ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0181	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0173	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0272	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0551	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0453	1-Jul-23	1-Jan-24	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0544	21-Jul-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0531	19-Jul-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0530	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0167	9-Dec-22	9-Jun-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0916	10-Dec-22	9-Jun-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0650	20-Jun-23	20-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0369	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0087	19-Jan-23	19-Jul-24	18
Ambient	1,4-dichlorobenzene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Acetaldehyde	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Benzene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	n-Hexane	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Propylene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Toluene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Propylene Oxide	Field Rotameter	BKK_FS1006	3-Jul-23	3-Oct-23	3
Ambient	Propylene Oxide	Field Rotameter	RYG_FS0199	3-Jul-23	3-Oct-23	3
Ambient	Propylene Oxide	Field Rotameter	BKK_FS1006	2-Oct-23	2-Jan-24	3
Ambient	Propylene Oxide	GC-FID	BKK_EN0126	21-Apr-23	21-Oct-24	18
Ambient	Hydrogen Peroxide	Field Rotameter	BKK_FS1040	3-Jul-23	3-Oct-23	3
Ambient	Hydrogen Peroxide	Field Rotameter	RYG_FS0198	3-Jul-23	3-Oct-23	3
Ambient	Hydrogen Peroxide	Field Rotameter	RYG_FS0197	3-Jul-23	3-Oct-23	3
Ambient	Hydrogen Peroxide	Field Rotameter	BKK_FS1040	2-Oct-23	2-Jan-24	3
Ambient	Hydrogen Peroxide	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, S	-	-	-	-
Stack (CEMs)	Oxygen	Analyzer , System calibration, S	-	-	-	-
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0468	13-Jul-23	13-Jan-24	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0465	23-Jan-23	23-Jan-24	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	1-Mar-23	1-Mar-24	12
Workplace	Propylene Oxide	Field Rotameter	RYG_FS0199	1-Jul-23	1-Oct-23	3
Workplace	Propylene Oxide	Field Rotameter	RYG_FS0199	2-Oct-23	2-Jan-24	3
Workplace	Propylene Oxide	GC-FID	BKK_EN0126	21-Apr-23	21-Oct-24	18
Workplace	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jan-23	25-Jan-24	12
Workplace	Total Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jan-23	25-Jan-24	12
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0437	7-Sep-22	7-Sep-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0616	12-Oct-22	12-Oct-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0434	25-Jan-23	25-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0433	25-Jan-23	25-Jan-24	12

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0493	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0494	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0495	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0303	10-Aug-23	10-Aug-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0302	10-Aug-23	10-Aug-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0304	1-Sep-23	1-Sep-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0218	14-Feb-23	14-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0218	14-Feb-23	14-Feb-24	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	27-Feb-25	27-Feb-26	12
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0052	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	29-May-23	29-Nov-24	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0064	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0063	20-Oct-22	20-Apr-24	18
Rayong Lab	Temperature	pH meter	RYG_FS0574	3-Apr-23	3-Apr-24	12
Rayong Lab	Temperature	pH meter	RYG_FS0425	8-Jun-23	8-Jun-24	12
Rayong Lab	Color (at Chemal pH)	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Water Lab	Methanol	Gas Chromatography	BKK_EN0041	26-Jun-23	26-Dec-24	18
Water Lab	Silver	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Silver	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Silver	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Barium	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Barium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Lead	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Chromium	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Chromium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Nickel	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Arsenic	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Arsenic	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Selenium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Cadmium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	DUO-CVAFS / CVAAS	BKK_EL0023	24-May-23	24-May-24	12
Water Lab	Propylene Oxide	Gas Chromatography (FID)	BKK_EN0126	21-Apr-23	21-Oct-24	18

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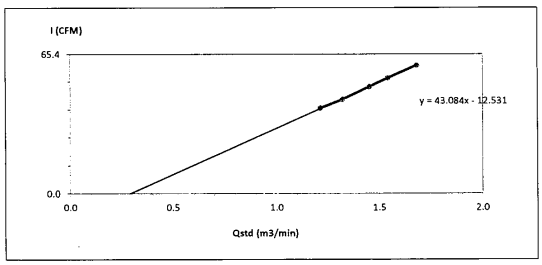
รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Copper	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Copper	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Zinc	ICP-MS	BKK_EL0026	12-Jun-23	11-Jun-24	12
Water Lab	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Propylene Oxide	Gas Chromatography (FID)	BKK_EN0126	29-Apr-20	28-Oct-21	18
Soil	Copper	ICP-OES	BKK_EL0037	2-Mar-21	2-Mar-22	12
Soil	Copper	Hot Block	BKK_EL0054	17-Nov-20	16-May-22	18
Soil	Copper	Chamber (Cold Room)	BKK_EN0167	16-May-21	16-Nov-22	18
Soil	Zinc	ICP-OES	BKK_EL0037	2-Mar-21	2-Mar-22	12
Soil	Zinc	Hot Block	BKK_EL0054	17-Nov-20	16-May-22	18
Soil	Zinc	Chamber (Cold Room)	BKK_EN0167	16-May-21	16-Nov-22	18

High Volume Air Sampler Calibration Worksheet

Project Site :	Dow Chemical Thailand Ltd.	**Barometric Pressure (mm Hg) :**	756
Calibrate Location :	ชุมชนชากลูกหญ้า	**Temperature (°C) :**	31
Calibrate Date :	9-Aug-23	**High Volume ID :**	RYG_FS0174
CalibrationSheet No.:	C-090823-RYG_FS0174	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0206	**High Volume S/N :**	4800
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.47433
Calibrator S/N :	1543	**Calibrator Intercept :**	-0.01503

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	3.2	1.2132	40	Slope :	43.0838
2	3.8	1.3207	44	Intercept :	-12.5306
3	4.6	1.4515	50	Correlation Coefficient :	0.9996
4	5.2	1.5423	54		
5	6.2	1.6828	60		



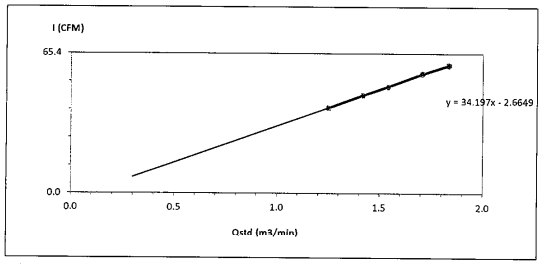
Calibrated by Mongkon Ph.
(Mr. Mongkon Phalathip)
Field Scientist(1)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	Dow Chemical Thailand Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	ชุมชนพญน	Temperature (°C) :	31
Calibrate Date :	9-Aug-23	High Volume ID :	RYG_FS0181
CalibrationSheet No.:	C-090823-RYG_FS0181	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	5334
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	3.4	1.2500	40	Slope : 34.1967
2	4.4	1.4200	46	Intercept : -2.6649
3	5.2	1.5423	50	Correlation Coefficient : 0.9998
4	6.4	1.7094	56	
5	7.4	1.8370	60	



Calibrated by Mongkon Ph.
(Mr. Mongkon Phalathip)
Field Scientist(1)

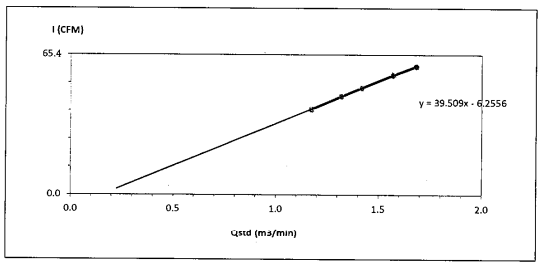
Approved by :
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Dow Chemical Thailand Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	ชุมชนมาบชลูด	Temperature (°C) :	31
Calibrate Date :	9-Aug-23	High Volume ID :	RYG_FS0173
CalibrationSheet No.:	C-090823-RYG_FS0173	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	4799
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1751	40	Slope : 39.5092
2	3.8	1.3207	46	Intercept : -6.2556
3	4.4	1.4200	50	Correlation Coefficient : 0.9997
4	5.4	1.5714	56	
5	6.2	1.6828	60	



Calibrated by Mongkon Ph.
(Mr. Mongkon Phalathip)
Field Scientist(1)

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

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

RYG_EN0001

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025
CALIBRATION 0426

SARTORIUS

REVIEW BY
APPROVED BY
NEXT CAL. DATE 01/03/24

Certificate of Calibration

Model Number :	LA130S-F	Certificate No. :	23BCI0110
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	25409664	Reference No. :	204833
ID No. :	RYG_EN0001		
Manufacturer :	Sartorius	Page No. :	1 0f 2

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

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

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 2023

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

Metrological data :
Capacity : 150 g Readability : 0.0001 g

Ambients Conditions:
Temperature : 24.2 °C ± 5.0 °C
Humidity : 60.0 % RH ± 10.0 % RH
Pressure ±

Reasons for calibration
☐ New Installation ☐ Service / Repaired ☑ Re-calibration/ Maintenance

Equipment Condition: ☑ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Cetificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 500mg E2 YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

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

Mr.chonchai Inthana(Technical Manager)

SARTORIUS ISO/IEC 17025 CERT

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	LA130S-F	Certificate No. :	23BCI0110
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	25409664	Reference No. :	204833
ID No. :	RYG_EN0001		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

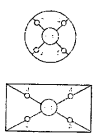
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	10.0000	100.0001
10 g	10.0000	100.0002
Tolerance	10.0001	100.0001
0.0001 g	10.0000	100.0000
	9.9999	100.0002
Nominal Value : (High Load)	10.0000	100.0001
100 g	10.0001	100.0001
Tolerance	10.0000	100.0001
0.0001 g	9.9999	100.0002
	9.9998	100.0001
Standard Deviation	0.00009	0.00006

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximim capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76)

Nominal value : 50 g
Tolerance *0.0004* g



	Difference
1	-
2	0.0000
3	-0.0001
4	0.0001
5	0.0000
6	-

Linearity

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

Tolerance *0.0002* g

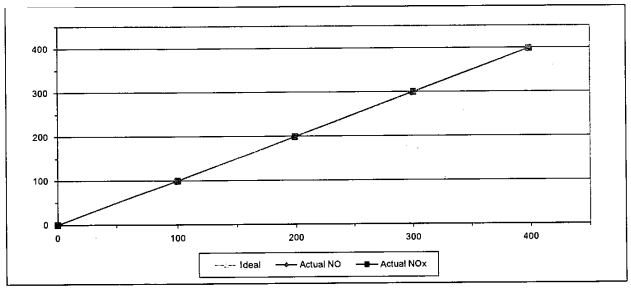
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00022
0.05	0.0500	0.0500	0.0000	0.00023
0.1	0.1000	0.1000	0.0000	0.00023
0.5	0.5000	0.5000	0.0000	0.00023
1	1.0000	1.0000	0.0000	0.00023
2	2.0000	2.0000	0.0000	0.00023
5	5.0000	5.0000	0.0000	0.00022
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00023
100	100.0000	100.0002	0.0002	0.00026

End of Report

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AV89544	Equipment ID	RYG_FS0272
Calibrator Manufacturar	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Cartified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.10	0.10	0.10
2	200.00	198.60	-1.40	-0.70	199.00	-1.00	-0.50
3	300.00	298.70	-1.30	-0.43	300.50	0.50	0.17
4	400.00	398.00	-2.00	-0.50	398.70	-1.30	-0.33
AVERAGE (%)				-0.50			-0.09



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

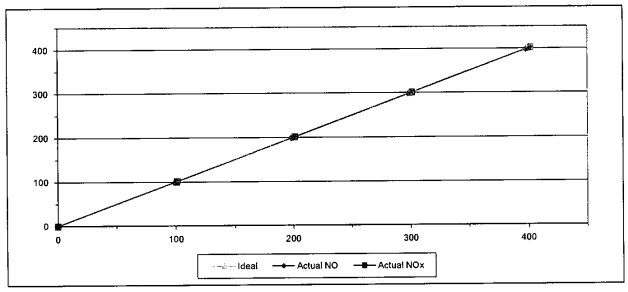
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	U8AOEAGK	Equipment ID	RYG_FS0551
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Data	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.00	1.00	1.00
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.40	-1.60	-0.53	301.50	1.50	0.50
4	400.00	398.20	-1.80	-0.45	402.00	2.00	0.50
AVERAGE (%)				-0.53			0.55



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

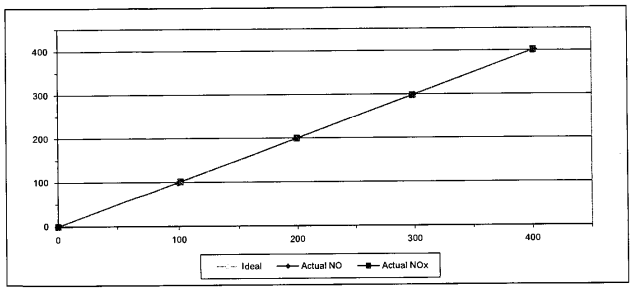
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	AWXG87CR	Equipment ID	RYG_FS0453
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	101.40	1.40	1.40
2	200.00	198.60	-1.40	-0.70	199.80	-0.20	-0.10
3	300.00	299.00	-1.00	-0.33	298.50	-1.50	-0.50
4	400.00	402.10	2.10	0.53	401.20	1.20	0.30
AVERAGE (%)				-0.16			0.24



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

ALS Laboratory Group

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

JNAC

Jiranatee Associates Co.,Ltd.
63/14 Th 6731-36
Petchkasem 2,27, Rd Wattharpra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6688808012
Mobile: +6683989453
E-mail: jnac-calibration@jiranatee.com
Website: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Manatee P.
21/1/25

Certificate Number
CWS-001-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: WS-02F Data logger: 110-WS-250L-D
SERIAL NUMBER	: Sensor: WSD-A5662 Data logger: A5662
ID NUMBER	: RYG_FS0544
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	: 11 Jul 2023
MEASUREMENT DATE	: 21 Jul 2023
ISSUE DATE	: 22 Jul 2023

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

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

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

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.0) °C, (41.7) %RH and (1005.1) hPa.

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

Calibrated by:
1. Mr. Sorawit Thachalad
2. Miss Jittraporn Leetsomphol

JNAC JIRANATEE ASSOCIATES CO., LTD.

Approved signatory
Mr. Pariniya Boonchiatowe
Calibration Department Manager

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology institute of Thailand) via Certificate number: MW-0052-23 and MW-0066-22

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

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

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

Certificate Number
CWS-001-66

MEASUREMENT RESULTS [5]

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

V_{std} [2] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc} [3] (m/s)	Error (m/s)	U (k=2) (m/s)
1.024	23.84	23.95	0.8	-0.2	0.31
2.079	24.08	23.95	1.8	-0.3	0.31
3.019	24.04	23.95	2.8	-0.2	0.31
4.150	24.12	23.95	3.9	-0.3	0.31
5.00	23.72	23.95	4.8	-0.2	0.31
5.99	23.88	23.95	5.8	-0.2	0.31
7.04	23.68	23.95	6.9	-0.2	0.31
8.15	23.64	23.95	7.9	-0.2	0.31
9.09	23.30	23.95	9.0	-0.1	0.31
10.05	23.40	23.95	9.9	-0.1	0.31
11.13	23.48	23.95	11.0	-0.2	0.31
12.11	23.40	23.95	12.0	-0.1	0.31
13.16	23.50	23.95	13.0	-0.1	0.31
14.22	23.40	23.95	14.0	-0.2	0.31
15.22	23.50	23.95	15.0	-0.2	0.31
16.27	23.44	23.95	16.1	-0.2	0.31

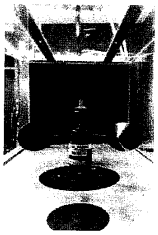
Remark:

[1] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[2] Velocity of standard

[3] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

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

JIRANATEE ASSOCIATES CO.,LTD.

Certificate Number
CWD-001-66

MEASUREMENT RESULTS [5]

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

Air speed m/s	D°_{std} Degree (°)	D°_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
	180.000	180	0	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0
	360.000	359	-1	1.0

Remark:

[1] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[2] Direction of standard

[3] Direction of Unit Under Calibration

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

JIRANATEE ASSOCIATES CO.,LTD.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +6586399945
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CWD-001-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5662
Data logger: A5662
ID NUMBER : RYG_FS0544
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 11 Jul 2023
MEASUREMENT DATE : 21 Jul 2023
ISSUE DATE : 21 Jul 2023

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8)°C, (43.0) %RH and (1011.6) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX40097S-DM04-P3-S-U0 in an close test section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WS-CI-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

JIRANATEE ASSOCIATES CO.,LTD.

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

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

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd.
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC-TISI-TIS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-037-66

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5662
ID No.: RYG_FS0544

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

Received date: 11 Jul 2023
Calibration date: 21 Jul 2023
Issue date: 21 Jul 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 28 Mar 2024
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3) °C
Relative Humidity: (55±15)%

Calibration Procedure
The temperature calibration was done by In-House calibration method as WI-CL-003 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: ER-0092-22

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

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

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

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC-TISI-TIS 17025 CALIBRATION 0367

Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20- 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: T2320591.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.060	19.6	-0.5	0.099
70	25.054	24.6	-0.5	0.099
70	30.050	29.7	-0.3	0.14
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	0.14

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 ★

JIRANATEE ASSOCIATES CO., LTD.

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5662
ID No. : RYG_FS0544
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±3)°C, and relative humidity of (50±15)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926-001. Due date: Sep 26, 2024.

Measurement Date : Jul 21, 2023
Issued Date : Jul 21, 2023

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: T2320591.
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.07	16.3	-3.8	0.51
50	50.23	45.0	-5.2	0.51
80	80.23	73.5	-6.7	0.51

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

JIRANATEE ASSOCIATES CO., LTD.

Approved Signatory: .....
Mr. Parinya Boonchoroen.
Calibration Department Manager

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

JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Soi Wathapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6602868812
Mobile: +66863599353
E-mail: jnac-calibration@jiranatee.com
Website: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

19/1/24

Certificate Number
CL-013-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-014
Data logger: A5789
ID NUMBER : RYG_FS0531
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

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

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.6)°C, (46.6) %RH and (1014.9) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX40095-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

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

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

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

Certificate Number
CL-013-66

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.99	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	227	2	0.74
	270.000	272	2	0.74
	315.000	317	2	0.74

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

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel.: +6628680812
Mob.tel.: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-013-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-014
Data logger: A5789
ID NUMBER : RYG_F50531
CONDITION AS-RECEIVED : Used Item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.7) °C, (44.5) %RH and (1018.3) hPa.

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400 12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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

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

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

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

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

Certificate Number
CL-013-66

MEASUREMENT RESULTS [5]

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

v_{std}[4] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[5] (m/s)	Error (m/s)	U (k=2) (m/s)
0.983	23.60	23.70	0.7	-0.3	0.18
2.024	23.74	23.70	1.7	-0.3	0.16
3.044	23.50	23.70	2.9	-0.2	0.18
4.119	23.82	23.70	3.9	-0.2	0.19
5.02	23.50	23.70	4.9	-0.2	0.18
5.99	23.88	23.70	5.8	-0.2	0.18
7.08	23.50	23.70	6.9	-0.1	0.20
8.18	23.58	23.70	8.0	-0.2	0.18
9.11	23.50	23.70	9.0	-0.1	0.19
10.08	23.66	23.70	10.0	-0.1	0.25
11.15	23.32	23.70	11.0	-0.2	0.21
12.14	23.66	23.70	12.0	-0.2	0.20
13.20	23.32	23.70	13.2	0.0	0.25
14.25	23.50	23.70	14.1	-0.1	0.27
15.23	23.30	23.70	15.1	-0.2	0.27
16.29	23.40	23.70	16.2	-0.1	0.23

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

PHOTO OF CALIBRATION SET-UP

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

End of Certificate of Calibration

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
TTel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC - TISI - TIS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No.: CL-006-66

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5789
ID No.: RYG_F50531

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

Received date: 16 Jan 2023
Calibration date: 18 Jan 2023
Issue date: 20 Jan 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500. Serial No.: 667682-09. Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II. Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±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-0034-22, Certificate number: ER-0092-22

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

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

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC - TISI - TIS 17025 CALIBRATION 0367

Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment
Calibration Range: 20-40 °C

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

Dimension : Diameter 12 mm. Length 80 mm.

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

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

✱ End of Certificate ✱

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No. : RH 06012023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5789
ID No. : RYG_FS0531
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±3)°C, and relative humidity of (50±15)%.

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

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

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

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: T0210901.
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

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

Performed by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

Approved Signatory:
Mr. Parinya Boonchoroen.
Calibration Department Manager

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

JIRANATEE ASSOCIATES CO., LTD.
Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd.Watthapra, Bangkokyai,
Bangkok 10600,Thailand
Tel: +6608680812
Mobile: +6683999553
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Reviewed by: Nanthorn P.
Approved by:
19/1/24

Certificate Number
CL-012-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-011
Data logger: A5660
ID NUMBER : RYG_FS0530
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

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

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.7)°C, (44.2) %RH and (1015.2) hPa.

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX40GRTS-DM04-P3.5-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CI-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline

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

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

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

Approved signatory
Mr Parinya Boonchoroen
Calibration Department Manager

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

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

Certificate Number
CL-012-66

Page 2 of 2 Pages

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.000	0	0	0.58
	45.000	42	-3	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.68
	180.000	179	-1	0.74
	225.000	226	1	0.74
	270.000	270	0	0.74
	315.000	316	1	0.74

Remark:
[5] Calibration results only count for the testee circumstances and environmental conditions during which calibration took place
D'_{std} Direction of standard
D'_{uuc} Direction of Unit Under Calibration

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO., LTD.
Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd.Watthapra, Bangkokyai,
Bangkok 10600,Thailand
Tel: +6608680812
Mobile: +6683999553
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-012-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-011
Data logger: A5660
ID NUMBER : RYG_FS0530
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.7) °C, (50.2) %RH and (1017.1) hPa.

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CI-002 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NMIT (National Metrology Institute of Thailand) via Certificate number: MW 0057-21 and MW 0066-22

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

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

Approved signatory
Mr. Parinya Boonchoroen
Calibration Department Manager

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

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

Certificate Number
CL-012-66

MEASUREMENT RESULTS [5]

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

v_{std} [1] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc} [2] (m/s)	Error (m/s)	U (k=2) (m/s)
0.979	23.56	23.70	0.8	-0.2	0.16
2.025	23.80	23.70	1.8	-0.2	0.16
3.046	23.50	23.70	2.8	-0.2	0.20
4.120	23.64	23.70	3.9	-0.3	0.20
5.01	23.44	23.70	4.8	-0.2	0.18
5.98	23.60	23.70	5.8	-0.2	0.18
7.05	23.28	23.70	6.9	-0.1	0.19
8.17	23.60	23.70	8.0	-0.2	0.19
9.09	23.70	23.70	9.0	0.0	0.22
10.09	23.52	23.70	9.9	-0.2	0.20
11.13	23.20	23.70	10.9	-0.2	0.21
12.13	23.50	23.70	11.9	-0.2	0.21
13.19	23.20	23.70	13.0	-0.2	0.22
14.25	23.45	23.70	14.3	0.0	0.24
15.22	23.20	23.70	15.1	-0.1	0.34
15.31	23.30	23.70	15.1	-0.2	0.29

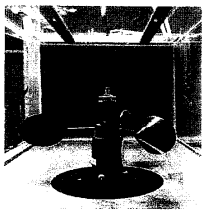
Remark:

[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[1] Velocity of standard

[2] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai, Bangkok 10600 Thailand.
TTel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No.: CL-005-66

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5660
ID No.: RYG_FS0530

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: 16 Jan 2023
Calibration date: 18 Jan 2023
Issue date: 20 Jan 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500. Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±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-0034-22, Certificate number: ER-0092-22

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

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

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

Certificate No.: CL-005-66

Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: S4620631.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.066	19.8	-0.3	0.099
60	25.058	24.6	-0.5	0.14
60	30.052	29.5	-0.6	0.099
60	35.047	34.5	-0.5	0.099
60	40.038	39.4	-0.6	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 ✱

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No. : RH-05012023

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5660
ID No. : RYG_FS0530
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±3)°C, and relative humidity of (50±15)%.

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

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

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

Measurement Results:
This equipment was connected with Incoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: S4620631.
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.03	17.8	-2.2	0.58
50	50.28	48.6	-1.7	0.57
80	80.29	79.8	-0.5	0.58

Performed by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

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

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

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-015-65

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4984
ID NUMBER : BKK_FS0167
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 02 Dec 2022
MEASUREMENT DATE : 06 Dec 2022
ISSUE DATE : 12 Dec 2022

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.9) °C, (47.5) %RH and (1008.9) hPa.

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

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

Approved signatory
Mr. Parinya Boonchuroen
Calibration Department Manager

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

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

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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

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

Certificate Number
CL-015-65

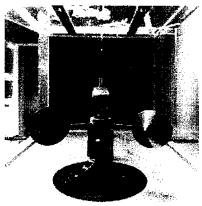
MEASUREMENT RESULTS [5]

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

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.990	23.80	23.85	0.8	-0.2	0.19
2.045	23.94	23.85	1.9	-0.2	0.16
3.031	23.90	23.85	2.9	-0.1	0.26
4.221	24.10	23.85	4.1	-0.2	0.20
5.01	23.66	23.85	4.9	-0.1	0.19
6.00	24.10	23.85	6.0	0.0	0.21
7.06	23.54	23.85	6.9	-0.2	0.21
8.16	24.10	23.85	8.1	-0.1	0.19
9.10	23.60	23.85	9.1	0.0	0.27
10.10	24.08	23.85	10.0	-0.1	0.23
11.16	23.64	23.85	11.0	-0.1	0.22
12.15	23.96	23.85	12.0	-0.1	0.28
13.20	23.70	23.85	13.0	-0.2	0.45
14.28	23.90	23.85	14.1	-0.2	0.28
15.27	23.74	23.85	15.2	-0.1	0.29
16.32	23.74	23.85	16.3	-0.1	0.49

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

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-015-65

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4984
ID NUMBER : BKK_FS0167
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 07 Dec 2022
MEASUREMENT DATE : 12 Dec 2022
ISSUE DATE : 12 Dec 2022

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3)°C, (49.4) %RH and (1006.8) hPa.

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

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

Approved signatory
Mr. Parinya Boonchuroen
Calibration Department Manager

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

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

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

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

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

Certificate Number
CL-015-65

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.001	0	0	0.58
	45.000	43	-2	0.76
	90.000	87	-3	0.68
5.02	135.000	133	-2	0.68
	180.000	179	-1	0.68
	225.001	227	2	0.58
	270.000	274	4	0.68
	315.000	319	4	0.74

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

End of Certificate of Calibration

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
TTeL: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC - TISI - TIS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No.: CL-201-65
Page 1 of 2

Marakom P.
9/6/24

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalynx
Model: 200-WS-25LB
Serial No.: A5263
ID No.: BKK_FS0910

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: 02 Dec 2022
Calibration date: 10 Dec 2022
Issue date: 12 Dec 2022

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500. Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591, Due date: 22 July 2023

Calibration Condition
Temperature: (23±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-0034-22, Certificate number: ER-0092-22

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved Signatory: .....
Mr. Parinya Boonchareon
Calibration Department Manager

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 ˚C

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: N0330786.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (˚C)	UUC Reading (˚C)	Error (˚C)	Uncertainty (˚C)
60	20.063	19.7	-0.4	0.099
60	25.057	24.7	-0.4	0.099
60	30.049	29.7	-0.3	0.099
60	35.043	34.7	-0.3	0.099
60	40.033	39.7	-0.3	0.099

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

✱ End of Certificate ✱

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No. : RH-20122022
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 200-WS-25LB
Serial Number : A5263
ID No. : BKK_FS0910
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±3)˚C, and relative humidity of (50±15)%.

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

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

Measurement Date : Dec 10, 2022
Issued Date : Dec 12, 2022

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: N0330786.
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	19.98	18.2	-1.8	0.52
50	50.28	47.8	-2.4	0.54
80	80.38	77.4	-3.0	0.52

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved Signatory: .....
Mr. Parinya Boonchareon.
Calibration Department Manager

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

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd Wattnapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +660868012
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-014-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5263
ID NUMBER : BKK_FS0910
CONDITION AS-RECEIVED : Used Item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 02 Dec 2022
MEASUREMENT DATE : 09 Dec 2022
ISSUE DATE : 12 Dec 2022

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3) ˚C, (46.3) %RH and (1011.4) hPa.

