5'-Heptachlorobiphenyl</li> <li>- 2,2',3,4,4',5',6-Heptachlorobiphenyl</li> <li>- 2,2',3,4',5,5',6-Heptachlorobiphenyl</li> <li>- 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl</li> </ul>	
97	Pentachlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
98	Phenanthrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
99	Phenol	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>
100	Pyrene	Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[25,31]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
101	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
102	Silver	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
103	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
106	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
107	Toxaphene	1) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,22]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
108	TPH (C <sub>5</sub> -C <sub>6</sub> )	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
109	TPH (C <sub>8</sub> - C <sub>16</sub> )	1) Solvent Extraction, Gas Chromatographic Method <sup>[11,21]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[21,31]</sup>
110	TPH (C <sub>16</sub> - C <sub>35</sub> )	1) Solvent Extraction, Gas Chromatographic Method <sup>[11,21]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[21,31]</sup>
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
115	2,4,5-Trichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>

วิมล

116 2,4,6-Trichlorophenol...

(นางวิภาดาญ์ ฉัตรสกุลวิไล)

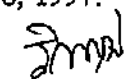
ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
116	2,4,6-Trichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[25,31]</sup>
117	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
118	Vanadium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>
119	Vinyl Acetate	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
120	Vinyl Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
121	m-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
122	o-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
123	p-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
124	Xylene (Total)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[14,24]</sup>
125	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[7,15]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,16]</sup>

#### เอกสารอ้างอิง

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