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-32 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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

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

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

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

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

Certificate Number
CL-014-65

MEASUREMENT RESULTS [5]

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

v_{ref} [1] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc} [2] (m/s)	Error (m/s)	U (k=2) (m/s)
0.977	24.18	24.25	0.8	-0.2	0.15
2.043	24.30	24.25	1.8	-0.2	0.16
3.068	24.10	24.25	2.9	-0.2	0.21
4.197	24.58	24.25	3.9	-0.3	0.19
5.02	24.06	24.25	4.8	-0.2	0.22
6.01	24.54	24.25	5.9	-0.1	0.18
7.06	23.94	24.25	6.8	-0.2	0.18
8.17	24.40	24.25	8.0	-0.2	0.18
9.11	23.90	24.25	9.0	-0.1	0.22
10.10	24.24	24.25	10.0	-0.1	0.24
11.17	23.88	24.25	11.0	-0.1	0.24
12.16	24.16	24.25	12.0	-0.2	0.23
13.19	24.00	24.25	13.0	-0.2	0.25
14.25	24.10	24.25	14.1	-0.2	0.26
15.25	24.06	24.25	15.1	-0.1	0.24
16.31	24.08	24.25	16.1	-0.3	0.35

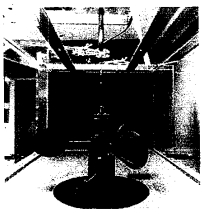
Remark:

Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[1] Velocity of standard

[2] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-014-65

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5263
ID NUMBER : BKK_FS0910
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 02 Dec 2022
MEASUREMENT DATE : 12 Dec 2022
ISSUE DATE : 12 Dec 2022

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3)°C, (48.2) %RH and (1007.5) hPa.

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

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

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

Certificate Number
CL-014-65

MEASUREMENT RESULTS [5]

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

Air speed m/s	D°_{ref} Degree (°)	D°_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.001	0	0	0.58
	45.000	41	-4	0.68
	90.000	87	-3	0.58
5.02	135.000	135	0	0.74
	180.000	182	2	0.68
	225.001	227	2	0.68
	270.000	274	4	0.68
	315.000	319	4	0.74

Remark:

[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[1] Direction of standard

[2] Direction of Unit Under Calibration

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
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E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department

PREPARED BY
APPROVED BY
DATE 20/12/24

Certificate Number
CC-016-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5988
Data logger: A5988
ID NUMBER : RYG_FS0650
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 20 Jun 2023
ISSUE DATE : 20 Jun 2023

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3) °C, (44.7) %RH and (1009.5) hPa.

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: B455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-22 and MW-0066-22

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

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

Approved signatory .....
Mr. Pattriya Booncharoen
Calibration Department Manager

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

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

Certificate Number
CC-016-66

MEASUREMENT RESULTS [5]

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

V_{std} [4] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc} [5] (m/s)	Error (m/s)	U (k=2) (m/s)
1.025	24.16	24.30	0.9	-0.1	0.31
2.029	24.50	24.30	1.9	-0.1	0.31
3.013	24.08	24.30	2.9	-0.1	0.31
4.121	24.18	24.30	4.0	-0.1	0.31
5.02	24.00	24.30	4.9	-0.1	0.31
5.99	24.26	24.30	5.9	-0.1	0.31
7.04	23.90	24.30	7.0	-0.1	0.31
8.18	24.12	24.30	8.0	-0.2	0.31
9.09	23.90	24.30	9.0	-0.1	0.31
10.09	24.02	24.30	10.0	-0.1	0.31
11.14	23.86	24.30	11.0	-0.2	0.31
12.15	23.90	24.30	12.0	-0.1	0.31
13.19	23.80	24.30	13.0	-0.2	0.31
14.26	23.88	24.30	14.1	-0.2	0.31
15.23	23.80	24.30	15.0	-0.2	0.31
16.31	23.80	24.30	16.1	-0.2	0.31

Remark:

Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[4] Velocity of standard

[5] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP

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

End of Certificate of Calibration

JIRANATE ASSOCIATES CO.

Certificate Number
CD-016-66

MEASUREMENT RESULTS [5]

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

Air speed m/s	D°_{std} Degree (°)	D°_{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	42	-3	1.0
	90.000	87	-3	1.0
5.00	135.000	132	-3	1.0
	180.000	179	-1	1.0
	225.000	227	2	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0

Remark:

Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[4] Direction of standard

[5] Direction of Unit Under Calibration

End of Certificate of Calibration

JIRANATE ASSOCIATES CO.

JIRANATE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel +66868808812
Mobile. +66863309453
E-mail :jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CD-016-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5988
Data logger: A5988
ID NUMBER : RYG_FS0650
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 20 Jun 2023
ISSUE DATE : 20 Jun 2023

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3)°C, (51.8) %RH and (1008.5) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04 P3.5-L0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

JIRANATE ASSOCIATES CO.

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

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

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

ILAC-MRA
NSC - TISI - TIS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CT-026-66

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novalynx
Model: 110-WS-25DL D
Serial No.: A5988
ID No.: RYG_FS0650

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: 16 Jun 2023
Calibration date: 20 Jun 2023
Issue date: 22 Jun 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 28 Mar 2024
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3) °C
Relative Humidity: (55±15)%

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

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: ER 0092 22

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

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

JIRANATE ASSOCIATES CO.

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

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63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC - TISI - TIS 17025 CALIBRATION 0367

Certificate No. : CT-026-66

Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: V1920215.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.058	20.0	-0.1	0.099
70	25.051	24.9	-0.2	0.099
70	30.044	29.8	-0.2	0.099
70	35.039	34.8	-0.2	0.099
70	40.034	39.7	-0.3	0.099

UUC* : Unit Under Calibration

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

★ End of Certificate ★

JIRANATE ASSOCIATES CO.,

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No. : RH-09062023

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5988
ID No. : RYG_FS0650
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±3)°C, and relative humidity of (50±15)%.

Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860 3 in the humidity generator chamber to determine the errors.

Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926-601. Due date: Sep 26, 2024.

Measurement Date : Jun 20, 2023
Issued Date : Jun 22, 2023

Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: V1920215.

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

The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.03	19.2	-0.9	0.52
50	50.24	49.5	-0.8	0.52
80	80.33	80.5	0.2	0.52

Performed by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoomirit

JIRANATE ASSOCIATES CO.,

Approved Signatory: .....
Mr. Parinya Boonchieroen
Calibration Department Manager

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

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel. +6680812
M.Phone +6586399 9453
E-mail : jiranatee@jiranatee.com
Web site: www.jiranatee.com

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

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CP-010-66

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A5988
Data logger: A5988
ID NUMBER : RYG_FS0650
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 20 Jun 2023
ISSUE DATE : 20 Jun 2023

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

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number. MP-0205-22

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0205-22	02 Dec 2023

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

JIRANATE ASSOCIATES CO.

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

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

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

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel. +6680812
Mobile +6586399 9453
E-mail : jiranatee@jiranatee.com
Web site: www.jiranatee.com

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

Pressure measurement laboratory
Calibration services department.

NSC - TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CP-010-66

MEASUREMENT RESULTS : ☑ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.08	950.7	0.7	0.85
970.10	970.5	0.4	0.63
990.05	990.4	0.4	0.57
1010.10	1010.2	0.1	0.40
1030.07	1030.0	-0.1	0.38
1050.10	1049.8	-0.3	0.52

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

End of certificate

JIRANATE ASSOCIATES CO.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7 7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Approved Rungkorn P
10/8/24

Certificate Number
CL-020-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor. WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5375
ID NUMBER : RYG_FS0413
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

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

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

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

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

CALIBRATION CONDITIONS

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

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel type wind tunnel with 900 cm^2 cross test section area. The WI-CL-027 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number. MW 0052-21 and MW-0066-22

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

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

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

Approved signatory: Mr. Parinya Boonchareon
Calibration Department Manager

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

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

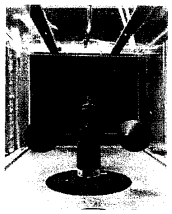
MEASUREMENT RESULTS [5]

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

v_{ind}[1] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{ref}[2] (m/s)	Error (m/s)	U (k=2) (m/s)
0.984	24.10	24.00	0.7	-0.3	0.16
2.029	23.98	24.00	1.8	-0.3	0.16
3.044	23.96	24.00	2.9	-0.2	0.19
4.136	24.20	24.00	3.8	-0.3	0.20
5.00	23.80	24.00	4.8	-0.2	0.21
5.98	24.24	24.00	5.8	-0.2	0.17
7.05	23.90	24.00	6.9	-0.2	0.19
8.19	24.14	24.00	8.0	-0.2	0.19
9.09	23.88	24.00	8.9	-0.2	0.20
10.09	23.88	24.00	9.6	-0.2	0.19
11.16	23.74	24.00	11.0	-0.2	0.23
12.13	23.82	24.00	12.0	-0.2	0.24
13.19	23.70	24.00	13.0	-0.2	0.22
14.26	23.66	24.00	14.0	-0.3	0.28
15.24	23.66	24.00	14.9	0.3	0.23
16.30	23.70	24.00	16.0	-0.3	0.23

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

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7 7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-018-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5375
ID NUMBER : RYG_FS0413
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

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

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8)°C, (50.2) %RH and (1012.2) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4029TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

Approved signatory: Mr. Parinya Boonchareon
Calibration Department Manager

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

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

MEASUREMENT RESULTS [5]

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

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

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

End of Certificate of Calibration

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/24-15, 67/35-36
Petchkasem 7, 7/1, Rd. Watthapra, Bangkoyai,
Bangkok 10600(Thailand)
Tel. +6608680812
Mobile +6683989453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Prapakorn P.
19/3/24

Certificate Number
CL-011-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4987
ID NUMBER : RYG_FS0089
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

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

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

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

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

CALIBRATION CONDITION

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1)°C, (54.3) %RH and (1015.2) hPa.

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model, AX400975-DM04-P3-S-U0 in an close test-section of Eiffel type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1 Wind energy generation systems – Part 12 1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

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

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

Certificate Number
CL-011-66

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.03	0.000	0	0	0.58
	45.000	41	-4	0.68
	90.000	88	-2	0.74
	135.000	133	-2	0.58
	180.000	180	0	0.74
	225.000	228	3	0.74
	270.000	273	3	0.68
	315.000	316	1	0.74

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

End of Certificate of Calibration

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/24-15, 67/35-36
Petchkasem 7, 7/1, Rd. Watthapra, Bangkoyai,
Bangkok 10600(Thailand)
Tel. +6608680812
Mobile +6683989453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-011-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4987
ID NUMBER : RYG_FS0089
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

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

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

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

CALIBRATION CONDITIONS

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.5) °C, (52.8) %RH and (1014.1) hPa.

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: B255-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems - Part 12 1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0057-21 and MW-0066-22

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

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

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

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

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

Certificate Number
CL-011-66

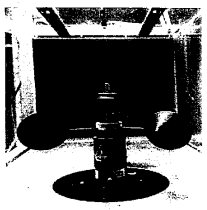
MEASUREMENT RESULTS [5]

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

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.983	23.50	23.45	0.8	-0.2	0.17
2.035	23.44	23.45	1.9	-0.1	0.16
3.049	23.50	23.45	2.9	-0.2	0.19
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.2	0.19
9.10	23.26	23.45	9.0	-0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.20	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.1	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

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

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6686808812
Mobile: +6686359453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-010-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	: Wind Direction Sensor		
MANUFACTURER	: Novalynx		
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-25DL		
SERIAL NUMBER	: Sensor: - Data logger: A4986		
ID NUMBER	: RYG_F50087		
CONDITION AS-RECEIVED	: Used item		
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.		
RECEIVED DATE	: 16 Jan 2023		
MEASUREMENT DATE	: 19 Jan 2023		
ISSUE DATE	: 20 Jan 2023		
ENVIRONMENTAL CONDITIONS:			
Ambient condition in the laboratory are as follow:			
Temperature	: 23.0 ± 3.0	°C	
Relative Humidity	: 55.0 ± 15.0	%RH	
Atmospheric Pressure	: 1010± 10	hPa	
PLACE OF CALIBRATION	: Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.		
CALIBRATION CONDITION	: Wind tunnel cross-section area[1]	900	cm^2
	Win direction frontal area[2]	129	cm^2
	Diameter of mounting pipe[3]	-	mm
	Blockage ratio of test object[4]	0.143	[-]
Preconditioning	: 24 hours at ambient conditions.		
Measurement Condition	: The average values during measurement are (23.5)°C, (47.4) %RH and (1015.6) hPa.		

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DMG4-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1 Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

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

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

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

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

Approved signatory .....
Mr. Parinya Boonchareon
Calibration Department Manager

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

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

Certificate Number
CL-010-66

MEASUREMENT RESULTS [5]

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

Air speed m/s	D'_{std} Degree (°)	D'_{unc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.02	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	225	0	0.68
	270.000	273	3	0.58
	315.000	319	4	0.74

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

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6686808812
Mobile: +6686359453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-010-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	: Cup anemometer		
MANUFACTURER	: Novalynx		
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-25DL		
SERIAL NUMBER	: Sensor: - Data logger: A4986		
ID NUMBER	: RYG_F50087		
CONDITION AS-RECEIVED	: Used item		
CUSTOMER	: ALS laboratory group (Thailand) co., ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.		
RECEIVED DATE	: 16 Jan 2023		
MEASUREMENT DATE	: 18 Jan 2023		
ISSUE DATE	: 20 Jan 2023		
ENVIRONMENTAL CONDITIONS:			
Ambient condition in the laboratory are as follow:			
Temperature	: 23.0 ± 3.0	°C	
Relative Humidity	: 55.0 ± 15.0	%RH	
Atmospheric Pressure	: 1010 ± 10	hPa	
PLACE OF CALIBRATION	: Eiffel type wind tunnel of Jiranatee Associates Co., Ltd.		
CALIBRATION CONDITIONS	: Wind tunnel cross-section area[1]	900	cm^2
	Win direction frontal area[2]	100	cm^2
	Diameter of mounting pipe[3]	-	mm
	Blockage ratio of test object[4]	0.111	[-]
Preconditioning	: 24 hours at ambient conditions.		
Measurement Condition	: The average values during measurement are (23.6) °C, (55.3) %RH and (1013.5) hPa.		

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL 007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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

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

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

Approved signatory .....
Mr. Parinya Boonchareon
Calibration Department Manager

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

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

Certificate Number
CL 010-66

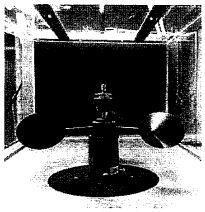
MEASUREMENT RESULTS [5]

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

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{unc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.985	23.68	23.60	0.8	-0.2	0.15
2.033	23.54	23.60	1.8	-0.2	0.16
3.046	23.68	23.60	2.9	-0.1	0.19
4.136	23.66	23.60	3.9	-0.2	0.20
5.03	23.50	23.60	4.9	-0.1	0.20
5.98	23.50	23.60	5.9	-0.1	0.18
7.05	23.36	23.60	7.0	-0.1	0.18
8.18	23.54	23.60	8.0	-0.2	0.20
9.10	23.30	23.60	8.9	-0.2	0.20
10.10	23.50	23.60	10.0	-0.1	0.19
11.14	23.28	23.60	11.1	-0.1	0.22
12.12	23.40	23.60	11.9	-0.2	0.21
13.19	23.10	23.60	13.0	-0.2	0.26
14.25	23.46	23.60	14.0	-0.2	0.32
15.26	23.10	23.60	15.0	-0.2	0.23
16.31	23.26	23.60	16.2	-0.1	0.29

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

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID:	RYG_EN0136
Organization Name:	ALS Laboratory Group (Thailand) Co Ltd.
Organization Location:	616/10 Moo 5, Tambol Mae Nam Koo, A.Pluakdaeng, Rayong,21140, Thailand
Date:	July 7, 2022 11:27:53 AM
EQP Name:	AgilentRecommended , AgilentRecommended
EQP Revision:	GC.02.52, GCMS.02.52
Overall Qualification Status:	Pass

REVIEW BY Mr. Bunnit
APPROVED BY
NEXT CAL. DATE 07/01/24

CDS Logon Verification - GC

Logon: dej.changchon

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 SSL

Setpoint Status: Pass

	Setpoint	Actual	
Inlet Pressure:	25.0 psi	25.1 psi	
Accuracy:		0.1	psi
Agilent Recommended:		<= 1.2	

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

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)

Setpoint Status: Pass

Zone: Oven

	Setpoint/Actual				
Temperature:	100.0	99.9	°C		
Accuracy:		-0.1	°C		
Agilent Recommended:	>= -1.0	% setpoint in K		(-3.7	°C)
	<= 1.0	% setpoint in K		(3.7	°C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

	Setpoint/Average		
Temperature:	100.0	99.91667	°C
Stability:		0.1	°C
Agilent Recommended:	<=	0.5	

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Amu:	1050 m/z	Drift After Five Minutes:	RFPA Voltage:
		-1 mV	479 mV
Agilent Recommended:		>= -100 and <= 100	<= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Filament: 1

Setpoint Status: Pass

Filament: 2

Overall Tune EI Test Status

Pass

Signal to Noise EI

Tested Combination1 Front SSL / External SQ

Name: 5977B

Source: EI - Extractor Filament: 1

Setpoint Status: Pass

Signal to Noise: 7485

Agilent Recommended: >= 1200

Source: EI - Extractor Filament: 2

Setpoint Status: Pass

Signal to Noise: 2097

Agilent Recommended: >= 1200

This test's 2 comment(s) and 7 deviation(s) are available in the Attachments section.

Overall Signal to Noise EI Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	RYG_EN0136
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

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	CN16463238
Firmware Revision	B.02.04.3
Component ID/Asset No.	081117000236
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	5977B
Serial Number	US1701M008
Firmware Revision	5977 6.00.34
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
Component ID/Asset No.	081117000236

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:	Eaknarin Puangsopa
Logged On User Name:	eaknarin_puangsopa@agilent.com
Signature Creation Date:	July 7, 2022
Reason for Signature:	Executed protocol and published this original version of document

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 1:11:54 PM	Audit	SessionCreated	Session	None
July 6, 2022 1:11:54 PM	Start	Configuration	Session	None
July 6, 2022 1:11:54 PM	Audit	Entitlement	Licensing	User is Nonpaying and does not require an unlock code
July 6, 2022 1:17:19 PM	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/02.52/GcMs.02.52.eqp], EQP File Name: [GcMs.02.52.eqp], EQP Name: [AgilentRecommended]
July 6, 2022 1:17:25 PM	End	Configuration	Session	None
July 6, 2022 1:17:29 PM	Start	Qualification	Session	OQ
July 6, 2022 1:17:30 PM	Start	Execution	CDS Logon Verification - GC : - Qualitative test	None
July 6, 2022 1:19:43 PM	End	Execution	CDS Logon Verification - GC : - Qualitative test	Run Count : 1
July 6, 2022 1:19:46 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 1:19:00 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
July 6, 2022 1:20:15 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
July 6, 2022 1:21:43 PM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
July 6, 2022 1:21:45 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
July 6, 2022 1:25:12 PM	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
July 6, 2022 1:25:15 PM	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
July 6, 2022 1:25:17 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
July 6, 2022 1:25:32 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
July 6, 2022 1:33:42 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 1:33:43 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
July 6, 2022 1:33:45 PM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
July 6, 2022 1:53:05 PM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
July 6, 2022 1:53:07 PM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
July 6, 2022 1:53:11 PM	Start	Execution	Log Amp - 5977B SQ: - Source: EI - Extractor	None
July 6, 2022 1:57:10 PM	End	Execution	Log Amp - 5977B SQ: - Source: EI - Extractor	Run Count : 1
July 6, 2022 1:57:24 PM	Start	Execution	RFPA - 5977B SQ: - Source: EI - Extractor	None
July 6, 2022 2:09:24 PM	End	Execution	RFPA - 5977B SQ: - Source: EI - Extractor	Run Count : 1
July 6, 2022 2:09:28 PM	Start	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
July 6, 2022 2:24:46 PM	End	Qualification	Session	OQ
July 6, 2022 2:24:48 PM	Start	Reporting	Session	None
July 6, 2022 2:41:39 PM	End	Reporting	Session	None
July 6, 2022 2:41:39 PM	Start	Configuration	Session	None
July 6, 2022 2:41:40 PM	End	Configuration	Session	None

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 2:41:40 PM	Start	Qualification	Session	OQ
July 6, 2022 2:41:40 PM	Start	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
July 6, 2022 2:41:56 PM	End	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
July 6, 2022 2:41:58 PM	Start	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
July 6, 2022 2:42:48 PM	End	Qualification	Session	OQ
July 6, 2022 2:42:48 PM	Start	Reporting	Session	None
July 6, 2022 2:50:52 PM	End	Reporting	Session	None
July 6, 2022 2:50:52 PM	Start	Qualification	Session	OQ
July 6, 2022 2:50:52 PM	Start	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
July 6, 2022 2:51:12 PM	End	Qualification	Session	OQ
July 6, 2022 2:51:12 PM	Start	Reporting	Session	None
July 6, 2022 2:55:29 PM	End	Reporting	Session	None
July 6, 2022 2:55:29 PM	Start	Qualification	Session	OQ
July 6, 2022 2:55:29 PM	Start	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 2:55:40 PM	End	Execution	Tune EI - 5977B SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	Run Count : 1
July 6, 2022 2:55:45 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 6, 2022 3:21:52 PM	End	Qualification	Session	OQ
July 6, 2022 3:21:52 PM	Start	Reporting	Session	None
July 6, 2022 3:25:04 PM	End	Reporting	Session	None
July 6, 2022 3:25:04 PM	Start	Qualification	Session	OQ
July 6, 2022 3:25:04 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 6, 2022 4:06:40 PM	Audit	AceClosed	Session	None
July 7, 2022 9:13:47 AM	Audit	AceRestarted	Session	None
July 7, 2022 9:13:49 AM	Audit	SessionReloaded	Session	None
July 7, 2022 9:13:54 AM	Start	Qualification	Session	OQ
July 7, 2022 9:13:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 9:58:06 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 9:59:53 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 1
July 7, 2022 10:01:46 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 1
July 7, 2022 10:01:46 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:02:00 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D
July 7, 2022 10:04:55 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 2
July 7, 2022 10:07:30 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 2
July 7, 2022 10:07:30 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:07:44 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:08:16 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 3
July 7, 2022 10:10:28 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 3
July 7, 2022 10:10:28 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:10:55 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D
July 7, 2022 10:14:03 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 4
July 7, 2022 10:14:54 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 4
July 7, 2022 10:14:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:15:15 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:15:27 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 5
July 7, 2022 10:16:48 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 5
July 7, 2022 10:16:48 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:17:05 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D
July 7, 2022 10:17:14 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 6
July 7, 2022 10:18:40 AM	End	Qualification	Session	OQ
July 7, 2022 10:18:40 AM	Start	Reporting	Session	None
July 7, 2022 10:21:10 AM	End	Reporting	Session	None
July 7, 2022 10:21:10 AM	Start	Qualification	Session	OQ
July 7, 2022 10:21:17 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 10:56:49 AM	End	Qualification	Session	OQ
July 7, 2022 10:56:49 AM	Start	Reporting	Session	None
July 7, 2022 10:57:38 AM	End	Reporting	Session	None

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:57:38 AM	Start	Qualification	Session	OQ
July 7, 2022 10:57:38 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:06:50 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F021.D
July 7, 2022 11:11:47 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:13:13 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 1
July 7, 2022 11:14:29 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 1
July 7, 2022 11:14:29 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:14:47 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F021.D
July 7, 2022 11:16:34 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 2

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User Name: eaknarin_puangsopa
Hostname: ASRYGW7002

System Id: RYG_EN0136
Print Date: July 7, 2022 11:27:55 AM

ALS_RYG_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 11:19:56 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 2
July 7, 2022 11:19:56 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:20:13 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F021.D
July 7, 2022 11:21:52 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 3
July 7, 2022 11:22:49 AM	End	Qualification	Session	OQ
July 7, 2022 11:22:49 AM	Start	Reporting	Session	None
July 7, 2022 11:26:46 AM	Audit	Reporting	Session	Report Generated : Certificate

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Date: July 7, 2022 11:27:53 AM
System ID: RYG_EN0136

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ROTA METER CALIBRATION RESULT JULY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS0577	03 Jul 23	Y = 1.2484x - 0.6741	0.9931
BKK_FS0579	03 Jul 23	Y = 1.0997x - 0.4918	1.0000
BKK_FS0583	01 Jul 23	Y = 1.0068x + 1.6459	0.9998
BKK_FS0584	01 Jul 23	Y = 0.9804x + 9.469	0.9999
BKK_FS0585	07 Jul 23	Y = 1.0248x + 0.8333	0.9996
BKK_FS0586	01 Jul 23	Y = 0.9907x + 11.074	1.0000
BKK_FS0587	07 Jul 23	Y = 0.986x + 17.77	0.9993
BKK_FS0588	01 Jul 23	Y = 0.9751x + 9.8452	0.9999
BKK_FS0589	03 Jul 23	Y = 1.0174x + 0.0381	1.0000
BKK_FS0590	01 Jul 23	Y = 1.0127x - 3.4333	1.0000
BKK_FS0591	03 Jul 23	Y = 1.0452x - 51.824	0.9998
BKK_FS0592	07 Jul 23	Y = 1.0003x + 14.344	1.0000
BKK_FS0593	01 Jul 23	Y = 1.0386x - 41.415	0.9997
BKK_FS0594	07 Jul 23	Y = 1.0025x + 6.32	0.9999
BKK_FS0595	01 Jul 23	Y = 1.0871x - 114.97	0.9985
BKK_FS0596	03 Jul 23	Y = 1.038x - 51.974	0.9993
BKK_FS0597	01 Jul 23	Y = 1.0059x - 9.9086	1.0000
BKK_FS1004	01 Jul 23	Y = 1.0186x + 6.731	0.9998
BKK_FS1005	01 Jul 23	Y = 0.9922x + 13.993	0.9970
BKK_FS1006	01 Jul 23	Y = 1.1747x - 3.1235	0.9991
BKK_FS1007	07 Jul 23	Y = 1.0737x + 0.8677	0.9997
BKK_FS1008	07 Jul 23	Y = 1.0446x + 1.2156	0.9999
BKK_FS1009	01 Jul 23	Y = 1.1044x - 0.8245	1.0000
BKK_FS1010	03 Jul 23	Y = 1.2271x - 2.0139	1.0000
BKK_FS1011	03 Jul 23	Y = 1.261x - 1.7003	1.0000
BKK_FS1012	03 Jul 23	Y = 0.9978x - 3.7238	0.9990
BKK_FS1013	03 Jul 23	Y = 1.0245x - 28.65	0.9999
BKK_FS1014	01 Jul 23	Y = 1.3135x - 7.0966	0.9961
BKK_FS1015	01 Jul 23	Y = 0.9802x + 3.8214	0.9999
BKK_FS1016	01 Jul 23	Y = 1.0726x - 85.581	0.9995
BKK_FS1020	01 Jul 23	Y = 1.1161x - 1.1986	1.0000
BKK_FS1021	01 Jul 23	Y = 0.9566x + 16.524	0.9987
BKK_FS1022	01 Jul 23	Y = 1.0712x - 89.51	0.9990
BKK_FS1023	01 Jul 23	Y = 1.3791x - 8.8721	0.9944
BKK_FS1024	01 Jul 23	Y = 0.9449x + 11.421	0.9993
BKK_FS1025	01 Jul 23	Y = 1.0477x - 41.116	1.0000
BKK_FS1026	01 Jul 23	Y = 1.3389x - 4.918	1.0000
BKK_FS1027	01 Jul 23	Y = 0.9852x + 1.5238	1.0000
BKK_FS1028	01 Jul 23	Y = 1.0281x - 19.897	0.9996

ROTA METER CALIBRATION RESULT JULY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS1029	01 Jul 23	Y = 1.3382x - 8.9776	0.9941
BKK_FS1030	01 Jul 23	Y = 0.9818x + 2.3476	0.9995
BKK_FS1031	01 Jul 23	Y = 1.0526x - 64.415	0.9997
BKK_FS1039	01 Jul 23	Y = 0.998x + 14.823	0.9997
BKK_FS1040	01 Jul 23	Y = 1.0041x - 2.7552	0.9999
BKK_FS1041	01 Jul 23	Y = 1.116x - 1.0078	0.9999
BKK_FS1042	01 Jul 23	Y = 1.0209x + 3.56	0.9980
BKK_FS1043	01 Jul 23	Y = 1.0039x - 5.0143	0.9999
BKK_FS1044	01 Jul 23	Y = 1.0807x + 0.9837	0.9998
BKK_FS1164	03 Jul 23	Y = 1.0589x + 4.6061	0.9996
BKK_FS1165	03 Jul 23	Y = 0.9809x + 7.5262	0.9981
BKK_FS1166	03 Jul 23	Y = 1.0567x - 50.446	0.9999
BKK_FS1200	03 Jul 23	Y = 1.3634x - 1.3816	0.9991
BKK_FS1201	03 Jul 23	Y = 1.0388x - 7.0524	0.9999
BKK_FS1202	03 Jul 23	Y = 1.0518x - 59.531	0.9998
RYG_FS0197	01 Jul 23	Y = 1.0087x - 3.2838	0.9999
RYG_FS0198	01 Jul 23	Y = 0.9877x + 36.487	0.9999
RYG_FS0199	01 Jul 23	Y = 1.0299x - 0.367	0.9992
PHK_FS0027	13 Jul 23	Y = 1.1219x - 2.2432	0.9984
PHK_FS0028	13 Jul 23	Y = 1.0341x - 6.7967	0.9999
PHK_FS0029	13 Jul 23	Y = 0.9977x + 8.7829	0.9999
SGK_FS0135	14 Jul 23	Y = 0.9877x + 11.513	0.9974
SGK_FS0138	13 Jul 23	Y = 1.0571x - 1.1565	0.9991
SGK_FS0139	13 Jul 23	Y = 0.9801x + 8.6267	0.9997
SGK_FS0140	13 Jul 23	Y = 0.9978x + 11.644	1.0000
SGK_FS0141	13 Jul 23	Y = 1.1349x - 2.2867	0.9990
SGK_FS0142	13 Jul 23	Y = 0.9915x + 11.403	0.9994
SGK_FS0143	13 Jul 23	Y = 1.0054x - 4.0648	1.0000

Review By : (Mr. Wichan Choonharat) Enviro Field Services Manager

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

ROTA METER CALIBRATION RESULT OCTOBER 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS0577	02 Oct 23	Y = 1.2862x - 1.2952	0.9963
BKK_FS0579	02 Oct 23	Y = 1.2546x + 0.0065	0.9946
BKK_FS0583	03 Oct 23	Y = 1.0773x - 2.4138	0.9989
BKK_FS0584	02 Oct 23	Y = 0.9787x + 12.569	0.9999
BKK_FS0585	18 Oct 23	Y = 1.0322x + 3.7767	0.9998
BKK_FS0586	02 Oct 23	Y = 0.9777x + 15.405	0.9997
BKK_FS0587	18 Oct 23	Y = 1.0175x + 14.717	0.9997
BKK_FS0589	03 Oct 23	Y = 1.0148x + 2.4143	1.0000
BKK_FS0590	03 Oct 23	Y = 1.0088x + 0.8429	1.0000
BKK_FS0591	02 Oct 23	Y = 1.0733x - 88.805	0.9989
BKK_FS0592	18 Oct 23	Y = 1.0037x + 10.388	1.0000
BKK_FS0593	02 Oct 23	Y = 1.0538x - 60.63	0.9996
BKK_FS0594	18 Oct 23	Y = 1.0052x + 5.3238	0.9999
BKK_FS0596	03 Oct 23	Y = 1.0449x - 48.241	0.9996
BKK_FS0597	03 Oct 23	Y = 1.0697x - 83.62	0.9994
BKK_FS1004	02 Oct 23	Y = 0.9855x + 14.75	0.9992
BKK_FS1005	02 Oct 23	Y = 1.02x + 1.7167	0.9996
BKK_FS1006	02 Oct 23	Y = 1.1762x - 3.5619	0.9999
BKK_FS1007	18 Oct 23	Y = 1.1405x + 2.6044	0.9993
BKK_FS1008	18 Oct 23	Y = 1.1267x + 4.8333	0.9991
BKK_FS1010	03 Oct 23	Y = 1.0027x + 2.5832	0.9986
BKK_FS1011	02 Oct 23	Y = 1.3811x - 6.2068	0.9998
BKK_FS1012	02 Oct 23	Y = 1.0017x + 0.9	1.0000
BKK_FS1013	02 Oct 23	Y = 1.0593x - 46.02	0.9994
BKK_FS1014	03 Oct 23	Y = 1.0961x - 1.6895	0.9983
BKK_FS1015	03 Oct 23	Y = 0.9979x + 6.2595	0.9993
BKK_FS1016	03 Oct 23	Y = 1.0683x - 82.491	0.9995
BKK_FS1017	06 Oct 23	Y = 0.9981x - 2.2235	0.9998
BKK_FS1018	06 Oct 23	Y = 0.9817x - 20.653	0.9999
BKK_FS1019	06 Oct 23	Y = 1.0152x - 64.485	0.9998
BKK_FS1020	02 Oct 23	Y = 1.2691x - 2.4721	0.9983
BKK_FS1021	02 Oct 23	Y = 1.0036x + 2.3286	0.9999
BKK_FS1022	02 Oct 23	Y = 1.0633x - 73.266	0.9990
BKK_FS1023	03 Oct 23	Y = 1.0879x - 1.0694	0.9984
BKK_FS1024	02 Oct 23	Y = 1.0035x + 1.4857	1.0000
BKK_FS1025	03 Oct 23	Y = 1.0556x - 58.597	0.9999
BKK_FS1026	02 Oct 23	Y = 1.2894x - 1.497	0.9970
BKK_FS1027	02 Oct 23	Y = 1.0032x + 1.5167	1.0000
BKK_FS1028	02 Oct 23	Y = 1.0433x - 30.012	0.9994

ROTA METER CALIBRATION RESULT OCTOBER 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS1029	02 Oct 23	Y = 1.3494x - 3.5078	0.9981
BKK_FS1030	02 Oct 23	Y = 1.0015x + 1.2214	1.0000
BKK_FS1031	02 Oct 23	Y = 1.0516x - 56.996	0.9994
BKK_FS1039	02 Oct 23	Y = 0.9991x + 14.527	0.9994
BKK_FS1040	02 Oct 23	Y = 1.0049x - 2.4324	1.0000
BKK_FS1041	02 Oct 23	Y = 1.1682x - 2.1293	1.0000
BKK_FS1042	02 Oct 23	Y = 1.0051x + 6.2533	0.9989
BKK_FS1043	02 Oct 23	Y = 1.0022x + 3.96	1.0000
BKK_FS1044	02 Oct 23	Y = 1.0796x + 2.9806	0.9993
BKK_FS1164	02 Oct 23	Y = 1.2714x + 0.234	0.9945
BKK_FS1165	02 Oct 23	Y = 1.0029x + 3.3571	0.9994
BKK_FS1166	02 Oct 23	Y = 1.061x - 56.83	1.0000
BKK_FS1200	02 Oct 23	Y = 1.2803x - 1.4599	0.9962
BKK_FS1201	02 Oct 23	Y = 1.0374x - 6.1952	1.0000
BKK_FS1202	02 Oct 23	Y = 1.0486x - 44.05	0.9997
PHK_FS0027	09 Oct 23	Y = 1.1052x + 1.0293	1.0000
PHK_FS0028	09 Oct 23	Y = 1.0377x - 1.0833	1.0000
PHK_FS0029	09 Oct 23	Y = 1.0021x + 7.5248	1.0000
RYG_FS0197	02 Oct 23	Y = 1.0036x + 9.0133	1.0000
RYG_FS0198	02 Oct 23	Y = 0.9991x + 17.568	1.0000
RYG_FS0199	02 Oct 23	Y = 1.0814x - 1.2993	0.9997
RYG_FS0654	02 Oct 23	Y = 1.1168x - 2.1207	1.0000
RYG_FS0655	02 Oct 23	Y = 1.0086x + 6.2733	0.9991
RYG_FS0656	02 Oct 23	Y = 1.0009x + 8.48	1.0000
RYG_FS0657	02 Oct 23	Y = 1.0435x + 2.6459	0.9999
RYG_FS0658	02 Oct 23	Y = 0.9788x + 10.283	0.9992
RYG_FS0659	02 Oct 23	Y = 1.0074x - 6.621	1.0000
SGK_FS0135	18 Oct 23	Y = 0.9831x + 14.843	0.9994
SGK_FS0138	06 Oct 23	Y = 1.0831x - 0.8401	0.9998
SGK_FS0139	06 Oct 23	Y = 0.9826x + 8.6567	1.0000
SGK_FS0140	06 Oct 23	Y = 1.0011x + 7.8095	1.0000
SGK_FS0141	06 Oct 23	Y = 1.125x - 1.2259	0.9998
SGK_FS0142	06 Oct 23	Y = 0.9956x + 10.257	0.9997
SGK_FS0143	06 Oct 23	Y = 1.004x + 3.3105	1.0000

Review By : (Mr. Wichan Choonharat) Enviro Field Services Manager

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

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ

REVIEW BY Linda K.
APPROVED BY Jamptorn M.
NEXT CAL DATE 21 Oct 24

System ID: CN11461066
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Soi 40 Phatthanakan Rd,Khwang Suan Luang, Khet Suan Luang, Bangkok 10250

Date: April 21, 2023 3:26:38 PM
EQP Name: AgilentRecommended
EQP Revision: GC.02.52
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Saenguthai Tarak

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 Decay

Name: 7890
Front SSL

Setpoint Status: **Pass**
Pressure: 25.0 psi

Pressure Change: -0.1 psi /5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL

Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.2	psi

Accuracy: 0.2 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7890
Back SSL

Setpoint Status: Pass
Pressure: 25.0 psi

Pressure Change: 0.0 psi /5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Back SSL

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Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	24.8	psi

Accuracy: 0.2 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front FID

Setpoint Status: Pass
Flow Type: Fuel
Setpoint: 30.0 mL/min Measured Flow: 28.9 mL/min
Accuracy: 1.1 mL/min
Agilent Recommended: <= 10.0 % setpoint (3.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Oxidizer
Setpoint: 400.0 mL/min Measured Flow: 400 mL/min
Accuracy: 0.0 mL/min
Agilent Recommended: <= 10.0 % setpoint (40.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Makeup
Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min
Accuracy: 0.1 mL/min
Agilent Recommended: <= 10.0 % setpoint (2.5 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Back FID

Setpoint Status: Pass

Flow Type: Fuel
Setpoint: 30.0 mL/min Measured Flow: 30.7 mL/min
Accuracy: 0.7 mL/min
Agilent Recommended: <= 10.0 % setpoint (3.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Oxidizer
Setpoint: 400.0 mL/min Measured Flow: 399 mL/min
Accuracy: 1.0 mL/min
Agilent Recommended: <= 10.0 % setpoint (40.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Makeup
Setpoint: 25.0 mL/min Measured Flow: 24.6 mL/min
Accuracy: 0.4 mL/min
Agilent Recommended: <= 10.0 % setpoint (2.5 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

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)

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)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint/Average
Temperature: 100.0 100.8833 °C
Stability: 0.1 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1 Front SSL / Front FID
Injection Tower
Name: 7693A

Setpoint Status: Completed
Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1 Front SSL / Front FID
Name: 7890
Setpoint Status: Pass
Base Signal: 22.7 pA

	ASTM Noise pA	Drift pA/Hr
	0.06	0.05
Agilent Recommended:	<= 0.10	<= 2.50
Status:	Pass	Pass

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 Front SSL / Front FID
Name: 7693A
Setpoint Status: Pass
Injection Volume on Column: 1.0 uL
Area RSD: 0.32 % Retention Time RSD: 0.67 %
Agilent Recommended: <= 3.00 <= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination1 Front SSL / Front FID
Injection Tower
Name: 7890
Setpoint Status: Pass
Signal to Noise: 721755
Agilent Recommended: >= 300000

Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7693A
Setpoint Status: Completed
Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID
Name: 7890
Setpoint Status: Pass
Base Signal: 22.6 pA

	ASTM Noise pA	Drift pA/Hr
	0.07	0.09
Agilent Recommended:	<= 0.10	<= 2.50
Status:	Pass	Pass

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2 Back SSL / Back FID

Name: 7693A

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD: 1.28 %

Agilent Recommended: <= 3.00

Retention Time RSD: 0.83 %

<= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2 Back SSL / Back FID

Injection Tower

Name: 7890

Setpoint Status: Pass

Signal to Noise: 2404398

Agilent Recommended: >= 300000

Overall Signal to Noise Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	CN11461066
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
Sampler Identifier	Sampler 2
Inlet	Front
Detector	Front
LTM Included?	No

Tested Combination2

Injection Technique	Injection Tower
Sampler Identifier	Sampler 3
Inlet	Back
Detector	Back
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN15380030
Firmware Revision	A.11.01
Vial Heater	Not installed

Sampler 2

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

Sampler 3

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN10340103
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
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

Inlet 2

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

Detector 1

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Detector 2

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

Electronic Signature

Purpose

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Details

Full Name of Signer:	Saenguthai Tarak
Logged On User Name:	saenguthai.tarak@non.agilent.com
Signature Creation Date:	April 21, 2023
Reason for Signature:	Executed protocol and published this original version of document

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User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN6127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:21:35 AM	Audit	SessionCreated	Session	None
April 21, 2023 11:21:36 AM	Start	Configuration	Session	None
April 21, 2023 11:21:36 AM	Audit	Entitlement	Licensing	User is Nonpaying and does not require an unlock code
April 21, 2023 11:22:04 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].Protocol Revision: [Gc.02.52]
April 21, 2023 11:22:06 AM	End	Configuration	Session	None
April 21, 2023 11:22:14 AM	Start	Qualification	Session	OQ
April 21, 2023 11:22:14 AM	Start	Execution	CDS Logon Verification - GC : - Qualitative test	None
April 21, 2023 11:23:14 AM	End	Execution	CDS Logon Verification - GC : - Qualitative test	Run Count : 1
April 21, 2023 11:23:16 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
April 21, 2023 11:23:35 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
April 21, 2023 11:23:37 AM	Start	Execution	Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN6127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:24:01 AM	End	Execution	Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count : 1
April 21, 2023 11:24:04 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
April 21, 2023 11:24:09 AM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
April 21, 2023 11:24:11 AM	Start	Execution	Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
April 21, 2023 11:24:43 AM	End	Execution	Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count : 1
April 21, 2023 11:24:45 AM	Start	Execution	Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
April 21, 2023 11:24:51 AM	End	Execution	Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
April 21, 2023 11:24:53 AM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:20 AM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:25 AM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN6127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:25:26 AM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:40 AM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:42 AM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
April 21, 2023 11:25:44 AM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:01 AM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:04 AM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:05 AM	Start	Execution	Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:19 AM	Audit	Data	Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:22 AM	End	Execution	Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:24 AM	Start	Execution	Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:38 AM	Audit	Data	Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV
System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:26:43 AM	End	Execution	Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:45 AM	Start	Execution	Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:27:01 AM	Audit	Data	Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:27:05 AM	End	Execution	Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
April 21, 2023 11:27:07 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 21, 2023 11:27:33 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
April 21, 2023 11:27:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
April 21, 2023 11:27:37 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 21, 2023 11:27:54 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: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV
System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:27:57 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
April 21, 2023 11:27:59 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
April 21, 2023 11:29:07 AM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
April 21, 2023 11:29:10 AM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
April 21, 2023 11:29:12 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated	None
April 21, 2023 11:30:27 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\F_SC01.D\FID1A.ch
April 21, 2023 11:31:04 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated	Run Count : 1
April 21, 2023 11:31:07 AM	Start	Execution	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	None

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV
System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:31:43 AM	Audit	Data	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\ND-01--005F.D\FID1A.ch
April 21, 2023 11:32:00 AM	End	Execution	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Run Count : 1
April 21, 2023 11:32:03 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	None
April 21, 2023 11:32:23 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	None
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--013F.D\FID1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--014F.D\FID1A.ch

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV
System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--015F.D\FID1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--016F.D\FID1A.ch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--017F.D\FID1A.ch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\Pre01--018F.D\FID1A.ch
April 21, 2023 11:35:00 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Rel. Time): <= 1.00%	Run Count : 1
April 21, 2023 11:35:04 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000	None

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:35:28 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\SN_Front.D\FID1A.ch
April 21, 2023 11:36:00 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000	Run Count : 1
April 21, 2023 11:36:03 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated	None
April 21, 2023 11:36:36 AM	Audit	Data	GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\B_SC01.D\FID2B.ch
April 21, 2023 11:37:30 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated	Run Count : 1
April 21, 2023 11:37:32 AM	Start	Execution	Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	None

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:38:06 AM	Audit	Data	Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\ND-01--005B.D\FID2B.ch
April 21, 2023 11:38:23 AM	End	Execution	Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Run Count : 1
April 21, 2023 11:38:32 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	None
April 21, 2023 11:38:51 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	None
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--004B.D\FID2B.ch
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--005B.D\FID2B.ch

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--006B.D\FID2B.ch
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--007B.D\FID2B.ch
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--008B.D\FID2B.ch
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32\Pre11--009B.D\FID2B.ch
April 21, 2023 11:41:29 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Run Count : 1
April 21, 2023 11:41:33 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000	None

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV

System Id: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:42:22 AM	Audit	Data	Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000	Data files Path : C:\Users\Public\Documents\ChemStation\3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023 2023-04-20 14-36-08\SN_Back.D\FID2B.ch
April 21, 2023 11:42:50 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000	Run Count : 1
April 21, 2023 11:42:53 AM	End	Qualification	Session	OQ
April 21, 2023 11:42:53 AM	Start	Reporting	Session	None
April 21, 2023 12:01:47 PM	Audit	AceClosed	Session	None
April 21, 2023 3:16:07 PM	Audit	AceRestarted	Session	None
April 21, 2023 3:16:10 PM	Audit	SessionReloaded	Session	None
April 21, 2023 3:16:31 PM	Start	Qualification	Session	OQ
April 21, 2023 3:20:59 PM	Audit	AceRestarted	Session	None
April 21, 2023 3:21:00 PM	Audit	SessionReloaded	Session	None
April 21, 2023 3:21:07 PM	Start	Qualification	Session	OQ
April 21, 2023 3:25:45 PM	Audit	Reporting	Session	Report Generated : Certificate

Bara Scientific Co., Ltd.
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Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
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Certificate of Calibration

Certificate No.	BSCC-UV-307/22
Equipment	UV/Vis Spectrophotometer
Model	UV-1800
Manufacturer	Shimadzu
Serial No.	A11454908533CD
ID No.	BKK_EN0018
Date of receipt	16 September 2022
Date of calibration	16 September 2022
Date of issue	23 September 2022

REVIEW BY Siriluk P.
APPROVED BY
NEXT CAL. DATE 16/9/23 23/9/22

Customer name	ALS Laboratory Group (Thailand) Co., Ltd.
Address	104 Soi Phatthanakan 40, Phatthanakan Road, Phatthanakan, Suan Luang, Bangkok 10250
Temperature	(22.1-23.3) °C (On site)
Humidity	(58.8-63.2) %RH (On site)
Equipment condition	Good Operation
Calibration Location	Organic Prep
Calibration Procedure	In-house method WI-UV-702-01 based on ASTM E275-01
Traceability	Wavelength Accuracy is traceable to certificate No. 95917 and 95918 Photometric Accuracy is traceable to certificate No. 95924 and 95937 Stray Light is traceable to certificate No. 95908 The above certificate are traceble to SI unit through Starna Scientific Ltd. (UKAS accredited calibration laboratory NO. 0659)
Calibrated by	Mr.Waruth Janphung

Approved by

Mr.Kanchit Choothep
Technical Manager

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Certificate of Calibration

Calibration Results:

1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.65	-0.05	0.18
334.02	333.92	-0.10	0.18
418.53	418.46	-0.07	0.18
572.99	572.96	-0.03	0.18
879.41	879.17	-0.24	0.18

2.Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7461	-0.0006	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8647	-0.0015	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2911	0.0007	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6429	0.6426	-0.0003	0.0075

*CNR = Customer not request

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Certificate of Calibration

Calibration Results:

3.Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5777	-0.0006	0.0042
	0.7628	0.7635	0.0007	0.0046
	1.0206	1.0230	0.0024	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5618	-0.0003	0.0042
	0.7455	0.7460	0.0005	0.0048
	0.9985	1.0005	0.0020	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5219	-0.0008	0.0042
	0.6880	0.6884	0.0004	0.0051
	0.9487	0.9503	0.0016	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5199	-0.0008	0.0042
	0.6973	0.6971	-0.0002	0.0049
	0.9959	0.9964	0.0005	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5534	-0.0010	0.0042
	0.7253	0.7242	-0.0011	0.0050
	1.0942	1.0943	0.0001	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5606	-0.0010	0.0042
	0.6927	0.6921	-0.0006	0.0053
	1.0881	1.0885	0.0004	0.0042

*CNR = Customer not request

4.Stray Light*

Standard cut-off wavelenght (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.96±0.11nm	200.30	0.9505	2.0229

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A
***Stray Light not NSC-ONSC Accredited.**

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

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

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Certificate of Calibration

Certificate No.	BSCC-UV-367/23
Equipment	UV/Vis Spectrophotometer
Model	UV-1800
Manufacturer	Shimadzu
Serial No.	A11454908533CD
ID No.	BKK_EN0018
Date of receipt	15 September 2023
Date of calibration	15 September 2023
Date of issue	22 September 2023

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

Customer name	ALS Laboratory Group (Thailand) Co., Ltd
Address	104 Soi Phattanakan 40, Phattanakan Road, Phattanakan Suan Luang Bangkok 10250
Temperature	(23.4 - 24.7) °C (On site)
Humidity	(55.5 - 61.2) %RH (On site)
Equipment condition	Good Operation
Calibration Location	Organic Prep
Calibration Procedure	In-house method WI-UV-702-01 based on ASTM E275-01
Traceability	Wavelength Accuracy is traceable to certificate No. 95917 and 95918 Photometric Accuracy is traceable to certificate No. 95937 and 95924 Stray Light is traceable to certificate No. 95908 The above certificate are traceble 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

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NSC-TISI-TIS 17025 CALIBRATION 0202

Certificate of Calibration

Certificate No. BSCC-UV-367/23 Number of Page(s) 2 of 3

Calibration Results:

1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.99	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

2.Photometric Accuracy (UV)

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

*CNR = Customer not request

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Bara Scientific

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

NSC-TISI-TIS 17025 CALIBRATION 0202

Certificate of Calibration

Certificate No. BSCC-UV-367/23 Number of Page(s) 3 of 3

Calibration Results:

3.Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5793	0.0010	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.0206	1.0216	0.0010	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5625	0.0004	0.0042
	0.7455	0.7452	-0.0003	0.0042
	0.9985	0.9989	0.0004	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.9487	0.9486	-0.0001	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9959	0.9944	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7253	0.7236	-0.0017	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5612	-0.0004	0.0042
	0.6927	0.6909	-0.0018	0.0042
	1.0881	1.0866	-0.0015	0.0042

*CNR = Customer not request

4.Stray Light*

Standard	Unit Under Calibration(UUC)		
cut-off wavelenght (nm)	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.96±0.11nm	200.55	0.9770	2.0104

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A
*Stray Light not NSC-CNSC 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 mentioned in this report / certificate. Advertising the report / Certificate and publicity of the results are prohibited and shall not be reproduced except in full without written approval of the Bara Scientific Co., Ltd.

ALS

Lot No. 2390836-1

ANALYZER CALIBRATION DATA

Client : Dow Chemical Thailand Ltd. Location : TOX1 (ERU Stack)
Date : 10 Aug 23 Test Operator : Sakait P.

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.04
Low-Level Gas	8.04	8.02	8.03	0.04
Span Gas	16.00	15.98	15.99	0.04

NO_x ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.04	-0.01	0.03
Low-Level Gas	54.96	54.92	54.95	0.03
Span Gas	82.51	82.47	82.50	0.03

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 425
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.01
Low-Level Gas	54.84	54.82	54.83	0.00
Span Gas	79.74	79.72	79.73	0.01

Calibrated by

Sakait P

(Mr.Sakait Phaisanphiaut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

ALS

Lot No. 2390836-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Dow Chemical Thailand Ltd. Location : TOX1 (ERU Stack)
Date : 10 Aug 23 Test Operator : Sakait P.

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.04	0.04
Upscale Gas	15.98	15.98	0.00	15.99	0.04	0.04

NO_x ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.04	-0.04	0.00	-0.01	0.03	0.03
Upscale Gas	82.47	82.47	0.00	82.50	0.03	0.03

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	79.72	79.72	0.00	79.73	0.01	0.01

Calibrated by

Sakait P

(Mr.Sakait Phaisanphiaut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

EMISSION TEST RESULT

Client	Dow Chemical Thailand Ltd.	Run #	1
Date	10 Aug 23	Location	TOX1 (ERU Stack)
Start Time	12:00	Test Operator	Sakait P.
SO_2 Analyzer Model	TELEDYNE API 100EH	Finish Time	12:20
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:00	8.68	8.32	12.40	-	0.90	
12:01	8.71	8.34	12.41	-	0.91	
12:02	8.69	8.32	12.45	-	0.89	
12:03	8.72	8.31	12.37	-	0.76	
12:04	8.73	8.36	12.30	-	0.81	
12:05	8.73	8.34	12.27	-	0.82	
12:06	8.73	8.34	12.32	-	0.79	
12:07	8.73	8.33	12.32	-	0.79	
12:08	8.72	8.35	12.34	-	0.88	
12:09	8.73	8.38	12.38	-	0.80	
12:10	8.73	8.38	12.39	-	0.82	
12:11	8.73	8.37	12.40	-	0.82	
12:12	8.70	8.40	12.48	-	0.76	
12:13	8.66	8.46	12.54	-	0.70	
12:14	8.66	8.44	12.52	-	0.74	
12:15	8.64	8.39	12.49	-	0.71	
12:16	8.65	8.43	12.45	-	0.73	
12:17	8.64	8.33	12.42	-	0.61	
12:18	8.64	8.42	12.39	-	0.66	
12:19	8.62	8.48	12.37	-	0.66	
12:20	8.59	8.40	12.43	-	0.67	
Average	**8.68**	**8.37**	**12.40**	**-**	**0.77**	

Sakait P.

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

EMISSION TEST RESULT

Client	Dow Chemical Thailand Ltd.	Run #	2
Date	10 Aug 23	Location	TOX1 (ERU Stack)
Start Time	12:21	Test Operator	Sakait P.
SO_2 Analyzer Model	TELEDYNE API 100EH	Finish Time	12:41
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:21	8.55	8.45	12.58	-	0.69	
12:22	8.53	8.39	12.63	-	0.66	
12:23	8.51	8.54	12.64	-	0.71	
12:24	8.51	8.53	12.62	-	0.68	
12:25	8.52	8.47	12.59	-	0.67	
12:26	8.49	8.48	12.54	-	0.59	
12:27	8.46	8.56	12.53	-	0.59	
12:28	8.43	8.56	12.57	-	0.69	
12:29	8.41	8.52	12.63	-	0.44	
12:30	8.38	8.58	12.68	-	0.54	
12:31	8.37	8.60	12.66	-	0.62	
12:32	8.35	8.56	12.62	-	0.56	
12:33	8.35	8.60	12.64	-	0.55	
12:34	8.35	8.59	12.69	-	0.57	
12:35	8.36	8.63	12.69	-	0.59	
12:36	8.37	8.56	12.60	-	0.58	
12:37	8.39	8.61	12.57	-	0.56	
12:38	8.39	8.57	12.54	-	0.55	
12:39	8.41	8.50	12.38	-	0.56	
12:40	8.44	8.53	12.28	-	0.49	
12:41	8.46	8.45	12.23	-	0.49	
Average	**8.43**	**8.53**	**12.58**	**-**	**0.59**	

Sakait P.

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

EMISSION TEST RESULT

Client	Dow Chemical Thailand Ltd.	Run #	3
Date	10 Aug 23	Location	TOX1 (ERU Stack)
Start Time	12:42	Test Operator	Sakait P.
SO_2 Analyzer Model	TELEDYNE API 100EH	Finish Time	13:02
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:42	8.48	8.53	12.23	-	0.47	
12:43	8.48	8.49	12.22	-	0.49	
12:44	8.50	8.49	12.17	-	0.40	
12:45	8.52	8.53	12.12	-	0.43	
12:46	8.54	8.49	12.08	-	0.42	
12:47	8.54	8.46	12.01	-	0.43	
12:48	8.56	8.47	11.95	-	0.34	
12:49	8.57	8.50	11.93	-	0.48	
12:50	8.58	8.47	11.87	-	0.45	
12:51	8.58	8.41	11.85	-	0.42	
12:52	8.57	8.45	11.87	-	0.45	
12:53	8.57	8.43	11.85	-	0.43	
12:54	8.53	8.50	11.81	-	0.41	
12:55	8.52	8.50	11.88	-	0.37	
12:56	8.55	8.43	11.93	-	0.36	
12:57	8.55	8.43	11.91	-	0.38	
12:58	8.55	8.46	11.90	-	0.37	
12:59	8.55	8.36	11.83	-	0.35	
13:00	8.55	8.48	11.74	-	0.30	
13:01	8.55	8.47	11.66	-	0.30	
13:02	8.52	8.50	11.63	-	0.27	
Average	**8.54**	**8.48**	**11.92**	**-**	**0.40**	

Sakait P.

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

Lot No. 2391088-1

ANALYZER CALIBRATION DATA

Client : Dow Chemical Thailand Ltd. Location : TOX2 (ERU Stack)

Date : 09 Aug 23 Test Operator : Sakait P.

O_2 ANALYZER

Model : TELEDYNE API 200EH Serial No. : 735

Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.04
Low-Level Gas	8.04	8.02	8.03	0.04
Span Gas	16.00	15.98	15.99	0.04

NO_x ANALYZER

Model : TELEDYNE API 200EH Serial No. : 735

Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.07	-0.01	0.06
Low-Level Gas	54.96	54.89	54.95	0.06
Span Gas	82.51	82.44	82.50	0.06

CO ANALYZER

Model : TELEDYNE API 300EM Serial No. : 425

Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.01
Low-Level Gas	54.84	54.82	54.83	0.00
Span Gas	79.74	79.72	79.73	0.01

Calibrated by

Sakait P.

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

Lot No. 2391088-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Dow Chemical Thailand Ltd. Location : TOX2 (ERU Stack)
Date : 09 Aug 23 Test Operator : Sakait P.

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.04	0.04
Upscale Gas	15.98	15.98	0.00	15.99	0.04	0.04

NO_X ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.07	-0.07	0.00	-0.01	0.06	0.06
Upscale Gas	82.44	82.44	0.00	82.50	0.06	0.06

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	79.72	79.72	0.00	79.73	0.01	0.01

Calibrated by

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	1
Client	Dow Chemical Thailand Ltd.	Location	TOX2 (ERU Stack)
Date	09 Aug 23	Test Operator	Sakait P.
Start Time	12:30	Finish Time	12:50
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:30	5.19	9.61	6.61	-	0.82	
12:31	5.27	9.50	6.63	-	0.80	
12:32	5.31	9.50	6.64	-	0.86	
12:33	5.31	9.39	6.63	-	0.76	
12:34	5.34	9.36	6.62	-	0.69	
12:35	5.32	9.38	6.65	-	0.59	
12:36	5.34	9.46	6.69	-	0.47	
12:37	5.37	9.43	6.70	-	0.45	
12:38	5.37	9.42	6.73	-	0.34	
12:39	5.47	9.37	6.78	-	0.38	
12:40	5.59	9.20	6.82	-	0.49	
12:41	5.66	9.20	6.82	-	0.58	
12:42	5.72	9.27	6.82	-	0.68	
12:43	5.72	9.23	6.78	-	0.70	
12:44	5.77	9.21	6.74	-	0.76	
12:45	5.79	9.17	6.66	-	0.70	
12:46	5.81	9.04	6.64	-	0.76	
12:47	5.84	9.10	6.60	-	0.67	
12:48	5.82	9.12	6.61	-	0.74	
12:49	5.83	9.10	6.60	-	0.72	
12:50	5.88	9.04	6.55	-	0.81	
Average	**5.55**	**9.29**	**6.68**	**-**	**0.68**	

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	2
Client	Dow Chemical Thailand Ltd.	Location	TOX2 (ERU Stack)
Date	09 Aug 23	Test Operator	Sakait P.
Start Time	12:51	Finish Time	13:11
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:51	5.93	9.01	6.53	-	0.94	
12:52	5.98	8.97	6.51	-	0.97	
12:53	6.02	8.93	6.52	-	0.82	
12:54	6.07	8.96	6.52	-	0.85	
12:55	6.11	8.92	6.51	-	0.86	
12:56	6.15	8.83	6.48	-	0.83	
12:57	6.20	8.86	6.46	-	1.06	
12:58	6.24	8.84	6.48	-	1.22	
12:59	6.25	8.81	6.51	-	1.13	
13:00	6.25	8.86	6.54	-	0.95	
13:01	6.23	8.85	6.53	-	0.99	
13:02	6.29	8.82	6.51	-	1.20	
13:03	6.31	8.82	6.47	-	1.55	
13:04	6.26	8.83	6.50	-	1.41	
13:05	6.26	8.85	6.53	-	1.48	
13:06	6.29	8.77	6.55	-	1.04	
13:07	6.29	8.80	6.57	-	1.11	
13:08	6.27	8.81	6.58	-	1.42	
13:09	6.28	8.78	6.63	-	1.48	
13:10	6.32	8.79	6.62	-	1.25	
13:11	6.37	8.82	6.63	-	0.93	
Average	**6.20**	**8.85**	**6.53**	**-**	**1.12**	

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	3
Client	Dow Chemical Thailand Ltd.	Location	TOX2 (ERU Stack)
Date	09 Aug 23	Test Operator	Sakait P.
Start Time	13:12	Finish Time	13:32
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
13:12	6.38	8.75	6.60	-	1.46	
13:13	6.39	8.70	6.58	-	1.47	
13:14	6.40	8.76	6.53	-	1.16	
13:15	6.39	8.71	6.51	-	1.05	
13:16	6.40	8.65	6.52	-	1.02	
13:17	6.38	8.79	6.54	-	1.03	
13:18	6.34	8.81	6.55	-	1.05	
13:19	6.32	8.69	6.55	-	1.61	
13:20	6.33	8.76	6.59	-	1.89	
13:21	6.35	8.71	6.59	-	1.41	
13:22	6.34	8.81	6.58	-	1.42	
13:23	6.33	8.76	6.56	-	1.74	
13:24	6.31	8.86	6.56	-	1.75	
13:25	6.27	8.86	6.54	-	1.52	
13:26	6.28	8.79	6.55	-	1.04	
13:27	6.30	8.79	6.58	-	0.82	
13:28	6.26	8.80	6.60	-	0.70	
13:29	6.24	8.87	6.57	-	0.68	
13:30	6.28	8.82	6.57	-	0.99	
13:31	6.30	8.83	6.57	-	1.20	
13:32	6.29	8.77	6.55	-	1.09	
Average	**6.32**	**8.77**	**6.56**	**-**	**1.24**	

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

Lot No. 2390836-1

ANALYZER CALIBRATION DATA

Client : Dow Chemical Thailand Ltd. Location : TOX1 (ERU Stack)
Date : 10 Aug 23 Test Operator : Saksit P.

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 725
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.04
Low-Level Gas	8.04	8.02	8.03	0.04
Span Gas	16.00	15.98	15.99	0.04

NO_X ANALYZER
Model : TELEDYNE API 200EH Serial No. : 725
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	-0.01	0.02
Low-Level Gas	54.96	54.92	54.95	0.02
Span Gas	82.51	82.47	82.50	0.02

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 425
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.01
Low-Level Gas	54.84	54.82	54.83	0.00
Span Gas	79.74	79.72	79.73	0.01

Calibrated by

Saksit P.

(Mr.Saksit Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

Lot No. 2390836-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Dow Chemical Thailand Ltd. Location : TOX1 (ERU Stack)
Date : 10 Aug 23 Test Operator : Saksit P.

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.04	0.04
Upscale Gas	15.98	15.98	0.00	15.99	0.04	0.04

NO_X ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 200

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.04	-0.04	0.00	-0.01	0.02	0.02
Upscale Gas	82.47	82.47	0.00	82.50	0.02	0.02

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	79.72	79.72	0.00	79.73	0.01	0.01

Calibrated by

Saksit P.

(Mr.Saksit Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

CEMs Data

Client Name: Dow Chemical Thailand Ltd. Date: 10 Aug 23
Plant Name: AIE_HPPO-TPO Location: TOX1 (ERU Stack)

Run No: 1 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:00	-	10.48	0.00	8.63	-
10 Aug 23	12:01	-	10.32	0.00	8.62	-
10 Aug 23	12:02	-	10.40	0.00	8.63	-
10 Aug 23	12:03	-	10.15	0.00	8.66	-
10 Aug 23	12:04	-	10.27	0.00	8.66	-
10 Aug 23	12:05	-	10.26	0.00	8.64	-
10 Aug 23	12:06	-	10.17	0.00	8.66	-
10 Aug 23	12:07	-	10.36	0.00	8.65	-
10 Aug 23	12:08	-	10.21	0.00	8.65	-
10 Aug 23	12:09	-	10.37	0.00	8.66	-
10 Aug 23	12:10	-	10.34	0.00	8.66	-
10 Aug 23	12:11	-	10.59	0.00	8.64	-
10 Aug 23	12:12	-	10.56	0.00	8.58	-
10 Aug 23	12:13	-	10.54	0.00	8.59	-
10 Aug 23	12:14	-	10.33	0.00	8.56	-
10 Aug 23	12:15	-	10.56	0.00	8.58	-
10 Aug 23	12:16	-	10.51	0.00	8.57	-
10 Aug 23	12:17	-	10.40	0.00	8.56	-
10 Aug 23	12:18	-	10.43	0.00	8.55	-
10 Aug 23	12:19	-	10.54	0.00	8.52	-
10 Aug 23	12:20	-	10.58	0.00	8.48	-
Max		-	10.59	0.00	8.66	-
Avg		-	10.40	0.00	8.61	-

Run No: 2 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:21	-	10.81	0.00	8.45	-
10 Aug 23	12:22	-	10.89	0.00	8.45	-
10 Aug 23	12:23	-	10.83	0.00	8.42	-
10 Aug 23	12:24	-	10.72	0.00	8.46	-
10 Aug 23	12:25	-	10.59	0.00	8.43	-
10 Aug 23	12:26	-	10.59	0.00	8.38	-
10 Aug 23	12:27	-	10.66	0.00	8.36	-
10 Aug 23	12:28	-	10.65	0.00	8.35	-
10 Aug 23	12:29	-	10.57	0.00	8.30	-
10 Aug 23	12:30	-	10.52	0.00	8.30	-
10 Aug 23	12:31	-	10.53	0.00	8.27	-
10 Aug 23	12:32	-	10.52	0.00	8.27	-
10 Aug 23	12:33	-	10.65	0.00	8.28	-
10 Aug 23	12:34	-	10.49	0.00	8.28	-
10 Aug 23	12:35	-	10.16	0.00	8.30	-
10 Aug 23	12:36	-	10.26	0.00	8.30	-
10 Aug 23	12:37	-	10.15	0.00	8.32	-
10 Aug 23	12:38	-	9.91	0.00	8.33	-
10 Aug 23	12:39	-	9.83	0.00	8.35	-
10 Aug 23	12:40	-	9.70	0.00	8.39	-
10 Aug 23	12:41	-	9.93	0.00	8.41	-
Max		-	10.89	0.00	8.45	-
Avg		-	10.41	0.00	8.35	-

Run No: 3 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:42	-	9.81	0.00	8.40	-
10 Aug 23	12:43	-	9.86	0.00	8.43	-
10 Aug 23	12:44	-	9.94	0.00	8.43	-
10 Aug 23	12:45	-	9.78	0.00	8.46	-
10 Aug 23	12:46	-	9.74	0.00	8.46	-
10 Aug 23	12:47	-	9.72	0.00	8.45	-
10 Aug 23	12:48	-	9.83	0.00	8.49	-
10 Aug 23	12:49	-	9.55	0.00	8.52	-
10 Aug 23	12:50	-	9.46	0.00	8.48	-
10 Aug 23	12:51	-	9.57	0.00	8.50	-
10 Aug 23	12:52	-	9.52	0.00	8.50	-
10 Aug 23	12:53	-	9.63	0.00	8.46	-
10 Aug 23	12:54	-	9.70	0.00	8.44	-
10 Aug 23	12:55	-	9.59	0.00	8.47	-
10 Aug 23	12:56	-	9.59	0.00	8.49	-
10 Aug 23	12:57	-	9.53	0.00	8.46	-
10 Aug 23	12:58	-	9.43	0.00	8.48	-
10 Aug 23	12:59	-	9.34	0.00	8.45	-
10 Aug 23	13:00	-	9.17	0.00	8.49	-
10 Aug 23	13:01	-	9.12	0.00	8.44	-
10 Aug 23	13:02	-	9.14	0.00	8.42	-
Max		-	9.94	0.00	8.52	-
Avg		-	9.54	0.00	8.47	-

Run No: 4 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:03	-	8.96	0.00	8.41	-
10 Aug 23	13:04	-	8.93	0.00	8.45	-
10 Aug 23	13:05	-	8.80	0.00	8.53	-
10 Aug 23	13:06	-	8.53	0.00	8.56	-
10 Aug 23	13:07	-	8.57	0.00	8.54	-
10 Aug 23	13:08	-	8.67	0.00	8.52	-
10 Aug 23	13:09	-	8.73	0.00	8.49	-
10 Aug 23	13:10	-	8.68	0.00	8.45	-
10 Aug 23	13:11	-	8.70	0.00	8.50	-
10 Aug 23	13:12	-	8.87	0.00	8.43	-
10 Aug 23	13:13	-	9.01	0.00	8.42	-
10 Aug 23	13:14	-	9.26	0.00	8.34	-
10 Aug 23	13:15	-	9.35	0.00	8.28	-
10 Aug 23	13:16	-	9.63	0.00	8.22	-
10 Aug 23	13:17	-	9.73	0.00	8.19	-
10 Aug 23	13:18	-	9.67	0.00	8.13	-
10 Aug 23	13:19	-	9.69	0.00	8.13	-
10 Aug 23	13:20	-	9.67	0.00	8.12	-
10 Aug 23	13:21	-	9.65	0.00	8.14	-
10 Aug 23	13:22	-	8.68	0.00	8.09	-
10 Aug 23	13:23	-	8.73	0.00	8.08	-
Max		-	9.73	0.00	8.56	-
Avg		-	9.16	0.00	8.33	-

Run No: 5 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:24	-	9.64	0.00	8.09	-
10 Aug 23	13:25	-	9.41	0.00	8.12	-
10 Aug 23	13:26	-	9.46	0.00	8.15	-
10 Aug 23	13:27	-	9.08	0.00	8.21	-
10 Aug 23	13:28	-	9.01	0.00	8.26	-
10 Aug 23	13:29	-	9.02	0.00	8.26	-
10 Aug 23	13:30	-	9.00	0.00	8.28	-
10 Aug 23	13:31	-	8.69	0.00	8.28	-
10 Aug 23	13:32	-	8.65	0.00	8.32	-
10 Aug 23	13:33	-	8.73	0.00	8.30	-
10 Aug 23	13:34	-	8.79	0.00	8.32	-
10 Aug 23	13:35	-	8.76	0.00	8.31	-
10 Aug 23	13:36	-	8.62	0.00	8.33	-
10 Aug 23	13:37	-	8.65	0.00	8.39	-
10 Aug 23	13:38	-	8.51	0.00	8.31	-
10 Aug 23	13:39	-	8.50	0.00	8.34	-
10 Aug 23	13:40	-	8.52	0.00	8.34	-
10 Aug 23	13:41	-	8.59	0.00	8.34	-
10 Aug 23	13:42	-	8.84	0.00	8.33	-
10 Aug 23	13:43	-	8.85	0.00	8.30	-
10 Aug 23	13:44	-	8.88	0.00	8.27	-
Max		-	9.64	0.00	8.34	-
Avg		-	8.87	0.00	8.27	-

Run No: 6 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:45	-	8.97	0.00	8.25	-
10 Aug 23	13:46	-	9.30	0.00	8.22	-
10 Aug 23	13:47	-	9.22	0.00	8.23	-
10 Aug 23	13:48	-	9.27	0.00	8.20	-
10 Aug 23	13:49	-	9.15	0.00	8.21	-
10 Aug 23	13:50	-	9.19	0.00	8.23	-
10 Aug 23	13:51	-	9.12	0.00	8.23	-
10 Aug 23	13:52	-	9.07	0.00	8.26	-
10 Aug 23	13:53	-	9.03	0.00	8.30	-
10 Aug 23	13:54	-	9.04	0.00	8.21	-
10 Aug 23	13:55	-	9.74	0.00	8.24	-
10 Aug 23	13:56	-	8.94	0.00	8.23	-
10 Aug 23	13:57	-	8.80	0.00	8.22	-
10 Aug 23	13:58	-	8.92	0.00	8.21	-
10 Aug 23	13:59	-	8.85	0.00	8.18	-
10 Aug 23	14:00	-	8.85	0.00	8.19	-
10 Aug 23	14:01	-	8.73	0.00	8.15	-
10 Aug 23	14:02	-	8.68	0.00	8.19	-
10 Aug 23	14:03	-	8.71	0.00	8.15	-
10 Aug 23	14:04	-	8.64	0.00	8.14	-
10 Aug 23	14:05	-	8.76	0.00	8.16	-
Max		-	9.30	0.00	8.30	-
Avg		-	8.94	0.00	8.21	-

CEMs Data

Client Name: Dow Chemical Thailand Ltd. Date: 10 Aug 23
Plant Name: AIE_HPPO-TPO Location: TOX1 (ERU Stack)

Run No: 7 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:06	-	8.82	0.00	8.19	-
10 Aug 23	14:07	-	9.12	0.00	8.12	-
10 Aug 23	14:08	-	9.16	0.00	8.14	-
10 Aug 23	14:09	-	9.00	0.00	8.13	-
10 Aug 23	14:10	-	9.02	0.00	8.14	-
10 Aug 23	14:11	-	9.20	0.00	8.13	-
10 Aug 23	14:12	-	9.18	0.00	8.11	-
10 Aug 23	14:13	-	9.08	0.00	8.11	-
10 Aug 23	14:14	-	9.12	0.00	8.11	-
10 Aug 23	14:15	-	9.14	0.00	8.12	-
10 Aug 23	14:16	-	9.21	0.00	8.11	-
10 Aug 23	14:17	-	9.07	0.00	8.09	-
10 Aug 23	14:18	-	8.86	0.00	8.06	-
10 Aug 23	14:19	-	8.80	0.00	8.09	-
10 Aug 23	14:20	-	8.87	0.00	8.09	-
10 Aug 23	14:21	-	8.88	0.00	8.08	-
10 Aug 23	14:22	-	8.99	0.00	8.09	-
10 Aug 23	14:23	-	8.71	0.00	8.11	-
10 Aug 23	14:24	-	8.85	0.00	8.12	-
10 Aug 23	14:25	-	8.74	0.00	8.14	-
10 Aug 23	14:26	-	8.64	0.00	8.17	-
Max		-	9.21	0.00	8.19	-
Avg		-	8.97	0.00	8.12	-

Run No: 8 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:27	-	8.75	0.00	8.17	-
10 Aug 23	14:28	-	8.87	0.00	8.19	-
10 Aug 23	14:29	-	8.35	0.00	8.19	-
10 Aug 23	14:30	-	8.19	0.00	8.25	-
10 Aug 23	14:31	-	8.18	0.00	8.24	-
10 Aug 23	14:32	-	8.26	0.00	8.27	-
10 Aug 23	14:33	-	8.23	0.00	8.25	-
10 Aug 23	14:34	-	8.13	0.00	8.30	-
10 Aug 23	14:35	-	8.07	0.00	8.28	-
10 Aug 23	14:36	-	8.28	0.00	8.30	-
10 Aug 23	14:37	-	8.08	0.00	8.29	-
10 Aug 23	14:38	-	7.83	0.00	8.33	-
10 Aug 23	14:39	-	7.96	0.00	8.33	-
10 Aug 23	14:40	-	7.95	0.00	8.33	-
10 Aug 23	14:41	-	8.06	0.00	8.33	-
10 Aug 23	14:42	-	7.90	0.00	8.30	-
10 Aug 23	14:43	-	8.03	0.00	8.29	-
10 Aug 23	14:44	-	8.20	0.00	8.23	-
10 Aug 23	14:45	-	8.27	0.00	8.20	-
10 Aug 23	14:46	-	8.52	0.00	8.17	-
10 Aug 23	14:47	-	8.52	0.00	8.12	-
Max		-	8.75	0.00	8.33	-
Avg		-	8.20	0.00	8.26	-

Run No: 9 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:48	-	8.61	0.00	8.05	-
10 Aug 23	14:49	-	8.53	0.00	8.05	-
10 Aug 23	14:50	-	8.57	0.00	8.06	-
10 Aug 23	14:51	-	8.64	0.00	8.06	-
10 Aug 23	14:52	-	8.70	0.00	8.09	-
10 Aug 23	14:53	-	8.71	0.00	8.13	-
10 Aug 23	14:54	-	8.80	0.00	8.14	-
10 Aug 23	14:55	-	8.84	0.00	8.12	-
10 Aug 23	14:56	-	8.08	0.00	8.11	-
10 Aug 23	14:57	-	9.20	0.00	8.10	-
10 Aug 23	14:58	-	9.14	0.00	8.10	-
10 Aug 23	14:59	-	9.31	0.00	8.06	-
10 Aug 23	15:00	-	9.23	0.00	8.05	-
10 Aug 23	15:01	-	9.13	0.00	8.06	-
10 Aug 23	15:02	-	9.03	0.00	8.08	-
10 Aug 23	15:03	-	8.73	0.00	8.10	-
10 Aug 23	15:04	-	8.74	0.00	8.10	-
10 Aug 23	15:05	-	8.58	0.00	8.11	-
10 Aug 23	15:06	-	8.42	0.00	8.19	-
10 Aug 23	15:07	-	8.23	0.00	8.24	-
10 Aug 23	15:08	-	8.38	0.00	8.20	-
Max		-	9.31	0.00	8.24	-
Avg		-	8.79	0.00	8.10	-

Run No: 10 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:09	-	8.26	0.00	8.23	-
10 Aug 23	15:10	-	8.21	0.00	8.24	-
10 Aug 23	15:11	-	8.10	0.00	8.26	-
10 Aug 23	15:12	-	8.25	0.00	8.26	-
10 Aug 23	15:13	-	8.14	0.00	8.32	-
10 Aug 23	15:14	-	8.45	0.00	8.26	-
10 Aug 23	15:15	-	8.70	0.00	8.22	-
10 Aug 23	15:16	-	8.72	0.00	8.25	-
10 Aug 23	15:17	-	8.94	0.00	8.25	-
10 Aug 23	15:18	-	9.00	0.00	8.22	-
10 Aug 23	15:19	-	9.34	0.00	8.20	-
10 Aug 23	15:20	-	9.33	0.00	8.18	-
10 Aug 23	15:21	-	9.33	0.00	8.14	-
10 Aug 23	15:22	-	9.60	0.00	8.14	-
10 Aug 23	15:23	-	9.49	0.00	8.10	-
10 Aug 23	15:24	-	9.49	0.00	8.11	-
10 Aug 23	15:25	-	9.56	0.00	8.08	-
10 Aug 23	15:26	-	9.67	0.00	8.06	-
10 Aug 23	15:27	-	9.38	0.00	8.09	-
10 Aug 23	15:28	-	9.30	0.00	8.15	-
10 Aug 23	15:29	-	9.28	0.00	8.20	-
Max		-	9.67	0.00	8.32	-
Avg		-	8.96	0.00	8.19	-

Run No: 11 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:30	-	9.24	0.00	8.21	-
10 Aug 23	15:31	-	9.47	0.00	8.17	-
10 Aug 23	15:32	-	9.33	0.00	8.23	-
10 Aug 23	15:33	-	9.29	0.00	8.19	-
10 Aug 23	15:34	-	9.45	0.00	8.16	-
10 Aug 23	15:35	-	9.39	0.00	8.12	-
10 Aug 23	15:36	-	9.37	0.00	8.12	-
10 Aug 23	15:37	-	9.22	0.00	8.15	-
10 Aug 23	15:38	-	9.33	0.00	8.12	-
10 Aug 23	15:39	-	9.26	0.00	8.09	-
10 Aug 23	15:40	-	9.39	0.00	8.05	-
10 Aug 23	15:41	-	9.26	0.00	8.09	-
10 Aug 23	15:42	-	9.19	0.00	8.09	-
10 Aug 23	15:43	-	9.21	0.00	8.12	-
10 Aug 23	15:44	-	9.38	0.00	8.09	-
10 Aug 23	15:45	-	9.32	0.00	8.06	-
10 Aug 23	15:46	-	9.41	0.00	8.05	-
10 Aug 23	15:47	-	9.46	0.00	8.05	-
10 Aug 23	15:48	-	9.33	0.00	8.05	-
10 Aug 23	15:49	-	9.32	0.00	8.11	-
10 Aug 23	15:50	-	9.45	0.00	8.11	-
Max		-	9.47	0.00	8.21	-
Avg		-	9.34	0.00	8.12	-

Run No: 12 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:51	-	9.44	0.00	8.10	-
10 Aug 23	15:52	-	9.39	0.00	8.15	-
10 Aug 23	15:53	-	9.36	0.00	8.12	-
10 Aug 23	15:54	-	9.31	0.00	8.17	-
10 Aug 23	15:55	-	9.17	0.00	8.14	-
10 Aug 23	15:56	-	9.11	0.00	8.19	-
10 Aug 23	15:57	-	8.90	0.00	8.22	-
10 Aug 23	15:58	-	8.82	0.00	8.24	-
10 Aug 23	15:59	-	8.80	0.00	8.25	-
10 Aug 23	16:00	-	8.80	0.00	8.28	-
10 Aug 23	16:01	-	8.71	0.00	8.28	-
10 Aug 23	16:02	-	8.73	0.00	8.31	-
10 Aug 23	16:03	-	8.58	0.00	8.36	-
10 Aug 23	16:04	-	8.43	0.00	8.36	-
10 Aug 23	16:05	-	8.49	0.00	8.35	-
10 Aug 23	16:06	-	8.53	0.00	8.34	-
10 Aug 23	16:07	-	8.55	0.00	8.36	-
10 Aug 23	16:08	-	8.49	0.00	8.35	-
10 Aug 23	16:09	-	8.43	0.00	8.39	-
10 Aug 23	16:10	-	8.43	0.00	8.41	-
10 Aug 23	16:11	-	8.34	0.00	8.46	-
Max		-	9.44	0.00	8.46	-
Avg		-	8.80	0.00	8.28	-

Reference Method Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Date: 10 Aug 23
Location: TOX1 (ERU Stack)

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:00	-	12.40	0.90	8.69	8.32
10 Aug 23	12:01	-	12.41	0.91	8.71	8.34
10 Aug 23	12:02	-	12.45	0.89	8.69	8.32
10 Aug 23	12:03	-	12.37	0.76	8.72	8.31
10 Aug 23	12:04	-	12.30	0.81	8.73	8.36
10 Aug 23	12:05	-	12.27	0.82	8.73	8.34
10 Aug 23	12:06	-	12.32	0.79	8.73	8.34
10 Aug 23	12:07	-	12.32	0.79	8.73	8.33
10 Aug 23	12:08	-	12.34	0.88	8.72	8.35
10 Aug 23	12:09	-	12.38	0.85	8.73	8.38
10 Aug 23	12:10	-	12.39	0.82	8.73	8.38
10 Aug 23	12:11	-	12.40	0.82	8.73	8.37
10 Aug 23	12:12	-	12.48	0.76	8.70	8.40
10 Aug 23	12:13	-	12.54	0.70	8.66	8.46
10 Aug 23	12:14	-	12.52	0.74	8.66	8.44
10 Aug 23	12:15	-	12.49	0.71	8.64	8.39
10 Aug 23	12:16	-	12.45	0.73	8.65	8.43
10 Aug 23	12:17	-	12.42	0.61	8.64	8.33
10 Aug 23	12:18	-	12.39	0.66	8.64	8.42
10 Aug 23	12:19	-	12.37	0.68	8.62	8.48
10 Aug 23	12:20	-	12.43	0.67	8.59	8.49
Max		-	12.54	0.91	8.73	8.49
Avg		-	12.40	0.77	8.68	8.37

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:21	-	12.58	0.69	8.55	8.45
10 Aug 23	12:22	-	12.63	0.66	8.53	8.39
10 Aug 23	12:23	-	12.64	0.71	8.51	8.54
10 Aug 23	12:24	-	12.62	0.68	8.51	8.53
10 Aug 23	12:25	-	12.59	0.67	8.52	8.47
10 Aug 23	12:26	-	12.54	0.59	8.49	8.48
10 Aug 23	12:27	-	12.53	0.59	8.46	8.56
10 Aug 23	12:28	-	12.57	0.59	8.43	8.56
10 Aug 23	12:29	-	12.63	0.44	8.41	8.52
10 Aug 23	12:30	-	12.68	0.54	8.38	8.58
10 Aug 23	12:31	-	12.66	0.62	8.37	8.60
10 Aug 23	12:32	-	12.62	0.56	8.38	8.56
10 Aug 23	12:33	-	12.64	0.55	8.35	8.60
10 Aug 23	12:34	-	12.69	0.57	8.35	8.59
10 Aug 23	12:35	-	12.69	0.59	8.36	8.63
10 Aug 23	12:36	-	12.60	0.58	8.37	8.56
10 Aug 23	12:37	-	12.57	0.56	8.39	8.61
10 Aug 23	12:38	-	12.54	0.55	8.39	8.57
10 Aug 23	12:39	-	12.38	0.56	8.41	8.50
10 Aug 23	12:40	-	12.28	0.49	8.44	8.53
10 Aug 23	12:41	-	12.23	0.49	8.46	8.45
Max		-	12.69	0.71	8.55	8.63
Avg		-	12.56	0.59	8.43	8.53

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	12:42	-	12.23	0.47	8.48	8.53
10 Aug 23	12:43	-	12.22	0.49	8.48	8.49
10 Aug 23	12:44	-	12.17	0.40	8.50	8.49
10 Aug 23	12:45	-	12.12	0.43	8.52	8.53
10 Aug 23	12:46	-	12.08	0.42	8.54	8.49
10 Aug 23	12:47	-	12.01	0.43	8.54	8.46
10 Aug 23	12:48	-	11.95	0.34	8.56	8.47
10 Aug 23	12:49	-	11.93	0.48	8.57	8.50
10 Aug 23	12:50	-	11.87	0.45	8.59	8.47
10 Aug 23	12:51	-	11.85	0.42	8.58	8.41
10 Aug 23	12:52	-	11.87	0.45	8.57	8.45
10 Aug 23	12:53	-	11.85	0.43	8.57	8.43
10 Aug 23	12:54	-	11.81	0.41	8.53	8.50
10 Aug 23	12:55	-	11.99	0.37	8.52	8.50
10 Aug 23	12:56	-	11.93	0.36	8.55	8.43
10 Aug 23	12:57	-	11.91	0.38	8.55	8.43
10 Aug 23	12:58	-	11.90	0.37	8.55	8.46
10 Aug 23	12:59	-	11.83	0.35	8.55	8.39
10 Aug 23	13:00	-	11.74	0.30	8.56	8.48
10 Aug 23	13:01	-	11.65	0.30	8.56	8.47
10 Aug 23	13:02	-	11.63	0.27	8.52	8.50
Max		-	12.23	0.49	8.59	8.53
Avg		-	11.92	0.40	8.54	8.46

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:03	-	11.61	0.28	8.50	8.49
10 Aug 23	13:04	-	11.57	0.25	8.49	8.50
10 Aug 23	13:05	-	11.49	0.23	8.54	8.45
10 Aug 23	13:06	-	11.39	0.20	8.61	8.43
10 Aug 23	13:07	-	11.28	0.09	8.64	8.44
10 Aug 23	13:08	-	11.23	0.17	8.61	8.47
10 Aug 23	13:09	-	11.23	0.20	8.60	8.52
10 Aug 23	13:10	-	11.21	0.28	8.55	8.50
10 Aug 23	13:11	-	11.23	0.26	8.55	8.53
10 Aug 23	13:12	-	11.22	0.17	8.55	8.56
10 Aug 23	13:13	-	11.27	0.16	8.51	8.55
10 Aug 23	13:14	-	11.34	0.17	8.48	8.57
10 Aug 23	13:15	-	11.50	0.13	8.41	8.57
10 Aug 23	13:16	-	11.72	0.18	8.35	8.61
10 Aug 23	13:17	-	11.84	0.15	8.30	8.64
10 Aug 23	13:18	-	11.90	0.06	8.26	8.80
10 Aug 23	13:19	-	11.94	0.14	8.21	8.73
10 Aug 23	13:20	-	11.98	0.25	8.21	8.78
10 Aug 23	13:21	-	11.82	0.20	8.21	8.78
10 Aug 23	13:22	-	11.82	0.10	8.21	8.74
10 Aug 23	13:23	-	11.82	0.13	8.17	8.71
Max		-	11.94	0.29	8.64	8.80
Avg		-	11.53	0.18	8.42	8.58

Run No: 5 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:24	-	11.79	0.18	8.17	8.77
10 Aug 23	13:25	-	11.76	0.10	8.18	8.79
10 Aug 23	13:26	-	11.73	0.11	8.21	8.67
10 Aug 23	13:27	-	11.61	0.03	8.25	8.76
10 Aug 23	13:28	-	11.46	0.01	8.31	8.72
10 Aug 23	13:29	-	11.38	0.04	8.33	8.69
10 Aug 23	13:30	-	11.36	0.01	8.36	8.67
10 Aug 23	13:31	-	11.37	0.07	8.35	8.65
10 Aug 23	13:32	-	11.32	0.05	8.37	8.59
10 Aug 23	13:33	-	11.27	0.02	8.40	8.70
10 Aug 23	13:34	-	11.28	0.08	8.38	8.62
10 Aug 23	13:35	-	11.29	0.07	8.40	8.67
10 Aug 23	13:36	-	11.25	0.10	8.40	8.63
10 Aug 23	13:37	-	11.25	0.31	8.40	8.61
10 Aug 23	13:38	-	11.24	0.10	8.38	8.61
10 Aug 23	13:39	-	11.20	0.15	8.40	8.67
10 Aug 23	13:40	-	11.14	0.14	8.41	8.63
10 Aug 23	13:41	-	11.12	0.11	8.43	8.62
10 Aug 23	13:42	-	11.17	0.06	8.42	8.65
10 Aug 23	13:43	-	11.22	0.13	8.41	8.67
10 Aug 23	13:44	-	11.31	0.03	8.38	8.60
Max		-	11.79	0.21	8.43	8.79
Avg		-	11.35	0.09	8.34	8.65

Run No: 6 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	13:45	-	11.38	0.13	8.35	8.63
10 Aug 23	13:46	-	11.41	0.14	8.32	8.67
10 Aug 23	13:47	-	11.44	0.32	8.33	8.74
10 Aug 23	13:48	-	11.52	0.15	8.29	8.70
10 Aug 23	13:49	-	11.53	0.16	8.30	8.79
10 Aug 23	13:50	-	11.52	0.14	8.29	8.73
10 Aug 23	13:51	-	11.48	0.09	8.31	8.67
10 Aug 23	13:52	-	11.48	0.03	8.33	8.71
10 Aug 23	13:53	-	11.47	0.03	8.35	8.67
10 Aug 23	13:54	-	11.40	0.10	8.35	8.64
10 Aug 23	13:55	-	11.32	0.08	8.30	8.74
10 Aug 23	13:56	-	11.29	0.11	8.32	8.63
10 Aug 23	13:57	-	11.22	0.07	8.31	8.65
10 Aug 23	13:58	-	11.16	0.14	8.30	8.68
10 Aug 23	13:59	-	11.13	0.08	8.29	8.73
10 Aug 23	14:00	-	11.16	0.12	8.27	8.68
10 Aug 23	14:01	-	11.12	0.17	8.26	8.75
10 Aug 23	14:02	-	11.10	0.19	8.26	8.72
10 Aug 23	14:03	-	11.06	0.15	8.26	8.75
10 Aug 23	14:04	-	11.01	0.16	8.24	8.77
10 Aug 23	14:05	-	11.00	0.18	8.24	8.71
Max		-	11.53	0.32	8.36	8.79
Avg		-	11.29	0.13	8.29	8.70

Reference Method Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Date: 10 Aug 23
Location: TOX1 (ERU Stack)

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:06	-	11.05	0.20	8.26	8.67
10 Aug 23	14:07	-	11.10	0.18	8.26	8.69
10 Aug 23	14:08	-	11.16	0.18	8.21	8.65
10 Aug 23	14:09	-	11.20	0.17	8.23	8.67
10 Aug 23	14:10	-	11.21	0.22	8.22	8.69
10 Aug 23	14:11	-	11.23	0.28	8.23	8.72
10 Aug 23	14:12	-	11.41	[illegible]	[illegible]	[illegible]
10 Aug 23	14:13	-	11.40	0.43	8.20	8.78
10 Aug 23	14:14	-	11.44	0.32	8.20	8.81
10 Aug 23	14:15	-	11.46	0.31	8.20	8.75
10 Aug 23	14:16	-	11.51	0.25	8.21	8.83
10 Aug 23	14:17	-	11.51	0.24	8.19	8.80
10 Aug 23	14:18	-	11.48	0.23	8.18	8.80
10 Aug 23	14:19	-	11.40	0.28	8.16	8.75
10 Aug 23	14:20	-	11.30	0.32	8.18	8.73
10 Aug 23	14:21	-	11.31	0.24	8.18	8.79
10 Aug 23	14:22	-	11.30	0.29	8.18	8.74
10 Aug 23	14:23	-	11.32	0.26	8.19	8.75
10 Aug 23	14:24	-	11.30	0.27	8.20	8.74
10 Aug 23	14:25	-	11.33	0.23	8.21	8.79
10 Aug 23	14:26	-	11.24	0.22	8.24	8.66
Max		-	11.51	0.43	8.26	8.83
Avg		-	11.31	0.26	8.20	8.74

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:27	-	11.23	0.33	8.26	8.72
10 Aug 23	14:28	-	11.21	0.37	8.27	8.71
10 Aug 23	14:29	-	11.14	0.34	8.27	8.63
10 Aug 23	14:30	-	11.06	0.28	8.29	8.65
10 Aug 23	14:31	-	11.00	0.24	8.32	8.63
10 Aug 23	14:32	-	10.94	0.24	8.34	8.57
10 Aug 23	14:33	-	10.89	0.26	8.36	8.55
10 Aug 23	14:34	-	10.82	0.20	8.35	8.66
10 Aug 23	14:35	-	10.73	0.29	8.38	8.53
10 Aug 23	14:36	-	10.70	0.33	8.37	8.60
10 Aug 23	14:37	-	10.68	0.22	8.38	8.60
10 Aug 23	14:38	-	10.63	0.37	8.39	8.60
10 Aug 23	14:39	-	10.54	0.43	8.43	8.53
10 Aug 23	14:40	-	10.51	0.43	8.41	8.57
10 Aug 23	14:41	-	10.47	0.38	8.42	8.48
10 Aug 23	14:42	-	10.43	0.41	8.41	8.57
10 Aug 23	14:43	-	10.43	0.35	8.39	8.58
10 Aug 23	14:44	-	10.48	0.33	8.36	8.61
10 Aug 23	14:45	-	10.61	0.36	8.32	8.58
10 Aug 23	14:46	-	10.76	0.32	8.27	8.63
10 Aug 23	14:47	-	10.81	0.25	8.25	8.70
Max		-	11.23	0.43	8.43	8.72
Avg		-	10.76	0.32	8.34	8.60

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	14:48	-	10.92	0.32	8.19	8.79
10 Aug 23	14:49	-	11.00	0.36	8.15	8.77
10 Aug 23	14:50	-	11.03	0.46	8.14	8.78
10 Aug 23	14:51	-	11.02	0.37	8.14	8.77
10 Aug 23	14:52	-	11.02	0.38	8.15	8.80
10 Aug 23	14:53	-	11.00	0.36	8.18	8.72
10 Aug 23	14:54	-	10.89	0.37	8.22	8.69
10 Aug 23	14:55	-	11.07	0.23	8.22	8.76
10 Aug 23	14:56	-	11.10	0.27	8.20	8.69
10 Aug 23	14:57	-	11.15	0.36	8.19	8.78
10 Aug 23	14:58	-	11.18	0.30	8.19	8.71
10 Aug 23	14:59	-	11.22	0.28	8.18	8.75
10 Aug 23	15:00	-	11.27	0.35	8.15	8.82
10 Aug 23	15:01	-	11.29	0.35	8.14	8.88
10 Aug 23	15:02	-	11.29	0.33	8.15	8.70
10 Aug 23	15:03	-	11.22	0.31	8.17	8.70
10 Aug 23	15:04	-	11.14	0.31	8.20	8.77
10 Aug 23	15:05	-	11.09	0.41	8.19	8.66
10 Aug 23	15:06	-	11.06	0.45	8.22	8.73
10 Aug 23	15:07	-	10.94	0.42	8.29	8.63
10 Aug 23	15:08	-	10.84	0.35	8.30	8.66
Max		-	11.29	0.46	8.30	8.92
Avg		-	11.08	0.35	8.19	8.73

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:09	-	10.82	0.45	8.29	8.64
10 Aug 23	15:10	-	10.83	0.36	8.32	8.64
10 Aug 23	15:11	-	10.80	0.42	8.33	8.62
10 Aug 23	15:12	-	10.77	0.45	8.35	8.65
10 Aug 23	15:13	-	10.80	0.37	8.36	8.60
10 Aug 23	15:14	-	10.84	0.42	8.38	8.63
10 Aug 23	15:15	-	10.95	0.40	8.34	8.65
10 Aug 23	15:16	-	11.13	0.37	8.31	8.65
10 Aug 23	15:17	-	11.26	0.34	8.33	8.61
10 Aug 23	15:18	-	11.35	0.34	8.33	8.59
10 Aug 23	15:19	-	11.47	0.32	8.30	8.68
10 Aug 23	15:20	-	11.55	0.35	8.28	8.70
10 Aug 23	15:21	-	11.57	0.38	8.24	8.66
10 Aug 23	15:22	-	11.57	0.32	8.23	8.73
10 Aug 23	15:23	-	11.61	0.48	8.21	8.78
10 Aug 23	15:24	-	11.69	0.51	8.19	8.69
10 Aug 23	15:25	-	11.73	0.43	8.18	8.67
10 Aug 23	15:26	-	11.77	0.47	8.18	8.73
10 Aug 23	15:27	-	11.74	0.49	8.17	8.76
10 Aug 23	15:28	-	11.66	0.42	8.18	8.71
10 Aug 23	15:29	-	11.55	0.40	8.26	8.66
Max		-	11.77	0.51	8.38	8.78
Avg		-	11.30	0.41	8.27	8.66

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:30	-	11.52	0.32	8.28	8.66
10 Aug 23	15:31	-	11.55	0.31	8.30	8.69
10 Aug 23	15:32	-	11.62	0.30	8.27	8.70
10 Aug 23	15:33	-	11.65	0.31	8.29	8.69
10 Aug 23	15:34	-	11.63	0.32	8.27	8.69
10 Aug 23	15:35	-	11.64	0.33	8.23	8.76
10 Aug 23	15:36	-	11.69	0.33	8.21	8.78
10 Aug 23	15:37	-	11.70	0.35	8.23	8.73
10 Aug 23	15:38	-	11.67	0.42	8.23	8.71
10 Aug 23	15:39	-	11.66	0.42	8.20	8.75
10 Aug 23	15:40	-	11.72	0.42	8.17	8.75
10 Aug 23	15:41	-	11.76	0.33	8.18	8.81
10 Aug 23	15:42	-	11.71	0.40	8.19	8.76
10 Aug 23	15:43	-	11.64	0.48	8.19	8.75
10 Aug 23	15:44	-	11.65	0.43	8.20	8.73
10 Aug 23	15:45	-	11.65	0.42	8.17	8.80
10 Aug 23	15:46	-	11.66	0.57	8.16	8.79
10 Aug 23	15:47	-	11.64	0.43	8.14	8.83
10 Aug 23	15:48	-	11.65	0.47	8.16	8.76
10 Aug 23	15:49	-	11.60	0.42	8.19	8.72
10 Aug 23	15:50	-	11.57	0.45	8.20	8.76
Max		-	11.76	0.57	8.30	8.83
Avg		-	11.64	0.39	8.21	8.74

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
10 Aug 23	15:51	-	11.62	0.46	8.19	8.72
10 Aug 23	15:52	-	11.63	0.42	8.22	8.73
10 Aug 23	15:53	-	11.65	0.47	8.21	8.82
10 Aug 23	15:54	-	11.58	0.46	8.23	8.73
10 Aug 23	15:55	-	11.56	0.54	8.24	8.77
10 Aug 23	15:56	-	11.56	0.51	8.24	8.80
10 Aug 23	15:57	-	11.51	0.53	8.29	8.59
10 Aug 23	15:58	-	11.45	0.52	8.31	8.71
10 Aug 23	15:59	-	11.40	0.51	8.34	8.60
10 Aug 23	16:00	-	11.34	0.49	8.35	8.70
10 Aug 23	16:01	-	11.22	0.59	8.37	8.61
10 Aug 23	16:02	-	11.16	0.54	8.37	8.57
10 Aug 23	16:03	-	11.15	0.56	8.42	8.64
10 Aug 23	16:04	-	11.13	0.50	8.44	8.64
10 Aug 23	16:05	-	11.10	0.49	8.43	8.62
10 Aug 23	16:06	-	11.09	0.60	8.43	8.71
10 Aug 23	16:07	-	11.12	0.46	8.44	8.57
10 Aug 23	16:08	-	11.14	0.60	8.43	8.66
10 Aug 23	16:09	-	11.14	0.55	8.46	8.52
10 Aug 23	16:10	-	11.02	0.42	8.47	8.63
10 Aug 23	16:11	-	10.88	0.41	8.52	8.55
Max		-	11.69	0.60	8.52	8.82
Avg		-	11.31	0.51	8.35	8.66

Lot No. 2391088-1

ANALYZER CALIBRATION DATA

Client : Dow Chemical Thailand Ltd.
Date : 09 Aug 23
Location : TOX2 (ERU Stack)
Test Operator : Sakait P.

O_2 ANALYZER
Model : TELEDYNE API 200EH
Span (%) : 25
Serial No. : 725

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.04
Low-Level Gas	8.04	8.02	8.03	0.04
Span Gas	16.00	15.98	15.99	0.04

NO_x ANALYZER
Model : TELEDYNE API 200EH
Span (ppm) : 200
Serial No. : 725

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.07	-0.01	0.03
Low-Level Gas	54.96	54.89	54.95	0.03
Span Gas	82.51	82.44	82.50	0.03

CO ANALYZER
Model : TELEDYNE API 300EM
Span (ppm) : 200
Serial No. : 425

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.02	-0.01	0.01
Low-Level Gas	54.84	54.82	54.83	0.00
Span Gas	79.74	79.72	79.73	0.01

Calibrated by

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

Lot No. 2391088-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Dow Chemical Thailand Ltd.
Date : 09 Aug 23
Location : TOX2 (ERU Stack)
Test Operator : Sakait P.

O_2 ANALYZER
Cylinder Conc. (%) : 16.00
Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.04	0.04
Upscale Gas	15.98	15.98	0.00	15.99	0.04	0.04

NO_x ANALYZER
Cylinder Conc. (ppm) : 82.51
Span (ppm) : 200

	NO_x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.07	-0.07	0.00	-0.01	0.03	0.03
Upscale Gas	82.44	82.44	0.00	82.50	0.03	0.03

CO ANALYZER
Cylinder Conc. (ppm) : 79.74
Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.02	-0.02	0.00	-0.01	0.01	0.01
Upscale Gas	79.72	79.72	0.00	79.73	0.01	0.01

Calibrated by

Sakait P

(Mr.Sakait Phaisanphisut)

Environmental Field Scientist (4)

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

ALS Laboratory Group

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Date: 09 Aug 23
Location: TOX2 (ERU Stack)

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	12:25	-	9.38	2.05	4.93	-
09 Aug 23	12:26	-	9.23	1.94	4.97	-
09 Aug 23	12:27	-	8.39	2.06	4.89	-
09 Aug 23	12:28	-	9.49	2.11	5.01	-
09 Aug 23	12:29	-	8.55	2.15	5.10	-
09 Aug 23	12:30	-	8.60	2.03	5.16	-
09 Aug 23	12:31	-	8.42	2.19	5.17	-
09 Aug 23	12:32	-	8.61	2.26	5.16	-
09 Aug 23	12:33	-	8.51	1.97	5.19	-
09 Aug 23	12:34	-	8.40	2.00	5.17	-
09 Aug 23	12:35	-	8.57	2.00	5.22	-
09 Aug 23	12:36	-	8.55	2.11	5.20	-
09 Aug 23	12:37	-	8.73	1.91	5.25	-
09 Aug 23	12:38	-	8.65	1.89	5.42	-
09 Aug 23	12:39	-	8.72	2.01	5.48	-
09 Aug 23	12:40	-	8.57	1.77	5.58	-
09 Aug 23	12:41	-	8.60	1.88	5.55	-
09 Aug 23	12:42	-	8.42	1.87	5.61	-
09 Aug 23	12:43	-	8.40	1.88	5.63	-
09 Aug 23	12:44	-	8.29	1.89	5.66	-
09 Aug 23	12:45	-	8.21	1.82	5.68	-
Max		-	9.73	2.26	5.68	-
Avg		-	8.49	1.98	5.29	-

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	12:46	-	9.24	1.85	5.70	-
09 Aug 23	12:47	-	9.25	1.93	5.67	-
09 Aug 23	12:48	-	8.36	1.75	5.72	-
09 Aug 23	12:49	-	8.45	2.09	5.78	-
09 Aug 23	12:50	-	8.27	2.04	5.82	-
09 Aug 23	12:51	-	8.32	2.34	5.87	-
09 Aug 23	12:52	-	8.23	1.95	5.92	-
09 Aug 23	12:53	-	8.25	2.06	5.96	-
09 Aug 23	12:54	-	8.10	2.15	6.01	-
09 Aug 23	12:55	-	8.03	2.23	6.03	-
09 Aug 23	12:56	-	8.03	2.49	6.11	-
09 Aug 23	12:57	-	8.22	2.43	6.10	-
09 Aug 23	12:58	-	8.16	2.29	6.14	-
09 Aug 23	12:59	-	8.12	2.30	6.09	-
09 Aug 23	13:00	-	8.09	2.68	6.12	-
09 Aug 23	13:01	-	8.09	2.73	6.19	-
09 Aug 23	13:02	-	8.22	2.81	6.15	-
09 Aug 23	13:03	-	8.19	2.73	6.10	-
09 Aug 23	13:04	-	8.24	2.50	6.15	-
09 Aug 23	13:05	-	8.20	1.90	6.17	-
09 Aug 23	13:06	-	8.20	2.75	6.13	-
Max		-	8.45	2.81	6.19	-
Avg		-	8.20	2.29	6.00	-

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	13:07	-	8.33	2.61	6.13	-
09 Aug 23	13:08	-	8.35	2.58	6.17	-
09 Aug 23	13:09	-	8.22	2.04	6.23	-
09 Aug 23	13:10	-	8.23	2.51	6.25	-
09 Aug 23	13:11	-	8.14	2.94	6.26	-
09 Aug 23	13:12	-	8.15	2.59	6.27	-
09 Aug 23	13:13	-	8.10	2.80	6.26	-
09 Aug 23	13:14	-	8.10	2.31	6.27	-
09 Aug 23	13:15	-	8.17	2.38	6.28	-
09 Aug 23	13:16	-	8.18	2.22	6.26	-
09 Aug 23	13:17	-	8.19	3.09	6.19	-
09 Aug 23	13:18	-	8.26	3.27	6.18	-
09 Aug 23	13:19	-	8.12	3.28	6.23	-
09 Aug 23	13:20	-	8.26	2.56	6.21	-
09 Aug 23	13:21	-	8.13	2.93	6.20	-
09 Aug 23	13:22	-	8.17	3.37	6.18	-
09 Aug 23	13:23	-	8.16	2.92	6.14	-
09 Aug 23	13:24	-	8.24	2.40	6.13	-
09 Aug 23	13:25	-	8.23	2.84	6.16	-
09 Aug 23	13:26	-	8.24	1.75	6.18	-
09 Aug 23	13:27	-	8.16	1.88	6.11	-
Max		-	8.35	3.37	6.28	-
Avg		-	8.20	2.58	6.20	-

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	13:28	-	8.17	1.91	6.12	-
09 Aug 23	13:29	-	8.17	2.24	6.19	-
09 Aug 23	13:30	-	9.09	1.96	6.16	-
09 Aug 23	13:31	-	8.16	2.09	6.18	-
09 Aug 23	13:32	-	8.25	1.74	6.11	-
09 Aug 23	13:33	-	8.32	1.81	6.06	-
09 Aug 23	13:34	-	8.30	1.73	6.08	-
09 Aug 23	13:35	-	8.32	2.00	6.11	-
09 Aug 23	13:36	-	8.16	2.22	6.12	-
09 Aug 23	13:37	-	8.21	2.30	6.11	-
09 Aug 23	13:38	-	8.23	2.49	6.12	-
09 Aug 23	13:39	-	8.24	2.69	6.12	-
09 Aug 23	13:40	-	8.30	2.33	6.15	-
09 Aug 23	13:41	-	8.35	2.49	6.15	-
09 Aug 23	13:42	-	8.25	2.79	6.16	-
09 Aug 23	13:43	-	8.21	2.87	6.19	-
09 Aug 23	13:44	-	8.11	2.78	6.19	-
09 Aug 23	13:45	-	8.27	2.93	6.21	-
09 Aug 23	13:46	-	8.22	2.54	6.24	-
09 Aug 23	13:47	-	8.22	1.94	6.23	-
09 Aug 23	13:48	-	8.30	2.12	6.19	-
Max		-	8.32	2.93	6.24	-
Avg		-	8.22	2.28	6.15	-

Run No: 5 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	13:49	-	8.28	1.95	6.16	-
09 Aug 23	13:50	-	8.32	1.97	6.17	-
09 Aug 23	13:51	-	8.19	2.17	6.18	-
09 Aug 23	13:52	-	8.23	2.03	6.16	-
09 Aug 23	13:53	-	8.14	2.75	6.19	-
09 Aug 23	13:54	-	8.08	3.23	6.23	-
09 Aug 23	13:55	-	8.07	3.02	6.24	-
09 Aug 23	13:56	-	8.20	3.11	6.23	-
09 Aug 23	13:57	-	8.22	2.99	6.23	-
09 Aug 23	13:58	-	8.32	2.54	6.20	-
09 Aug 23	13:59	-	8.38	2.50	6.22	-
09 Aug 23	14:00	-	8.17	2.99	6.27	-
09 Aug 23	14:01	-	8.16	2.88	6.28	-
09 Aug 23	14:02	-	8.41	2.19	6.28	-
09 Aug 23	14:03	-	8.34	2.85	6.22	-
09 Aug 23	14:04	-	8.25	3.39	6.22	-
09 Aug 23	14:05	-	8.39	3.11	6.23	-
09 Aug 23	14:06	-	8.40	3.10	6.28	-
09 Aug 23	14:07	-	8.35	2.53	6.27	-
09 Aug 23	14:08	-	8.40	3.15	6.27	-
09 Aug 23	14:09	-	8.33	3.00	6.27	-
Max		-	8.41	3.99	6.28	-
Avg		-	8.27	2.71	6.23	-

Run No: 6 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	14:10	-	8.24	3.34	6.27	-
09 Aug 23	14:11	-	8.18	3.51	6.26	-
09 Aug 23	14:12	-	8.23	3.75	6.25	-
09 Aug 23	14:13	-	8.24	4.52	6.24	-
09 Aug 23	14:14	-	8.36	3.91	6.17	-
09 Aug 23	14:15	-	8.44	2.98	6.20	-
09 Aug 23	14:16	-	8.30	3.22	6.22	-
09 Aug 23	14:17	-	8.44	4.55	6.17	-
09 Aug 23	14:18	-	8.62	4.25	6.13	-
09 Aug 23	14:19	-	8.49	2.87	6.09	-
09 Aug 23	14:20	-	8.46	3.36	6.10	-
09 Aug 23	14:21	-	8.58	3.69	6.08	-
09 Aug 23	14:22	-	8.50	3.72	6.07	-
09 Aug 23	14:23	-	8.60	3.39	6.09	-
09 Aug 23	14:24	-	8.73	2.49	6.07	-
09 Aug 23	14:25	-	8.47	2.81	6.09	-
09 Aug 23	14:26	-	8.46	2.47	6.07	-
09 Aug 23	14:27	-	8.69	3.01	6.08	-
09 Aug 23	14:28	-	8.83	4.06	6.07	-
09 Aug 23	14:29	-	8.74	3.58	6.01	-
09 Aug 23	14:30	-	8.75	3.10	6.00	-
Max		-	8.75	4.55	6.27	-
Avg		-	8.49	3.43	6.13	-

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Date: 09 Aug 23
Location: TOX2 (ERU Stack)

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	14:31	-	8.70	2.58	6.01	-
09 Aug 23	14:32	-	8.83	2.42	5.58	-
09 Aug 23	14:33	-	8.63	2.58	5.42	-
09 Aug 23	14:34	-	8.94	2.23	5.41	-
09 Aug 23	14:35	-	9.06	2.07	5.37	-
09 Aug 23	14:36	-	9.01	1.79	5.47	-
09 Aug 23	14:37	-	8.98	1.86	5.42	-
09 Aug 23	14:38	-	9.03	1.95	5.51	-
09 Aug 23	14:39	-	9.14	1.96	5.53	-
09 Aug 23	14:40	-	9.14	1.97	5.53	-
09 Aug 23	14:41	-	9.24	2.13	5.55	-
09 Aug 23	14:42	-	9.34	1.99	5.50	-
09 Aug 23	14:43	-	9.31	2.01	5.69	-
09 Aug 23	14:44	-	9.33	1.79	5.76	-
09 Aug 23	14:45	-	9.53	1.99	5.44	-
09 Aug 23	14:46	-	9.70	1.77	5.46	-
09 Aug 23	14:47	-	9.57	1.73	5.45	-
09 Aug 23	14:48	-	9.64	1.61	5.46	-
09 Aug 23	14:49	-	9.16	1.73	5.99	-
09 Aug 23	14:50	-	9.35	2.30	5.86	-
09 Aug 23	14:51	-	9.81	2.00	5.18	-
Max		-	9.70	3.09	6.18	-
Avg		-	9.19	2.07	5.50	-

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	14:52	-	9.33	3.49	5.79	-
09 Aug 23	14:53	-	9.46	3.25	5.73	-
09 Aug 23	14:54	-	9.51	3.89	5.75	-
09 Aug 23	14:55	-	9.82	3.18	5.67	-
09 Aug 23	14:56	-	9.66	2.38	5.59	-
09 Aug 23	14:57	-	9.84	2.97	5.60	-
09 Aug 23	14:58	-	10.09	2.64	5.53	-
09 Aug 23	14:59	-	10.33	1.79	5.46	-
09 Aug 23	15:00	-	10.55	1.88	5.42	-
09 Aug 23	15:01	-	10.67	1.71	5.35	-
09 Aug 23	15:02	-	10.69	1.81	5.38	-
09 Aug 23	15:03	-	10.72	1.56	5.60	-
09 Aug 23	15:04	-	10.66	1.98	5.69	-
09 Aug 23	15:05	-	11.04	1.40	5.33	-
09 Aug 23	15:06	-	10.87	1.73	5.71	-
09 Aug 23	15:07	-	11.32	1.55	5.36	-
09 Aug 23	15:08	-	11.46	1.69	5.22	-
09 Aug 23	15:09	-	11.56	1.53	5.37	-
09 Aug 23	15:10	-	11.56	1.54	5.53	-
09 Aug 23	15:11	-	11.98	1.43	5.22	-
09 Aug 23	15:12	-	11.92	1.37	5.25	-
Max		-	11.92	3.89	6.00	-
Avg		-	10.62	2.10	5.53	-

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	15:13	-	12.00	1.59	5.20	-
09 Aug 23	15:14	-	12.12	1.46	5.13	-
09 Aug 23	15:15	-	12.35	1.41	5.14	-
09 Aug 23	15:16	-	12.40	1.65	5.19	-
09 Aug 23	15:17	-	12.05	1.57	5.31	-
09 Aug 23	15:18	-	11.97	1.66	5.31	-
09 Aug 23	15:19	-	12.03	1.47	5.44	-
09 Aug 23	15:20	-	11.78	1.65	5.62	-
09 Aug 23	15:21	-	11.93	1.60	5.56	-
09 Aug 23	15:22	-	12.45	1.60	5.38	-
09 Aug 23	15:23	-	12.49	1.42	5.42	-
09 Aug 23	15:24	-	12.28	1.30	5.54	-
09 Aug 23	15:25	-	12.67	1.46	5.46	-
09 Aug 23	15:26	-	12.66	1.41	5.48	-
09 Aug 23	15:27	-	12.85	1.13	5.51	-
09 Aug 23	15:28	-	12.76	1.11	5.52	-
09 Aug 23	15:29	-	12.86	1.05	5.60	-
09 Aug 23	15:30	-	12.19	1.06	5.16	-
09 Aug 23	15:31	-	12.64	1.04	5.84	-
09 Aug 23	15:32	-	12.17	1.07	6.10	-
09 Aug 23	15:33	-	12.27	1.31	6.04	-
Max		-	12.86	1.67	6.16	-
Avg		-	12.31	1.30	5.60	-

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	15:34	-	12.69	1.14	5.76	-
09 Aug 23	15:35	-	12.19	1.27	6.24	-
09 Aug 23	15:36	-	12.34	1.45	6.37	-
09 Aug 23	15:37	-	12.55	1.28	6.11	-
09 Aug 23	15:38	-	12.05	1.53	6.65	-
09 Aug 23	15:39	-	12.41	1.44	6.20	-
09 Aug 23	15:40	-	12.79	1.00	6.03	-
09 Aug 23	15:41	-	12.44	1.65	6.35	-
09 Aug 23	15:42	-	12.33	2.29	6.71	-
09 Aug 23	15:43	-	12.45	2.24	6.43	-
09 Aug 23	15:44	-	12.68	3.41	6.47	-
09 Aug 23	15:45	-	12.66	3.37	6.42	-
09 Aug 23	15:46	-	12.94	3.21	6.34	-
09 Aug 23	15:47	-	12.89	3.29	6.44	-
09 Aug 23	15:48	-	12.96	3.14	6.47	-
09 Aug 23	15:49	-	13.19	2.85	6.13	-
09 Aug 23	15:50	-	12.88	2.74	6.61	-
09 Aug 23	15:51	-	13.19	2.87	6.18	-
09 Aug 23	15:52	-	12.96	2.71	6.60	-
09 Aug 23	15:53	-	13.42	2.94	6.18	-
09 Aug 23	15:54	-	13.30	2.94	6.27	-
Max		-	13.42	3.41	6.71	-
Avg		-	12.73	2.32	6.33	-

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	15:55	-	13.09	2.35	6.64	-
09 Aug 23	15:56	-	13.51	2.52	6.20	-
09 Aug 23	15:57	-	13.17	2.93	6.55	-
09 Aug 23	15:58	-	13.36	2.97	6.30	-
09 Aug 23	15:59	-	13.28	2.75	6.32	-
09 Aug 23	16:00	-	13.35	2.73	6.44	-
09 Aug 23	16:01	-	13.46	2.42	6.48	-
09 Aug 23	16:02	-	13.44	2.44	6.38	-
09 Aug 23	16:03	-	13.19	2.76	6.75	-
09 Aug 23	16:04	-	13.80	2.58	6.30	-
09 Aug 23	16:05	-	13.47	2.44	6.68	-
09 Aug 23	16:06	-	13.62	2.42	6.32	-
09 Aug 23	16:07	-	13.47	2.48	6.69	-
09 Aug 23	16:08	-	13.82	2.38	6.48	-
09 Aug 23	16:09	-	13.48	2.29	6.67	-
09 Aug 23	16:10	-	13.72	2.32	6.39	-
09 Aug 23	16:11	-	13.81	2.47	6.69	-
09 Aug 23	16:12	-	13.78	2.43	6.41	-
09 Aug 23	16:13	-	13.68	2.42	6.70	-
09 Aug 23	16:14	-	13.79	2.34	6.62	-
09 Aug 23	16:15	-	13.84	2.56	6.59	-
Max		-	13.84	2.79	6.75	-
Avg		-	13.51	2.49	6.51	-

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	16:16	-	13.68	2.26	6.75	-
09 Aug 23	16:17	-	13.77	2.11	6.67	-
09 Aug 23	16:18	-	13.79	2.14	6.58	-
09 Aug 23	16:19	-	13.54	2.24	6.80	-
09 Aug 23	16:20	-	13.66	2.03	6.61	-
09 Aug 23	16:21	-	13.56	1.89	6.91	-
09 Aug 23	16:22	-	12.40	2.14	7.01	-
09 Aug 23	16:23	-	13.71	2.19	6.79	-
09 Aug 23	16:24	-	13.71	2.19	6.86	-
09 Aug 23	16:25	-	14.07	2.03	6.65	-
09 Aug 23	16:26	-	13.69	2.15	6.99	-
09 Aug 23	16:27	-	13.80	2.39	6.63	-
09 Aug 23	16:28	-	13.46	2.10	7.02	-
09 Aug 23	16:29	-	13.66	2.11	6.77	-
09 Aug 23	16:30	-	13.46	2.08	7.05	-
09 Aug 23	16:31	-	13.84	2.22	6.75	-
09 Aug 23	16:32	-	13.51	2.28	7.14	-
09 Aug 23	16:33	-	13.87	2.14	6.76	-
09 Aug 23	16:34	-	13.59	2.25	7.11	-
09 Aug 23	16:35	-	13.70	2.19	6.92	-
09 Aug 23	16:36	-	13.84	2.04	6.92	-
Max		-	14.07	2.39	7.14	-
Avg		-	13.69	2.15	6.84	-

Reference Method Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Date: 09 Aug 23
Location: TOX2 (ERU Stack)

Run No: 1 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	12:25	-	6.42	0.83	5.31	9.64
09 Aug 23	12:26	-	6.45	0.78	5.13	9.57
09 Aug 23	12:27	-	6.47	0.89	5.11	9.59
09 Aug 23	12:28	-	6.49	0.95	5.14	9.57
09 Aug 23	12:29	-	6.55	0.94	5.14	9.56
09 Aug 23	12:30	-	6.61	0.93	5.19	9.51
09 Aug 23	12:31	-	6.63	0.80	5.27	9.50
09 Aug 23	12:32	-	6.64	0.86	5.31	9.50
09 Aug 23	12:33	-	6.63	0.76	5.31	9.39
09 Aug 23	12:34	-	6.62	0.69	5.34	9.36
09 Aug 23	12:35	-	6.65	0.59	5.32	9.38
09 Aug 23	12:36	-	6.69	0.47	5.34	9.40
09 Aug 23	12:37	-	6.70	0.45	5.37	9.43
09 Aug 23	12:38	-	6.73	0.34	5.37	9.42
09 Aug 23	12:39	-	6.78	0.36	5.47	9.37
09 Aug 23	12:40	-	6.82	0.65	5.39	9.20
09 Aug 23	12:41	-	6.82	0.58	5.66	9.20
09 Aug 23	12:42	-	6.82	0.68	5.72	9.27
09 Aug 23	12:43	-	6.78	0.70	5.72	9.23
09 Aug 23	12:44	-	6.74	0.79	5.77	9.21
09 Aug 23	12:45	-	6.69	0.70	5.79	9.17
Max		-	6.82	0.99	5.79	9.64
Avg		-	6.65	0.68	5.39	9.41

Run No: 2 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	12:46	-	6.64	0.76	5.81	9.04
09 Aug 23	12:47	-	6.60	0.67	5.84	9.10
09 Aug 23	12:48	-	6.61	0.74	5.82	9.12
09 Aug 23	12:49	-	6.60	0.72	5.83	9.10
09 Aug 23	12:50	-	6.55	0.81	5.88	9.04
09 Aug 23	12:51	-	6.53	0.94	5.92	9.01
09 Aug 23	12:52	-	6.51	0.97	5.98	8.97
09 Aug 23	12:53	-	6.52	0.82	6.02	8.93
09 Aug 23	12:54	-	6.52	0.85	6.07	8.96
09 Aug 23	12:55	-	6.51	0.88	6.11	8.92
09 Aug 23	12:56	-	6.48	0.83	6.15	8.93
09 Aug 23	12:57	-	6.46	1.06	6.20	8.88
09 Aug 23	12:58	-	6.48	1.22	6.24	8.84
09 Aug 23	12:59	-	6.51	1.13	6.25	8.81
09 Aug 23	13:00	-	6.54	0.95	6.25	8.86
09 Aug 23	13:01	-	6.53	0.99	6.23	8.85
09 Aug 23	13:02	-	6.51	1.20	6.29	8.82
09 Aug 23	13:03	-	6.47	1.55	6.31	8.82
09 Aug 23	13:04	-	6.50	1.41	6.28	8.83
09 Aug 23	13:05	-	6.53	1.03	6.29	8.85
09 Aug 23	13:06	-	6.55	1.04	6.29	8.77
Max		-	6.64	1.55	6.31	9.12
Avg		-	6.53	1.00	6.08	8.92

Run No: 3 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	13:07	-	6.57	1.11	6.29	8.80
09 Aug 23	13:08	-	6.58	1.42	6.27	8.81
09 Aug 23	13:09	-	6.63	1.48	6.28	8.78
09 Aug 23	13:10	-	6.62	1.23	6.32	8.79
09 Aug 23	13:11	-	6.63	0.93	6.37	8.82
09 Aug 23	13:12	-	6.60	1.46	6.38	8.75
09 Aug 23	13:13	-	6.58	1.47	6.39	8.70
09 Aug 23	13:14	-	6.53	1.16	6.40	8.76
09 Aug 23	13:15	-	6.51	1.05	6.39	8.71
09 Aug 23	13:16	-	6.52	1.02	6.40	8.65
09 Aug 23	13:17	-	6.54	1.03	6.38	8.79
09 Aug 23	13:18	-	6.55	1.05	6.34	8.81
09 Aug 23	13:19	-	6.55	1.61	6.32	8.69
09 Aug 23	13:20	-	6.59	1.69	6.33	8.76
09 Aug 23	13:21	-	6.59	1.41	6.35	8.71
09 Aug 23	13:22	-	6.58	1.42	6.34	8.81
09 Aug 23	13:23	-	6.56	1.74	6.33	8.76
09 Aug 23	13:24	-	6.56	1.75	6.31	8.86
09 Aug 23	13:25	-	6.54	1.53	6.37	8.96
09 Aug 23	13:26	-	6.55	1.04	6.28	8.79
09 Aug 23	13:27	-	6.58	0.92	6.35	8.79
Max		-	6.63	1.89	6.40	8.86
Avg		-	6.57	1.32	6.33	8.77

Run No: 4 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
09 Aug 23	13:28	-	6.60	0.70	6.26	8.80
09 Aug 23	13:29	-	6.57	0.88	6.24	8.87
09 Aug 23	13:30	-	6.57	0.99	6.28	8.82
09 Aug 23	13:31	-	6.57	1.20	6.30	8.83
09 Aug 23	13:32	-	6.55	1.09	6.28	8.77
09 Aug 23	13:33	-	6.52	0.98	6.27	8.88
09 Aug 23	13:34	-	6.56	0.88	6.22	8.90
09 Aug 23	13:35	-	6.60	0.88	6.19	8.84
09 Aug 23	13:36	-	6.64	0.78	6.22	8.84
09 Aug 23	13:37	-	6.65	1.02	6.24	8.76
09 Aug 23	13:38	-	6.62	1.03	6.25	8.87
09 Aug 23	13:39	-	6.59	1.08	6.24	8.87
09 Aug 23	13:40	-	6.55	1.32	6.24	8.77
09 Aug 23	13:41	-	6.57	1.21	6.20	8.85
09 Aug 23	13:42	-	6.58	1.16	6.28	8.75
09 Aug 23	13:43	-	6.61	1.33	6.28	8.85
09 Aug 23	13:44	-	6.59	1.43	6.30

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX1 (ERU Stack)

Run No: 1				Run No: 2				Run No: 3				Run No: 4			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
10-Aug-23	12:00	34264.7	209.8	10-Aug-23	12:20	33316.0	209.5	10-Aug-23	12:40	32810.8	209.1	10-Aug-23	13:00	33248.0	208.9
10-Aug-23	12:01	34395.4	209.7	10-Aug-23	12:21	33315.0	209.3	10-Aug-23	12:41	32865.5	209.0	10-Aug-23	13:01	33180.5	208.7
10-Aug-23	12:02	34356.1	209.6	10-Aug-23	12:22	33267.4	209.2	10-Aug-23	12:42	32920.2	208.8	10-Aug-23	13:02	33110.8	208.6
10-Aug-23	12:03	[illegible]	[illegible]	10-Aug-23	12:23	[illegible]	[illegible]	10-Aug-23	12:43	[illegible]	[illegible]	10-Aug-23	13:03	[illegible]	[illegible]
10-Aug-23	12:04	34456.8	209.4	10-Aug-23	12:24	33193.0	209.0	10-Aug-23	12:44	33029.6	208.7	10-Aug-23	13:04	32981.2	208.6
10-Aug-23	12:05	34419.7	209.4	10-Aug-23	12:25	33152.2	208.8	10-Aug-23	12:45	33079.3	208.6	10-Aug-23	13:05	32939.5	208.7
10-Aug-23	12:06	34417.5	209.5	10-Aug-23	12:26	33094.7	209.0	10-Aug-23	12:46	33112.6	208.7	10-Aug-23	13:06	32972.9	208.8
10-Aug-23	12:07	34355.9	209.6	10-Aug-23	12:27	33036.8	209.1	10-Aug-23	12:47	33146.8	208.8	10-Aug-23	13:07	32819.0	208.9
10-Aug-23	12:08	34280.2	209.8	10-Aug-23	12:28	32979.0	209.3	10-Aug-23	12:48	33181.4	209.0	10-Aug-23	13:08	32773.6	209.1
10-Aug-23	12:09	34204.4	210.0	10-Aug-23	12:29	32931.9	209.4	10-Aug-23	12:49	33224.1	209.1	10-Aug-23	13:09	32734.1	209.2
10-Aug-23	12:10	34143.6	210.2	10-Aug-23	12:30	32867.4	209.6	10-Aug-23	12:50	33266.4	209.3	10-Aug-23	13:10	32727.8	209.3
10-Aug-23	12:11	34093.1	210.4	10-Aug-23	12:31	32842.8	209.8	10-Aug-23	12:51	33309.3	209.5	10-Aug-23	13:11	32689.6	209.3
10-Aug-23	12:12	33954.4	210.5	10-Aug-23	12:32	32788.4	209.9	10-Aug-23	12:52	33350.2	209.7	10-Aug-23	13:12	32674.4	209.3
10-Aug-23	12:13	33822.8	210.6	10-Aug-23	12:33	32756.7	210.0	10-Aug-23	12:53	33392.0	209.8	10-Aug-23	13:13	32650.2	209.3
10-Aug-23	12:14	33711.2	210.6	10-Aug-23	12:34	32706.9	210.0	10-Aug-23	12:54	33435.8	209.8	10-Aug-23	13:14	32628.0	209.1
10-Aug-23	12:15	33605.4	210.5	10-Aug-23	12:35	32668.6	210.0	10-Aug-23	12:55	33437.1	209.7	10-Aug-23	13:15	32594.0	209.0
10-Aug-23	12:16	33543.4	210.4	10-Aug-23	12:36	32654.4	209.9	10-Aug-23	12:56	33422.1	209.6	10-Aug-23	13:16	32559.6	208.8
10-Aug-23	12:17	33488.6	210.2	10-Aug-23	12:37	32716.6	209.7	10-Aug-23	12:57	33381.8	209.4	10-Aug-23	13:17	32525.3	208.5
10-Aug-23	12:18	33401.5	210.0	10-Aug-23	12:38	32738.5	209.6	10-Aug-23	12:58	33342.6	209.2	10-Aug-23	13:18	32489.9	208.3
10-Aug-23	12:19	33389.1	209.8	10-Aug-23	12:39	32770.4	209.3	10-Aug-23	12:59	33310.2	209.0	10-Aug-23	13:19	32430.4	208.1
Max		34476.7	210.6	Max		33356.0	210.0	Max		33437.1	209.8	Max		33248.0	209.3
Avg		34031.6	210.0	Avg		32956.9	209.5	Avg		33189.5	209.2	Avg		32782.6	208.9

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX1 (ERU Stack)

Run No: 5				Run No: 6				Run No: 7				Run No: 8			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
10-Aug-23	13:20	32374.7	208.0	10-Aug-23	13:40	32063.3	207.5	10-Aug-23	14:00	30973.4	207.1	10-Aug-23	14:20	31841.1	207.3
10-Aug-23	13:21	32316.3	207.9	10-Aug-23	13:41	32062.4	207.5	10-Aug-23	14:01	30953.4	207.2	10-Aug-23	14:21	31901.0	207.5
10-Aug-23	13:22	32257.9	207.9	10-Aug-23	13:42	32137.4	207.6	10-Aug-23	14:02	30927.5	207.4	10-Aug-23	14:22	31951.5	207.7
10-Aug-23	13:23	[illegible]	[illegible]	10-Aug-23	13:43	[illegible]	[illegible]	10-Aug-23	14:03	[illegible]	[illegible]	10-Aug-23	14:23	[illegible]	[illegible]
10-Aug-23	13:24	32136.9	208.0	10-Aug-23	13:44	32234.9	207.8	10-Aug-23	14:04	30921.7	207.9	10-Aug-23	14:24	32083.2	208.2
10-Aug-23	13:25	32107.1	208.2	10-Aug-23	13:45	32185.8	208.0	10-Aug-23	14:05	30951.4	208.2	10-Aug-23	14:25	32155.8	208.4
10-Aug-23	13:26	32078.4	208.4	10-Aug-23	13:46	32146.6	208.2	10-Aug-23	14:06	31050.6	208.4	10-Aug-23	14:26	32231.4	208.5
10-Aug-23	13:27	32051.6	208.5	10-Aug-23	13:47	32066.5	208.3	10-Aug-23	14:07	31199.9	208.5	10-Aug-23	14:27	32307.0	208.6
10-Aug-23	13:28	32025.5	208.6	10-Aug-23	13:48	31955.9	208.4	10-Aug-23	14:08	31169.2	208.6	10-Aug-23	14:28	32382.0	208.6
10-Aug-23	13:29	32000.0	208.7	10-Aug-23	13:49	31822.0	208.4	10-Aug-23	14:09	31243.8	208.5	10-Aug-23	14:29	32461.7	208.5
10-Aug-23	13:30	31954.7	208.8	10-Aug-23	13:50	31682.0	208.4	10-Aug-23	14:10	31317.0	208.4	10-Aug-23	14:30	32495.6	208.4
10-Aug-23	13:31	31920.3	208.7	10-Aug-23	13:51	31578.8	208.3	10-Aug-23	14:11	31387.9	208.2	10-Aug-23	14:31	32509.6	208.2
10-Aug-23	13:32	31888.2	208.7	10-Aug-23	13:52	31492.6	208.1	10-Aug-23	14:12	31458.7	208.0	10-Aug-23	14:32	32552.5	208.1
10-Aug-23	13:33	31856.2	208.5	10-Aug-23	13:53	31387.0	207.9	10-Aug-23	14:13	31529.5	207.8	10-Aug-23	14:33	32569.0	207.9
10-Aug-23	13:34	31828.9	208.4	10-Aug-23	13:54	31299.8	207.7	10-Aug-23	14:14	31580.6	207.6	10-Aug-23	14:34	32442.1	207.7
10-Aug-23	13:35	31806.6	208.2	10-Aug-23	13:55	31248.7	207.5	10-Aug-23	14:15	31624.4	207.4	10-Aug-23	14:35	32314.2	207.5
10-Aug-23	13:36	31845.2	208.0	10-Aug-23	13:56	31189.0	207.3	10-Aug-23	14:16	31669.1	207.2	10-Aug-23	14:36	32191.4	207.4
10-Aug-23	13:37	31854.3	207.8	10-Aug-23	13:57	31132.4	207.2	10-Aug-23	14:17	31711.5	207.1	10-Aug-23	14:37	32069.3	207.4
10-Aug-23	13:38	31889.2	207.7	10-Aug-23	13:58	31077.0	207.1	10-Aug-23	14:18	31768.5	207.1	10-Aug-23	14:38	31941.6	207.4
10-Aug-23	13:39	31931.9	207.6	10-Aug-23	13:59	31020.0	207.1	10-Aug-23	14:19	31795.7	207.2	10-Aug-23	14:39	31812.5	207.5
Max		32374.7	208.8	Max		32234.9	208.4	Max		31795.7	208.6	Max		32569.0	208.6
Avg		32018.9	208.2	Avg		31697.1	207.8	Avg		31303.7	207.8	Avg		32210.8	207.9

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX1 (ERU Stack)

Run No: 9				Run No: 10				Run No: 11				Run No: 12			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
10-Aug-23	14:40	31706.5	207.6	10-Aug-23	15:00	32776.5	207.6	10-Aug-23	15:20	32726.9	208.0	10-Aug-23	15:40	33303.3	208.5
10-Aug-23	14:41	31628.8	207.6	10-Aug-23	15:01	32709.9	208.1	10-Aug-23	15:21	32669.5	208.9	10-Aug-23	15:41	33298.1	208.6
10-Aug-23	14:42	31605.0	208.0	10-Aug-23	15:02	32784.2	208.3	10-Aug-23	15:22	32599.2	209.1	10-Aug-23	15:42	33301.3	208.6
10-Aug-23	14:43	31573.4	208.2	10-Aug-23	15:03	32808.8	208.5	10-Aug-23	15:23	32516.9	209.3	10-Aug-23	15:43	33321.8	208.7
10-Aug-23	14:44	31548.3	208.4	10-Aug-23	15:04	32794.8	208.7	10-Aug-23	15:24	32445.6	209.4	10-Aug-23	15:44	33324.2	208.7
10-Aug-23	14:45	31523.1	208.6	10-Aug-23	15:05	32794.3	208.8	10-Aug-23	15:25	32374.3	209.5	10-Aug-23	15:45	33331.5	208.8
10-Aug-23	14:46	31488.0	208.7	10-Aug-23	15:06	32793.9	209.0	10-Aug-23	15:26	32303.0	209.5	10-Aug-23	15:46	33326.2	208.5
10-Aug-23	14:47	31474.6	208.7	10-Aug-23	15:07	32795.2	208.9	10-Aug-23	15:27	32218.4	209.4	10-Aug-23	15:47	33340.2	208.4
10-Aug-23	14:48	31466.8	208.7	10-Aug-23	15:08	32797.1	208.9	10-Aug-23	15:28	32235.5	209.2	10-Aug-23	15:48	33364.9	208.3
10-Aug-23	14:49	31553.8	208.6	10-Aug-23	15:09	32802.4	208.7	10-Aug-23	15:29	32479.2	208.9	10-Aug-23	15:49	33380.6	208.2
10-Aug-23	14:50	31535.8	208.4	10-Aug-23	15:10	32809.9	208.5	10-Aug-23	15:30	32492.8	208.8	10-Aug-23	15:50	33377.8	208.0
10-Aug-23	14:51	31629.0	208.2	10-Aug-23	15:11	32806.6	208.4	10-Aug-23	15:31	32707.5	208.5	10-Aug-23	15:51	33375.0	207.9
10-Aug-23	14:52	31762.7	208.1	10-Aug-23	15:12	32803.3	208.2	10-Aug-23	15:32	32832.1	208.4	10-Aug-23	15:52	33372.2	207.8
10-Aug-23	14:53	31800.4	207.9	10-Aug-23	15:13	32799.6	208.0	10-Aug-23	15:33	33162.1	208.2	10-Aug-23	15:53	33369.4	207.7
10-Aug-23	14:54	32039.1	207.8	10-Aug-23	15:14	32782.5	208.0	10-Aug-23	15:34	33313.0	208.1	10-Aug-23	15:54	33364.4	207.7
10-Aug-23	14:55	32117.3	207.6	10-Aug-23	15:15	32783.8	207.9	10-Aug-23	15:35	33321.5	208.1	10-Aug-23	15:55	33359.3	207.7
10-Aug-23	14:56	32319.1	207.6	10-Aug-23	15:16	32776.0	207.9	10-Aug-23	15:36	33335.8	208.1	10-Aug-23	15:56	33350.7	207.7
10-Aug-23	14:57	32462.2	207.6	10-Aug-23	15:17	32784.9	208.0	10-Aug-23	15:37	33339.3	208.2	10-Aug-23	15:57	33311.8	207.8
10-Aug-23	14:58	32598.0	207.6	10-Aug-23	15:18	32788.4	208.2	10-Aug-23	15:38	33314.6	208.3	10-Aug-23	15:58	33241.2	207.9
10-Aug-23	14:59	32690.3	207.7	10-Aug-23	15:19	32760.1	208.4	10-Aug-23	15:39	33295.3	208.4	10-Aug-23	15:59	33181.8	207.9
Max		32690.3	208.7	Max		32809.9	209.0	Max		33338.3	209.5	Max		33380.6	208.7
Avg		31831.4	208.1	Avg		32792.1	208.4	Avg		32787.6	208.7	Avg		33328.7	208.2

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX2 (ERU Stack)

Run No: 1				Run No: 2				Run No: 3				Run No: 4			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
9-Aug-23	12:30	37177.6	207.1	9-Aug-23	12:50	38503.3	208.3	9-Aug-23	13:10	41104.0	209.5	9-Aug-23	13:30	40664.6	209.5
9-Aug-23	12:31	37145.7	207.1	9-Aug-23	12:51	39573.5	208.4	9-Aug-23	13:11	41115.7	209.6	9-Aug-23	13:31	40663.7	209.5
9-Aug-23	12:32	37119.9	207.1	9-Aug-23	12:52	39647.1	208.5	9-Aug-23	13:12	41072.3	209.7	9-Aug-23	13:32	40652.8	209.5
9-Aug-23	12:33	37235.3	207.1	9-Aug-23	12:53	39740.5	208.6	9-Aug-23	13:13	41003.7	209.8	9-Aug-23	13:33	40643.6	209.5
9-Aug-23	12:34	37370.6	207.1	9-Aug-23	12:54	39835.6	208.7	9-Aug-23	13:14	40934.8	209.8	9-Aug-23	13:34	40613.7	209.5
9-Aug-23	12:35	37507.5	207.2	9-Aug-23	12:55	39918.3	208.8	9-Aug-23	13:15	40866.0	209.8	9-Aug-23	13:35	40602.5	209.5
9-Aug-23	12:36	37659.8	207.2	9-Aug-23	12:56	40034.2	208.8	9-Aug-23	13:16	40737.1	209.8	9-Aug-23	13:36	40591.6	209.5
9-Aug-23	12:37	37787.8	207.3	9-Aug-23	12:57	40132.1	209.0	9-Aug-23	13:17	40726.2	209.8	9-Aug-23	13:37	40599.7	209.6
9-Aug-23	12:38	37916.1	207.4	9-Aug-23	12:58	40210.0	209.1	9-Aug-23	13:18	40659.4	209.8	9-Aug-23	13:38	40588.8	209.6
9-Aug-23	12:39	38074.2	207.5	9-Aug-23	12:59	40333.1	209.2	9-Aug-23	13:19	40590.5	209.8	9-Aug-23	13:39	40558.9	209.6
9-Aug-23	12:40	38292.4	207.6	9-Aug-23	13:00	40440.7	209.2	9-Aug-23	13:20	40521.6	209.7	9-Aug-23	13:40	40546.6	209.6
9-Aug-23	12:41	38522.7	207.7	9-Aug-23	13:01	40531.4	209.3	9-Aug-23	13:21	40491.5	209.7	9-Aug-23	13:41	40542.7	209.6
9-Aug-23	12:42	38752.9	207.8	9-Aug-23	13:02	40605.2	209.3	9-Aug-23	13:22	40492.1	209.6	9-Aug-23	13:42	40560.9	209.6
9-Aug-23	12:43	38952.5	207.9	9-Aug-23	13:03	40666.4	209.3	9-Aug-23	13:23	40522.0	209.6	9-Aug-23	13:43	40583.2	209.6
9-Aug-23	12:44	39095.4	208.0	9-Aug-23	13:04	40727.7	209.3	9-Aug-23	13:24	40549.1	209.5	9-Aug-23	13:44	40599.6	209.7
9-Aug-23	12:45	39159.7	208.0	9-Aug-23	13:05	40789.0	209.3	9-Aug-23	13:25	40570.7	209.5	9-Aug-23	13:45	40619.9	209.6
9-Aug-23	12:46	39225.3	208.0	9-Aug-23	13:06	40851.7	209.4	9-Aug-23	13:26	40589.5	209.5	9-Aug-23	13:46	40635.7	209.6
9-Aug-23	12:47	39293.1	208.1	9-Aug-23	13:07	40916.9	209.4	9-Aug-23	13:27	40608.3	209.6	9-Aug-23	13:47	40652.1	209.6
9-Aug-23	12:48	39362.7	208.2	9-Aug-23	13:08	40979.6	209.4	9-Aug-23	13:28	40627.1	209.6	9-Aug-23	13:48	40668.4	209.6
9-Aug-23	12:49	39431.1	208.3	9-Aug-23	13:09	41041.8	209.5	9-Aug-23	13:29	40645.9	209.6	9-Aug-23	13:49	40684.7	209.5
Max		39431.1	208.3	Max		41041.8	209.5	Max		41115.7	209.8	Max		40684.7	209.7
Avg		38255.7	207.6	Avg		40326.0	209.0	Avg		40724.5	209.7	Avg		40611.6	209.6

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX2 (ERU Stack)

Run No: 5				Run No: 6				Run No: 7				Run No: 8			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
9-Aug-23	13:50	40702.8	209.5	9-Aug-23	14:10	40641.8	209.7	9-Aug-23	14:30	39112.4	209.5	9-Aug-23	14:50	39519.9	208.8
9-Aug-23	13:51	40727.1	209.5	9-Aug-23	14:11	40659.9	209.8	9-Aug-23	14:31	38984.0	209.6	9-Aug-23	14:51	39452.0	209.0
9-Aug-23	13:52	40721.8	209.5	9-Aug-23	14:12	40668.9	209.9	9-Aug-23	14:32	38798.7	209.4	9-Aug-23	14:52	39469.3	209.0
9-Aug-23	13:53	40712.8	209.6	9-Aug-23	14:13	40668.1	209.9	9-Aug-23	14:33	38762.3	209.2	9-Aug-23	14:53	39428.7	208.9
9-Aug-23	13:54	40703.8	209.6	9-Aug-23	14:14	40668.2	209.9	9-Aug-23	14:34	38756.9	208.8	9-Aug-23	14:54	39397.1	208.9
9-Aug-23	13:55	40695.1	209.7	9-Aug-23	14:15	40671.5	209.9	9-Aug-23	14:35	38756.5	208.7	9-Aug-23	14:55	39403.3	208.8
9-Aug-23	13:56	40686.2	209.7	9-Aug-23	14:16	40679.0	209.8	9-Aug-23	14:36	39002.5	208.5	9-Aug-23	14:56	39387.5	209.0
9-Aug-23	13:57	40676.0	209.7	9-Aug-23	14:17	40693.6	209.7	9-Aug-23	14:37	38992.3	209.4	9-Aug-23	14:57	39203.3	209.0
9-Aug-23	13:58	40663.1	209.7	9-Aug-23	14:18	40693.1	209.6	9-Aug-23	14:38	38911.9	208.3	9-Aug-23	14:58	39146.5	208.9
9-Aug-23	13:59	40652.6	209.7	9-Aug-23	14:19	40693.2	209.5	9-Aug-23	14:39	38871.6	208.2	9-Aug-23	14:59	39099.6	208.8
9-Aug-23	14:00	40633.2	209.7	9-Aug-23	14:20	40647.1	209.4	9-Aug-23	14:40	38831.2	209.1	9-Aug-23	15:00	39052.6	208.7
9-Aug-23	14:01	40596.7	209.7	9-Aug-23	14:21	40544.9	209.4	9-Aug-23	14:41	39423.3	209.1	9-Aug-23	15:01	38111.9	208.6
9-Aug-23	14:02	40601.4	209.7	9-Aug-23	14:22	40423.4	209.3	9-Aug-23	14:42	39423.4	209.1	9-Aug-23	15:02	38552.4	208.6
9-Aug-23	14:03	40608.8	209.7	9-Aug-23	14:23	40279.9	209.3	9-Aug-23	14:43	39339.3	209.2	9-Aug-23	15:03	38372.7	208.7
9-Aug-23	14:04	40611.6	209.7	9-Aug-23	14:24	40144.0	209.2	9-Aug-23	14:44	39291.5	208.3	9-Aug-23	15:04	38742.4	208.7
9-Aug-23	14:05	40616.2	209.7	9-Aug-23	14:25	40011.1	209.2	9-Aug-23	14:45	39244.8	208.4	9-Aug-23	15:05	38186.8	208.8
9-Aug-23	14:06	40620.7	209.7	9-Aug-23	14:26	39978.6	209.2	9-Aug-23	14:46	39207.8	208.4	9-Aug-23	15:06	38257.4	208.9
9-Aug-23	14:07	40628.3	209.7	9-Aug-23	14:27	39741.7	209.3	9-Aug-23	14:47	39562.2	208.4	9-Aug-23	15:07	38363.8	209.0
9-Aug-23	14:08	40635.1	209.7	9-Aug-23	14:28	39669.8	209.3	9-Aug-23	14:48	39594.1	208.5	9-Aug-23	15:08	38561.9	209.1
9-Aug-23	14:09	40647.6	209.7	9-Aug-23	14:29	39479.6	209.4	9-Aug-23	14:49	39604.8	208.7	9-Aug-23	15:09	38135.3	209.3
Max		40727.1	209.7	Max		40693.2	209.9	Max		39604.8	209.5	Max		39742.4	209.3
Avg		40656.8	209.7	Avg		40374.3	209.5	Avg		39117.2	208.6	Avg		39397.2	208.9

CEMs Data

Client Name: Dow Chemical Thailand Ltd.
Plant Name: AIE_HPPO-TPO
Location: TOX2 (ERU Stack)

Run No: 9				Run No: 10				Run No: 11				Run No: 12			
Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C	Date	Time	Flowrate kg/hr	Temperature °C
9-Aug-23	15:10	39144.4	209.5	9-Aug-23	15:30	42241.2	210.8	9-Aug-23	15:50	44843.9	212.8	9-Aug-23	16:10	46918.1	214.3
9-Aug-23	15:11	39164.4	209.6	9-Aug-23	15:31	42562.5	211.0	9-Aug-23	15:51	44917.1	213.0	9-Aug-23	16:11	46135.4	214.4
9-Aug-23	15:12	39164.4	209.7	9-Aug-23	15:32	42723.9	211.3	9-Aug-23	15:52	44958.3	213.2	9-Aug-23	16:12	46190.5	214.5
9-Aug-23	15:13	39202.2	209.8	9-Aug-23	15:33	42792.7	211.5	9-Aug-23	15:53	44723.5	213.3	9-Aug-23	16:13	46369.8	214.6
9-Aug-23	15:14	39285.8	209.7	9-Aug-23	15:34	42747.3	211.7	9-Aug-23	15:54	44817.7	213.4	9-Aug-23	16:14	46489.4	214.7
9-Aug-23	15:15	39511.5	209.7	9-Aug-23	15:35	42883.5	212.1	9-Aug-23	15:55	45096.5	213.6	9-Aug-23	16:15	46678.0	214.8
9-Aug-23	15:16	41202.8	209.7	9-Aug-23	15:36	43811.9	212.4	9-Aug-23	15:56	45180.3	213.7	9-Aug-23	16:16	46724.9	214.8
9-Aug-23	15:17	40400.5	209.8	9-Aug-23	15:37	43411.6	212.6	9-Aug-23	15:57	45448.2	213.8	9-Aug-23	16:17	46858.1	214.9
9-Aug-23	15:18	40864.8	209.9	9-Aug-23	15:38	43657.1	212.8	9-Aug-23	15:58	45539.8	214.0	9-Aug-23	16:18	46115.7	214.9
9-Aug-23	15:19	41158.8	210.1	9-Aug-23	15:39	43919.4	212.8	9-Aug-23	15:59	45193.1	214.1	9-Aug-23	16:19	46667.6	215.0
9-Aug-23	15:20	41674.5	210.3	9-Aug-23	15:40	44112.8	212.8	9-Aug-23	16:00	44085.1	214.2	9-Aug-23	16:20	46198.8	215.0
9-Aug-23	15:21	41117.4	210.3	9-Aug-23	15:41	43969.9	212.9	9-Aug-23	16:01	44670.6	214.1	9-Aug-23	16:21	46696.2	215.2
9-Aug-23	15:22	41180.6	210.3	9-Aug-23	15:42	44307.2	212.9	9-Aug-23	16:02	44743.6	214.1	9-Aug-23	16:22	46188.4	215.3
9-Aug-23	15:23	40981.9	210.3	9-Aug-23	15:43	44488.0	213.0	9-Aug-23	16:03	45360.5	214.1	9-Aug-23	16:23	46653.8	215.3
9-Aug-23	15:24	40889.7	210.3	9-Aug-23	15:44	44604.2	212.8	9-Aug-23	16:04	44918.1	214.1	9-Aug-23	16:24	46462.1	215.3
9-Aug-23	15:25	40843.6	210.3	9-Aug-23	15:45	44391.8	212.9	9-Aug-23	16:05	45327.9	214.1	9-Aug-23	16:25	46938.7	215.3
9-Aug-23	15:26	40780.5	210.3	9-Aug-23	15:46	44334.1	212.9	9-Aug-23	16:06	45337.6	214.1	9-Aug-23	16:26	46963.7	215.3
9-Aug-23	15:27	40810.9	210.3	9-Aug-23	15:47	43749.5	212.9	9-Aug-23	16:07	45744.2	214.1	9-Aug-23	16:27	47191.8	215.3
9-Aug-23	15:28	42404.8	210.4	9-Aug-23	15:48	45063.4	212.9	9-Aug-23	16:08	45690.5	214.2	9-Aug-23	16:28	47543.7	215.4
9-Aug-23	15:29	41887.8	210.6	9-Aug-23	15:49	43769.2	212.8	9-Aug-23	16:09	46086.9	214.3	9-Aug-23	16:29	46014.0	215.4
Max		42404.8	210.6	Max		45063.4	213.0	Max		46086.9	214.3	Max		47543.7	215.4
Avg		40557.5	210.0	Avg		43641.6	212.4	Avg		45045.3	213.8	Avg		46388.2	215.0

Airgas
an Air Liquide company

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

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E15A021C	Reference Number:	160-402020199-1
Cylinder Number:	CC709609	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Feb 22, 2021

Expiration Date: Feb 22, 2029

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.96 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.84 PPM	G1	+/- 0.7% NIST Traceable	02/15/2021
NITRIC OXIDE	55.00 PPM	54.69 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14060753	CC434455	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D885025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-04	CC707958	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Feb 04, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:
Gross Weight: 28.8 Kg
Net Weight: 4.8 Kg

Approved for Release

Airgas
an Air Liquide company

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

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E3HA0002	Reference Number:	160-402138465-1
Cylinder Number:	ND11222	Cylinder Volume:	247.2 Cubic Feet
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2215 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jul 15, 2021

Expiration Date: Jul 15, 2029

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.74 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.76 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D885025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200610-50	CC735426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 05, 2028
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003838	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jul 09, 2021

Triad Data Available Upon Request

NOTES:
Gross Weight: 46.0 Kg
Net Weight: 7.8 Kg

Approved for Release

THE LINDE GROUP

Linde

CERTIFICATE OF ANALYSIS

Customer Detail:
ALS Laboratory Group (Thailand)

Cylinder Description:
STEEL 47 L

Production Order Number: **90145553**
Material Number: **478100-J-44**
Certification Date: **07-Dec-2017**
Expiry Date: **07-Dec-2025**

Certificate Number:
3982/17

Analyst:
Anissara T.

Cylinder Number:
14465

Nominal Cylinder Content:
6.520 M³

Approve:

Nominal Pressure:
145.0 Bar

Valve Outlet:
CGA 590 BRASS

To Re-Order Please Quote:
478100-J-44

Comment:
- It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig
- Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component
- Keep and use in well-ventilated and secure area

Page 1 of 2

บริษัท ลินแด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 บางนาทาวเวอร์ เอ 2/3 หมู่ 14 ถนนบางนา-ตราด กม. 6.5 ตำบลบางพึ่ง
อำเภอเมือง จังหวัดสมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานแหลมฉบัง 105 หมู่ 5 ตำบลมาบตาพุด อำเภอเมือง จังหวัดระยอง 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38 570-323

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180
Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

THE LINDE GROUP

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CERTIFICATE OF ANALYSIS

Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen In Nitrogen	8.00 %	8.04 %	± 1% relative	(2) I-PB-354	04-Dec-2017

Reference Standard used in Assay

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

Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
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 **14465**
Production Order Number **90145553**

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

Page 2 of 2

บริษัท ลินแด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 บางนาทาวเวอร์ เอ 2/3 หมู่ 14 ถนนบางนา-ตราด กม. 6.5 ตำบลบางพึ่ง
อำเภอเมือง จังหวัดสมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานแหลมฉบัง 105 หมู่ 5 ตำบลมาบตาพุด อำเภอเมือง จังหวัดระยอง 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38.570-323

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180
Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

THE LINDE GROUP

Linde

CERTIFICATE OF ANALYSIS

Customer Detail:
ALS Laboratory Group (Thailand)

Cylinder Description:
STEEL 47 L

Production Order Number: **90145554**
Material Number: **557200-J-44**
Certification Date: **07-Dec-2017**
Expiry Date: **07-Dec-2025**

Certificate Number:
3977/17

Analyst:
Anissara T.

Cylinder Number:
94892

Nominal Cylinder Content:
6.560 M³

Approve:

Nominal Pressure:
145.0 Bar

Valve Outlet:
CGA 590 BRASS

To Re-Order Please Quote:
557200-J-44

Comment:
- It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig
- Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component
- Keep and use in well-ventilated and secure area

Page 1 of 2

บริษัท ลินแด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 บางนาทาวเวอร์ เอ 2/3 หมู่ 14 ถนนบางนา-ตราด กม. 6.5 ตำบลบางพึ่ง
อำเภอเมือง จังหวัดสมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานแหลมฉบัง 105 หมู่ 5 ตำบลมาบตาพุด อำเภอเมือง จังหวัดระยอง 24180

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180

THE LINDE GROUP

Linde

CERTIFICATE OF ANALYSIS

Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen In Nitrogen	16.0 %	16.0 %	± 1% relative	(2) I-PB-354	04-Dec-2017

Reference Standard used in Assay

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

Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
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 **94892**
Production Order Number **90145554**

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

Page 2 of 2

บริษัท ลินแด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 บางนาทาวเวอร์ เอ 2/3 หมู่ 14 ถนนบางนา-ตราด กม. 6.5 ตำบลบางพึ่ง
อำเภอเมือง จังหวัดสมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานแหลมฉบัง 105 หมู่ 5 ตำบลมาบตาพุด อำเภอเมือง จังหวัดระยอง 24180

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 13-Jul-23
Next Cal. Date : 13-Jan-24

Barometric Pressure (mmHg) : 751
Relative Humidity (%) : 60.0
Temperature (C°) : 29.0

Console Control Meter Data

Calibration No. : C-130723-BKK_FS0468
Dry Gas Meter ID : BKK_FS0469
Serial No. : 1302005
Model No. : XC-572-V

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A2003240
Correction Factor (Y) : 1.0160
Next Calibration Date : 25-Nov-23

ΔH (mm.H_2O)	Θ Minutes	Reference Dry Gas Meter Calibration Vr (Liters) Final	Vr (Liters) Initial	Vr (Liters) Total	Tr (°C)	Console Control ; Drygas Meter Vm (Liters) Final	Vm (Liters) Initial	Vm (Liters) Total	Ti (°C)	To (°C)	Avg.Tm (°C)	Dry Gas Meter Correction Factor (Y)	Orifice Calibration Factor Δ@
15	12.65	150.00	0.00	150.00	26.0	241330.0	241175.0	155.00	25.0	26.0	26.0	0.9818	48.8873
25	9.90	150.00	0.00	150.00	26.0	241498.0	241343.0	155.00	26.0	26.0	26.0	0.9808	49.9039
50	6.82	150.00	0.00	150.00	26.0	241659.0	241504.0	155.00	26.0	26.0	26.0	0.9784	47.3656
100	4.82	150.00	0.00	150.00	26.0	241823.0	241669.0	154.00	26.0	26.0	26.0	0.9800	47.3171
150	4.02	150.00	0.00	150.00	26.0	241998.0	241344.0	154.00	27.0	26.0	27.0	0.9785	49.2059
											Avg.	0.9799	48.5360

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

Δ@ : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury, mmH2O ; tolerance for individual values ± 5.08 from average .

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

Calibrated by: Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist(4)

Approved by: Natthapon Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Field Specialist(1)

FORM NO.: F 06-025 REVISION NO.: 2 ISSUE DATE: 30 Jun 22

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0472
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-130723-BKK_FS0472

Calibration Date : 13 Jul 23
Standard Pitot ID : BKK_FS0441
Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			$\overline{Cp}$	0.842	0.842

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

$$\left|\overline{Cp}_{(A)} - \overline{Cp}_{(B)}\right| \text{ must BE} \leq 0.01$$

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

Calibrated by : Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist (4)

Approved by : Natthapon Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jun 22

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0473
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-130723-BKK_FS0473

Calibration Date : 13 Jul 23
Standard Pitot ID : BKK_FS0441
Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			$\overline{Cp}$	0.842	0.842

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

$$\left|\overline{Cp}_{(A)} - \overline{Cp}_{(B)}\right| \text{ must BE} \leq 0.01$$

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

Calibrated by : Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist (4)

Approved by : Natthapon Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jun 22

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	13 Jul 23	Ambient Temperature (°C)	29
Calibration sheet No. :	C-130723-BKK_FS0469	Relative Humidity (%) :	60
Digital Temperature ID :	BKK_FS0469	Reference Temperature ID	BKK_FS1144
Serial No. :	1302005	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	14 Aug 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	501	1	±3	Pass
Probe	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	101	-	±3	-
	120	121	-	±3	-
	140	141	-	±3	-
Filter	100	102	2	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	19	-1	±3	Pass
Meter	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
	50	48	-2	±3	Pass
AUX	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมได้

Calibrated by : Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist (4)

Approved by : Natthapon Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Specialist (1)

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

PROBE NOZZLE DIAMETER

CALIBRATION DATA SHEET

Calibration Date :	13 Jul 23	Nozzle Set ID. :	BKK_FS0474
Calibration Sheet No. : C-130723-BKK_FS0474		Vernier Caliper ID.:	BKK_FS1123

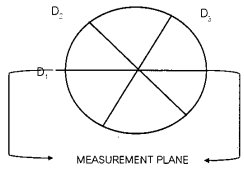
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.300	0.299	0.300	0.001	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.599	0.602	0.601	0.003	0.601
4	0.763	0.769	0.770	0.007	0.767
5	0.931	0.932	0.932	0.001	0.932
6	1.090	1.092	1.092	0.002	1.091
7	1.264	1.263	1.264	0.001	1.264
8	1.599	1.600	1.599	0.001	1.599

Where :

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

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

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



Calibrated by : Saksit Phaisanphisut

(Mr. Saksit Phaisanphisut)

Field Scientist (4)

Approved by : Nattapon Jiengwareewong

(Mr.Natthapol Jiengwareewong)

Field Specialist (1)

FORM NO. F 06-026 REVISION NO. : ISSUE DATE 9/1/03

ENTECH

Calibration Certificate

Certificate No: G 660041

Date of issue : 24-Jan-23

Instrument description	:	Flue gas Analyzer
Instrument model	:	Testo 340
Instrument serial no.	:	62150585
ID no. or control no.	:	RYG_FS0465
Manufacturer	:	Testo SE & Co. KGaA
Probe description	:	-
Probe model	:	-
Probe serial	:	-
Customer name	:	ALS LABORATORY GROUP (THAILAND) CO.,LTD.
Customer address	:	104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand
Total pages of certificate	:	2 Pages
Receiving no.	:	L-230166
Receiving date.	:	20-Jan-23
Parameter of calibration	:	Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,80.96,601.1 ppm)
Condition of UUC.	:	Used
Ambient condition	:	All of the Measurment ware caried out the stabilized labotary Temperature : 23 ±5 °C Humidity : 55 ± 15 %RH
Calibration place	:	1/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no.	:	WI-CL-28-C

REVIEW BY Naratorn P.

APPROVED BY

NEXT CAL DATE 23/1/24

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.

This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 23-Jan-23

Mr. Sedtawut Nuoathong — **Calibration Technician**

Mrs. Nongluck Wongsettee — **Technical Manager**

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

ENTECH

Calibration Certificate

Certificate No.: G 660041

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitric Oxide (NO) 30.08 ppm	SGS10068	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov 24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.6 °C Humidity : 57.8 %RH Pressure : 1015.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1018.2 mbar

Calibration Results (before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.46	-0.038	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.18	0.16	0.80
CO (ppm)	80.14	84	3.86	3.0
CO (ppm)	309.9	326	16.1	6.0
CO (ppm)	1003	1061	58	12
NO (ppm)	30.08	27	-3.08	8.0
NO (ppm)	150.9	144	-6.9	8.0
NO (ppm)	320.6	309	-11.9	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	99	-1.8	6.0
SO2 (ppm)	601.1	597	-4.1	13

Calibration Results (after adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.46	-0.038	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.18	0.16	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO (ppm)	30.08	30	-0.08	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	316	-4.6	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	99	-1.8	6.0
SO2 (ppm)	601.1	597	-4.1	13

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

End of Report

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

RYG_EN0003

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025 CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY Thanthall

APPROVED BY

NEXT CAL DATE 01/03/24

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0115
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0031709552	Reference No. :	204833
ID No. :	RYG_EN0003		
Manufacturer :	Sartorius	Page No. :	1 0f 2

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

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

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Wednesday, March 01, 2023

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

Metrological data :

Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:

Temperature : 23.0 °C ± 5.0 °C

Humidity : 56.0 % RH ± 10.0 % RH

Pressure _ ± _

Reasons for calibration

☐ New Installation ☐ Service / Repaired ☑ Re-calibration/ Maintenance

Equipment Condition: ☑ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Cetificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2,YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.

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

Mr chonchai Inthana(Technical Manager)

STAMP: SARTORIUS (THAILAND) CO.,LTD. SARTORIUS ISO/IEC 17025:2017

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0115
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0031709552	Reference No. :	204833
ID No. :	RYG_EN0003		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

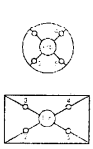
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	20.0000	200.0000
20 g	20.0001	200.0000
Tolerance	20.0000	200.0001
0.0001 g	20.0000	200.0000
	20.0000	200.0001
Nominal Value : (High Load)	20.0001	200.0001
200 g	20.0000	200.0001
Tolerance	20.0000	200.0000
0.0001 g	20.0000	200.0001
	20.0000	200.0001
Standard Deviation	0.00004	0.00005

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 100 g
Tolerance 0.0004 g



	Difference
1	–
2	0.0001
3	0.0000
4	0.0000
5	0.0001
6	-

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00013
0.05	0.0500	0.0500	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	200.0001	0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022

NAC

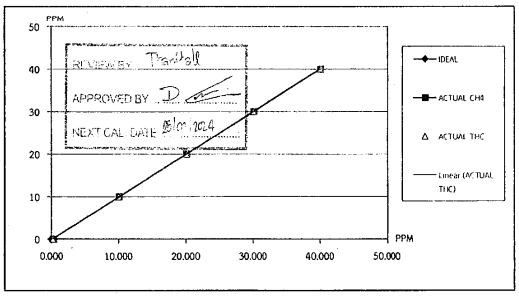
RYG_EN0038

TEST REPORT

CUSTOMER NAME	: ALS Laboratory Group (Thailand) Co., Ltd. [บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด]				
EQRIPMENT NAME	: THC Analyzer				
MANUFACTURER	: HORIBA	MODEL	: APHA-370	SERIAL NO	: UA3NG4TH
STANDARD GAS CONCENTRATION (PPM) :	506.1 PPM			CYLINDER NO	: CC734373
CYLINDER PRESSURE (psig) :	1,600 PSI			CERTIFIED DATE	: 12/05/2020
CERTIFIED BY :	AIRGAS			EXPIRED DATE	: 12/05/2028

TEST RESULTS

POINT NO	TEST RESULTS						
	IDEAL	ACTUAL CH4	ERROR CH4	%ERROR CH4	ACTUAL THC	ERROR THC	%ERROR THC
ZERO	0.000	0.210	0.210	-	0.200	0.200	-
1	10.000	10.050	0.050	0.50	10.050	0.050	0.50
2	20.000	20.120	0.120	0.60	20.150	0.150	0.75
3	30.000	30.110	0.110	0.37	30.050	0.050	0.17
4	40.000	40.030	0.030	0.08	40.030	0.030	0.08
AVERAGE (%)				0.39			0.37



CALIBRATED BY : DATE : 25/1/66
CHECKED BY : DATE : 25/1/66

NAC (JIRANATEE ASSOCIATES CO., LTD.)

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15,16 , E-Mail : Engineer@jiranatee.com
เลขที่ 63/14-15,67/35-36 ซอยเพชรเกษม 7,7/1 ถนนเพชรเกษม แขวงวัดท่าพระ เขตบางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-8680812-13 โทรสาร 02-868 1889

FO-EN-206 R01/22-10-14

NAC

CHECK LIST

CUSTOMER NAME	: ALS Laboratory Group (Thailand) Co., Ltd. [บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด]		
EQUIPMENT NAME	: THC Analyzer		
MANUFACTURER	: HORIBA	MODEL : APHA-370	SERIAL NO. : UA30GTHB

TEST VALUES

NO.	THC Analyzer (APHA - 370)	UNIT	BEFORE	AFTER
1	Signal (CH4)	mV	4.300	42.400
2	Signal (THC)	mV	3.200	64.400
3	Detector	Temp °C , Standard Value : Ambient temp+(5°Cto15°C)	46.700	50.000
		Pressure kPa , Standard Value : (Ambient/1013x100-20)±4kPa	70.000	70.100
4	Ambient	kPa current atmospheric pressure	101.000	101.100
5	Purlifire	°C , Standard Value : 390 °C to 430 °C	420.400	421.200
		kPa , Normal value : 8 kPa to 25 kPa	9.800	9.800
6	NMHC	°C , Standard Value : 230 °C to 260 °C	244.800	245.100
7	DC 24 V	V , Standard Value : 24 V ± 0.5 V	23.900	23.900
8	DC 5 V	V , Standard Value : 5 V ± 0.5 V	5.000	5.000
9	Bypass (Optional)	L/min, Normal value : 0.9 L/min ± 0.3 L/min		-
10	Over Flow (Optional)	L/min, Standard Value : 0.8 L/min or More	-	-
11	CH4 Samping Reading	PPM	3.530	2.330
12	NMHC Samping Reading	PPM	4.280	1.150
13	THC Samping Reading	PPM	8.810	3.480
14	Zero Gas CH4/THC	PPM	0.21/0.20	0.00/0.00
15	Span Gas	PPM	54.87/55.78	40.03/40.03
G	Gas H2 ...../.....	20 PSI	20	20

Remark : Reference EX-EN-017-56 , Ambient HC Monitor APHA-370 Operetion Manual Page #81
Remark : (Ambeint temperature = 5°C to 40°C)

อาการที่ตรวจพบ

- Service Maintenance

รายละเอียดการดำเนินการ

- ทำ Calibration Zero/Span , Multipoint

ผลการดำเนินการ

- เรียบร้อย เครื่องสามารถดำเนินการตรวจวัดได้ตามปกติ

CALIBRATED BY : DATE : 25/1/66
CHECKED BY : DATE : 25/1/66

NAC (JIRANATEE ASSOCIATES CO., LTD.)

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com
เลขที่ 63/14-15,67/35-36 ซอยเพชรเกษม 7,7/1 ถนนเพชรเกษม แขวงวัดท่าพระ เขตบางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02-868-1889

FO-EN-207 R00/01-06-13

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. : ACC23005
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufaeturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG_FS0496

Condition As Found : GOOD

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

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

Nathakorn P.
REVIEWED BY
NEXT CAL DATE 17/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

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.

QF-1S12-04-04-020664

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

T. Petch.

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	93.98	-0.02	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1000.0	0.0	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

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

End of Calibration Certificate

T. Petch.

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. : ACL22193
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597167 / 157778 / 34375
ID No.: RYG_FS0437

Condition As Found : GOOD

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

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

CHECKED BY Nanakorn P.
APPROVED BY
NEXT CAL.DATE 4/a/23

Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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

Cert. No. : ACL22193
Job No. : VC65AC0081
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.3

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

Frequency Weighting	Measured value (dB)
A - weight	15.1
C - weight	21.4
Flat	27.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.3	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.6	-0.6	-0.6	±5.0

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

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	34.0	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	24.9	-0.1	± 1.1

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

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 lavel 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. : ACL22230
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623391 / 198638 / 26419
ID No.: -

Condition As Found : GOOD

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

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

CHECKED BY
APPROVED BY
NEXT CALIBRATION DATE 12/10/23

Received Date : 28 SEPTEMBER 2022
Calibration Date : 12-17 OCTOBER 2022
Date of Issue : 18 OCTOBER 2022

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.

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.7

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

Frequency Weighting	Measured value (dB)
A - weight	12.8
C - weight	18.6
Flat	24.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.9	0.9	1.0	±5.0

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.1	0.1	± 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

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	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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.7	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 lavel 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. : ACL23080
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296517 / 135220 / 87527
ID No.: RYG_FS0434

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

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.

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

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

T. Petch.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	14.2
C - weight	19.9
Flat	25.5

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.5	-1.4	-1.4	±5.0

T. Petch.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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

7. Level linearity on the reference level range

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

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	136.2	-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	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

T. Petch.

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch.

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn 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. : ACL23079
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296516 / 180412 / 88182
ID No.: RYG_FS0433

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

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

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.4	0.5	0.4	±5.0

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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

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	29.8	-0.2	± 1.1
29.0	28.8	-0.2	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

T. Petch-

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch-

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. : ACC23009
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178121
ID No.: RYG_FS0213

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch-
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-03

Calibration Method :
This equipment was calibrated by based on IEC-60942-2003 Standard.
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :
1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.16	0.16	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.2	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.97	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.,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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900072 / 188465 / 01734
ID No.: RYG_FS0493

Condition As Found : GOOD

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

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

PREPARED BY Nonakorn P.
APPROVED BY
RELEASE DATE 13/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

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.

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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	17.2
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	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.9	±2.0

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

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. : ACL23044
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900073 / 188466 / 01735
ID No.: RYG_FS0494

Condition As Found : GOOD

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

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

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

PREPARED BY Nathakorn P
APPROVED BY
DATE 18/1/24

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

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

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

7. Level linearity on the reference level range

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

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	136.1	-0.3	±3.0

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY
451-451/1 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900074 / 188467 / 01736
ID No.: RYG_FS0495

Condition As Found : GOOD

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

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

BY Nanakorn P.
CHECKED BY
13/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakom 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.

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.8
Flat	22.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-2.0	-1.9	-1.9	±5.0

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

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. : ACL23248
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472130 / 169816 / 72464
ID No.: RYG_FS0303

Condition As Found : GOOD

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

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

REVIEW BY Nangkorn P.
APPROVED BY
10/8/24

Received Date : 13 JULY 2023
Calibration Date : 10 AUGUST 2023
Date of Issue : 11 AUGUST 2023

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.

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

Summary of Measurement Result :

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

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

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	17.8
Flat	23.2

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.7	0.7	0.7	± 1.5
1000	-0.1	0.0	0.0	± 1.0
8000	-4.1	-4.0	-4.1	±5.0

T. Petch.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch.

7. Level linearity on the reference level range

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

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.6	-0.8	±3.0

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch.

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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472127 / 169440 / 72461
ID No.: RYG_FS0302

Condition As Found : GOOD

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

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

REVIEW BY Apinakorn P.
APPROVED BY
NEXT CAL DATE 10/8/24

Received Date : 13 JULY 2023
Calibration Date : 10 AUGUST 2023
Date of Issue : 11 AUGUST 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-01

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

Condition of this result of calibration :
1. Reference Standard Instruments :

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

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

T. Petch.

Summary of Measurement Result :

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

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

T. Petch.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.0

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	20.3
Flat	25.9

3. Acoustical signal tests of frequency weightings

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

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

T. Petch.

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch.

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.1	0.1	± 1.1

T. Petch.

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

T. Petch.

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch...

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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472132 / 169445 / 72466
ID No.: RYG_FS0304

Condition As Found : GOOD

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

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

REVIEW BY Monakorn P.
APPROVED BY
NEXT CAL. DATE 1/01/24

Received Date : 23 AUGUST 2023
Calibration Date : 01 SEPTEMBER 2023
Date of Issue : 04 SEPTEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch...
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

T. Petch...

Summary of Measurement Result :

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

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

T. Petch...

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Nornal test

Measured Value (dB)
16.0

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	15.9
Flat	21.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.4	-1.5	-1.5	±5.0

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

11. Overload indication

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No. : CL-035-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer.: Delta OHM
Model: HD32.2
Serial No: 15006713
ID No: RYG_FS0218

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: 07 Feb 2023
Calibration date: 14 Feb 2023
Issue date: 14 Feb 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±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-0034-22, Certificate number: ER-0092-22

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

Approved Signatory:
Mr. Parinya Boonchaoen
Calibration Department Manager

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

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

Certificate No. : CL-035-66
Page 2 of 2

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 22035270.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.063	20.1	0.0	0.099
60	25.059	25.1	0.0	0.099
60	30.051	30.1	0.0	0.099
60	35.050	35.1	0.1	0.099
60	40.048	40.2	0.2	0.099

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

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.063	20.3	0.2	0.099
70	25.059	25.1	0.0	0.099
70	30.051	30.0	-0.1	0.099
70	35.051	34.9	-0.2	0.099
70	40.048	39.8	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 22035462.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.063	20.1	0.0	0.099
110	25.059	25.1	0.0	0.099
110	30.051	30.2	0.1	0.099
110	35.051	35.2	0.1	0.099
110	40.048	40.2	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 *

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534-4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX 0-2719-9482

Cert.No.: 23CH275
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact S220
Serial No. :	C104059460
ID No. :	RYG_EN0183
Condition As-Received:	Used Item
Received Date :	24 February 2023
Calibration Date :	27 February 2023
Reference :	2302-0886DSC-2
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM) - CP-CH8 by comparison with standard thermometer

REVIEW BY N. Bonnit
APPROVED BY
NEXT CAL. DATE 27/2/24

Calibrated by : Walalak Sirithean

Approved by : Approved Signatory

( ) Malee Butkruea
(✓) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 28 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

Cert.No.: 23CH275
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	22I1306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.000	177.48	177.4	4.000	0.058	2.00
S/N.: C104059460	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor *k*
pH Electrode	4.008	4.008	179.1	0.0046	2.00
S/N.: 1453404	6.987	6.988	4.7	0.0084	2.00
	10.010	10.013	-172.4	0.0069	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLabExpert Pro-ISM
- Serial No. : 1453404

Dimension of probe;

- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor *k*
25.0	25.001	24.8	-0.201	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

-o0o-

Saithip

a 1149924

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

NSC-TISI-TIS17025 CALIBRATION 0808

Certificate of Calibration

Equipment :	pH Meter
Manufacturer:	Mettler Tolado
Model :	SevenCompact S220
Serial No.:	C104059460
ID No.:	RYG_EN0183
Condition As-Received:	Used Item
Received Date:	24 February 2023
Calibration Date:	28 February 2023
Reference:	2302-0886DSC
Ambient Temperature:	(23 ± 2) °C
Relative Humidity:	(50 ± 10) %

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

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

Condition of this result of calibration

1.Reference standards instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6440007	22E1670	18 May 2023

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

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

4.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Wutchareeporn Wongchutikrane
Issue Date : 02 March 2023

Approved Signatory :
[ ] Phalinee Prabpaipal
[✓] Nuntawat Khamchai
[ ] Pornthippa Tameyakul

B 0309672

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

Function: DC voltage measuremer **Range:** 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (± µV)
-200.0000	-200.0	0.0	72
-150.0000	-150.0	0.0	69
-100.0000	-100.0	0.0	65
-50.0000	-50.0	0.0	62
0.0000	0.0	0.0	58
50.0000	50.0	0.0	62
100.0000	99.9	-0.1	65
150.0000	149.9	-0.1	69
200.0000	199.9	-0.1	72

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

UUC* = Unit Under Calibration.

-o0o-

a 1150477

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

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5000-115V
Serial No. :	15E102796
ID No. :	RYG_EN0032
Received Date :	21 July 2023
Test Date :	24 July 2023
Reference :	2307-0713DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	Saithip Approved Signatory

REVIEW BY N.Bamit
APPROVED BY
NEXT CAL DATE 24/07/65

( ) Malee Butkruea
(✓) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 26 July 2023

B 0320211

Condition of this result of calibration

1. Reference Standard Instruments :
   This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center,Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

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

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

Dissolved Oxygen Probe No.: 15E100464

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

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

-o0o-

a 1172155

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2719-9484

NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Equipment :	DO Meter with Sensor
Manufacturer :	YSI
Model :	5000-115V
Serial No. :	15E102796
ID No. :	RYG_EN0032
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	TPA On Site Calibration Laboratory
Received Order :	25 July 2023
Calibrated Date :	27 July 2023
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Preecha Hlahib
Approved by :	Approved Signatory

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

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616

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

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	22I1285	TPA	21 Oct 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1228475367

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

UUC* : Unit Under Calibration

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

-o0o-

a 1159515

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL.: 0-2717-3000-29 FAX: 0-2719-9484

NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Equipment :	Low Temp. Incubator
Manufacturer :	Memmert
Model :	IPP750
Serial No. :	V818.0084
ID No. :	RYG_EN0154
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	BOD Room
Received Order :	29 May 2023
Calibration Date :	29 May 2023
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Man Pattanapongpaiboon
Approved by :	Approved Signatory

REVIEW BY N. Bannit
APPROVED BY
NEXT CAL. DATE 29/11/24

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

Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0054967

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

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

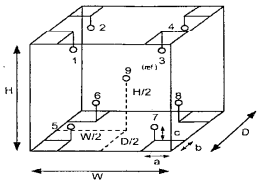
1. Reference standard instrument:-

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

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	23
REL.Humid. (%)	54	56
AC Supply (Volt)	223	222



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

Probe Installation Details :

a =	10	cm
b =	10	cm
c =	10	cm

Dimension of Chamber :

D =	0.60	m
W =	1.0	m
H =	1.2	m
Capacity =	0.75	m³

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

a 1165130

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

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

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

Calibration Point (°C)	Measured Temperature (°C) Position 1	2	3	4	5	6	7	8	9 (ref.)	Uncertainty (±°C)
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.116	0.30

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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a 1165129

DKSH

Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06220464
Model:	DR6000	Issued Date:	27 September 2022
Serial No. (or ID.):	1627845 (RYG_EN0037)	Job No.:	KSPR2212224
Manufacturer:	HACH	Page:	1 of 3
Condition:	In Condition		

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

REVIEW BY N.Bamrat
APPROVED BY
NEXT CAL. DATE 27/3/24

Environment Condition: Temperature 23.1 °C ± 0.6 °C; Humidity 65.4 %RH ± 3.2 %RH

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

Calibration By: Mr. Chattuphon Foithong
Calibration Date: 27 September 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.
The standard for Wavelength Certificate No. 91418 and 91435
The standard for Photometric Certificate No. 91441 and 101088
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

(Mr. Chattuphon Foithong)
Person in charge

(Mr. Thalerngkeat Poungngam)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงสวนหลวง เขตพระโขนง กรุงเทพมหานคร 10250
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10250
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.14
536.66	536.7	-0.04	0.14
637.98	638.3	-0.32	0.14
746.48	746.8	-0.32	0.14
807.03	807.4	-0.37	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5605	0.563	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6693	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0046
	0.9823	0.983	-0.0007	0.0045

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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Calibration Results:

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0080
	0.8609	0.861	-0.0001	0.0084
313 nm	0.0000	0.000	0.0000	0.0080
	0.2895	0.292	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6381	0.638	0.0001	0.0080

Stray light *

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
260.67 +/- 0.11 nm	260.7	2.1	1.678
391.94 +/- 0.11 nm	391.9	1.7	1.770

Spectral Resolution *

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.60	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.268		

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเซ็นเซอร์ เทคโนโลยี จำกัด
DKSH Technology Limited
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ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ) 27 Sep 2022 ปกติ	ไม่ปกติ	รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 27 Sep 2022 ปกติ	ไม่ปกติ	หมายเหตุ
		General			
☑	☐	1. ความสมบูรณ์เครื่อง	☑	☐	
☑	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☑	☐	
☑	☐	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Switch)	☑	☐	
☑	☐	4. ปุ่มกด (Keypad)	☑	☐	
☑	☐	5. หน้าจอ (Display, Screen Contrast)	☑	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☑	☐	8. ความยาวคลื่น (Wavelength Check)	☑	☐	656.1 ได้ 656.1 nm
☑	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☑	☐	
☑	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☑	☐	
☑	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☑	☐	
		pH Meter and Conductivity Meter			
☐	☐	12. อิเล็คโทรด (Electrode and Connection Cable)	☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับอิเล็คโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติม/ข้อแนะนำ :

Mr. Chattuphon Folthong

Service Engineer

บริษัท ดีเคเซ็นเซอร์ เทคโนโลยี จำกัด
DKSH Technology Limited
2633 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2633 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road. Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

ilac-MRA NSC-TISI-TIS 17025 CALIBRATION 0426

SARTORIUS

REVIEW BY Thanit all.
APPROVED BY
NEXT CAL. DATE 01/03/24

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0112
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0026207038	Reference No. :	204833
ID No. :	RYG_EN0002		
Manufacturer :	Sartorius	Page No. :	1 Of 2

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

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

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Wednesday, March 01, 2023

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

Metrological data :

Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:

Temperature : 23.6 °C ± 5.0 °C
Humidity : 60.0 % RH ± 10.0 % RH
Pressure – ± –

Reasons for calibration

☐ New Installation ☐ Service / Repaired ☑ Re-calibration/ Maintenance

Equipment Condition: ☑ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Cetificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2,YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.

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Mr.chonchai Intrhana(Technical Manager)

STAMP SARTORIUS (THAILAND) CO., LTD. ISO/IEC 17025 2017

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0112
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0026207038	Reference No. :	204833
ID No. :	RYG_EN0002		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

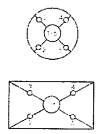
Nominal Value : (Low Load)	20.0000	199.9999
20 g	20.0000	200.0000
Tolerance	20.0000	199.9999
0.0001 g	20.0000	200.0000
	20.0000	199.9999
Nominal Value : (High Load)	20.0000	199.9999
200 g	19.9999	200.0000
Tolerance	20.0000	200.0000
0.0001 g	20.0000	199.9999
	20.0000	200.0000
Standard Deviation	0.00003	0.00005

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 100 g

Tolerance 0.0004 g



	Difference
1	–
2	-0.0001
3	-0.0001
4	0.0001
5	0.0002
6	-

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0001	0.0001	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00012
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report.

RYG_EN0010

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9483

NSC-TISI-TIS17025 CALIBRATION 0505

Cert. No.: 22TM1517
Page : 1 of 3

Certificate of Calibration

Equipment :	Hot Air Oven
Manufacturer :	Memmert
Model :	UFE 500
Serial No. :	G511.1572
ID No. :	RYG_EN0010
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	Oven Room
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Man Pattanapongpaiboon

REVIEW BY Thanitah
APPROVED BY
NEXT CAL. DATE 30/04/24

Approved by :
Approved Signatory

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

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0046908

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
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.

Cert. No.: 22TM1517
Page : 2 of 3

Condition of this result of calibration

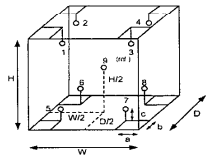
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL.Humid. (%)	54	59
AC Supply (Volt)	223	225



Position :	Ref. Std. ID No.: @ Calibration Point (180) °C	(104) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

Probe Installation Details :

a =	5.0	cm
b =	5.0	cm
c =	5.0	cm

Dimension of Chamber :

D =	0.40	m
W =	0.56	m
H =	0.48	m
Capacity =	0.11	m³

a 1132466

RYG_EN0006

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1517
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 *k*
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Calibration Point (°C)	Measured Temperature (°C) Position 1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243	179.605

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 %.

-oOo-

a 1132465

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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NSC-TISI-TIS17025 CALIBRATION 0505

Cert. No.: 22TM1492
Page : 1 of 3

Certificate of Calibration

Equipment :	Hot Air Oven
Manufacturer :	Memmert
Model :	UM 400
Serial No. :	b495.0899
ID No. :	RYG_EN0006
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location :	Oven Room
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Preecha Hlahib

REVIEW BY Thanitah
APPROVED BY
NEXT CAL. DATE 30/04/24

Approved by :
Approved Signatory

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

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0046905

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

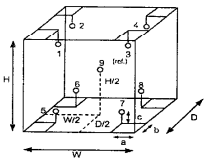
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 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)	28	29
REL.Humid. (%)	43	47
AC Supply (Volt)	220	221



Probe Installation Details :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :

D = 0.33 m
W = 0.40 m
H = 0.40 m
Capacity = 0.053 m³

Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

Malu.

a 1132473

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 3 of 3

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

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor *k*
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C) Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one senso
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 observatior
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 %.

-oOo-

Malu.

a 1132472

RYG_EN0061

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 22TM1491
Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath
Manufacturer : Memmert
Model : WNB22
Serial No. : L513.0648
ID No. : RYG_EN0061

REVIEW BY Thanitah.
APPROVED BY
NEXT CAL. DATE 20/04/24

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

Location : Wet Chemistry Lab

Received Order : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by : Malu.
Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Sutkruea
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the Head of Corporate Services 3 - Equipment Calibration and Testing Service

A 0046906

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-4

Cert. No.: 22TM1491
Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

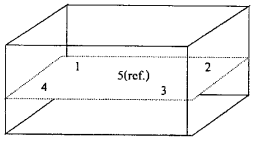
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 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

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



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Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

Malu.

a 1132471

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 22TM1491
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C) Position 1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor *k*
85.0	0.12	0.081	0.18	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Malu.

a 1132470

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NSC-TISI-TIS17025 CALIBRATION 0006

Cert.No.: 23CH442
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go TM pH/mV S2
Serial No. : C202355606
ID No. : RYG_FS0574
Condition As-Received: Used Item
Received Date : 31 March 2023
Calibration Date : 03 April 2023
Reference : 2303-1133DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

REVIEW BY Pornpath
APPROVED BY Sup/S
NEXT CAL. DATE 05/04/24

Calibrated by : Warakorn Lerngagtrakul

Approved by : Malu.
Approved Signatory
(✓) Malee Butkruea
( ) Salthip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 5 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0052954

Cert. No.: 23CH442
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained 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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement
Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor *k*
	pH	mV	mV	pH		
pH Meter	4.00	177.48	177	4.00	0.58	2.00
S/N.: C202355606	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 *k*
pH Electrode	4.008	4.01	170	0.0071	2.00
S/N.: 2015870	6.987	7.00	-5	0.011	2.00
	10.010	10.01	-181	0.0095	2.00

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

-o0o-

Malu.

a 1156432

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NSC-TISI-TIS17025 CALIBRATION 0006

Cert. No.: 23LM86
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2GoTM pH/mV S2
Serial No. : C202355606
ID No. : RYG_FS0574
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 31 March 2023
Calibrated Date : 05 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Preecha Hlahib

Approved by : Malu.
Approved Signatory
( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

Issue Date : 21 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0053338

Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2303-1133DSC-4

Cert. No.: 23LM86
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1502A	A52847	22I1325	31 Oct 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 2015870

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.002	25.1	0.098	0.16	2.00
40.0	100	40.001	40.2	0.199	0.16	2.00
60.0	100	60.005	60.5	0.495	0.16	2.00

UUC* : Unit Under Calibration

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

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a 1157393

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert.No.: 23CH721
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : B851952376
ID No. : RYG_FS0425
Condition As-Received: Used Item
Received Date : 07 June 2023
Calibration Date : 08 June 2023
Reference : 2306-0162DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

REVIEW BY Pitthayath
APPROVED BY Sup
NEXT CAL. DATE 08/06/24

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 : Uthen Kankawi

Approved by : Saithip
Approved Signatory

( ) Malee Butkruea
(✓) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 12 June 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0055209

BKK_EN0041

Cert. No.: 23CH721
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	43160066	130RC092	23E1284	09 Apr 2024

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.986	CPA chem	863833	28 Dec 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.00	177.48	178	4.00	0.58	2.00
S/N.: B851952376	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 k
pH Electrode	4.008	4.01	170	0.0099	2.11
S/N.: 1190753	6.986	6.99	-3	0.012	2.05
	10.010	10.01	-176	0.014	2.13

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-

Saithip

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-6
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phatthanakan 40, Phatthanakan Rd., Suan Luang, Bangkok 10250

Date: June 26, 2023 5:00:36 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.53, GCMS.02.54
Overall Qualification Status: Pass

REVIEW BY Nat Sant
APPROVED BY
NEXT CAL. DATE

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 SSL

Setpoint Status: **Pass**

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.1	psi
Accuracy:			0.1	psi
Agilent Recommended:			<= 1.2	

Overall Inlet Pressure Accuracy Test Status

Pass

Headspace Leak

Name: 7697A with Tray
Sampler 1

Setpoint Status: Pass

Overall Headspace Leak Test Status

Pass

Headspace Heated Zones Temperature Accuracy

Name: 7697A with Tray
Sampler 1

Setpoint Status: Pass
Zone: Transferline
Temperature:
Setpoint 115.0 °C
Actual 115.5

Accuracy: 0.5 °C
Agilent Recommended: >= -1.8 % setpoint (-2.1 °C)
<= 5.2 % setpoint (6.0 °C)

Setpoint Status: Pass
Zone: Sample Loop
Temperature:
Setpoint 110.0 °C
Actual 110.4

Accuracy: 0.4 °C
Agilent Recommended: >= -4.0
<= 4.0

Setpoint Status: Pass
Zone: Oven
Temperature:
Setpoint 100.0 °C
Actual 100.6

Accuracy: 0.6 °C
Agilent Recommended: >= -4.0
<= 4.0

Overall Headspace Heated Zones Temperature Accuracy Test

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 230.0 231.1 °C

Accuracy: 1.1 °C
Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)
<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 100.0 100.2 °C

Accuracy: 0.2 °C
Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)
<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass
Setpoint/Average
Temperature: 100.0 100.1667 °C

Stability: 0.1 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1 Front SSL / External SQ
Name: 5975C inert XL with TAD

Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front SSL / External SQ
Name: 5975C inert XL with TAD

Setpoint Status: Pass

Amu: 1050 m/z Drift After Five Minutes: RFPA Voltage:
22 mV 542 mV
Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front SSL / External SQ
Name: 5975C inert XL with TAD

Setpoint Status: Pass
Filament: 1

Setpoint Status: Pass
Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1 Front SSL / External SQ
Headspace
Name: 7697A with Tray
Source: EI - Inert

Setpoint Status: Completed
Injection Volume on Column: 1000 uL

Overall Scouting Run Status

Completed

Injection Precision

Tested Combination1 Front SSL / External SQ
Name: 7697A with Tray
Source: EI - Inert

Setpoint Status: Pass
Injection Volume on Column: 1000 uL

Area RSD: 1.27 % Retention Time RSD: 0.00 %
Agilent Recommended: <= 5.00 <= 1.00

Overall Injection Precision Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	SSL	/ External	SQ
	Headspace			
Name:	7697A with Tray			
Source:	EI - Inert			
Setpoint Status:	**Pass**			
Injection Volume on Column:	1000	uL		

	Area Mass 1 Abundance*s		Mass Ratio	
RSD:	1.27	%	0.26	%
Agilent Recommended:	<= 5.00		<= 5.00	
	Pass		Pass	

Overall Mass Ratio Precision Test Status

Pass

Injection Carry Over

Tested Combination1	Front	SSL	/ External	SQ
Name:	7697A with Tray			
Source:	EI - Inert			
Setpoint Status:	**Pass**			
Injection Volume on Column:	1000	uL		
Area Carry Over:	0.00	%		
Agilent Recommended:	<= 1.00			

Overall Injection Carry Over Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System	
System ID	GM-6
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging
Tested Combination1	
Injection Technique	Headspace
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Headspace
Name	7697A with Tray
Model Number	G4557A
Serial Number	CN13020009
Firmware Revision	A.01.05.1
Sampling System	Loop fill
Location	Front
Injection Volume (µL)	1000
Headspace to GC Connection	EPC Headspace

Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN12511186
Firmware Revision	A.01.14
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	5975C Inert XL with TAD
Model Number	G3172A
Serial Number	US13023A30
Firmware Revision	5.02.09
High Vacuum System	Turbo Pump
Scouting Run Standard	MRP Std

MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Inert
Number of filaments	2

Electronic Signature

Purpose

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Details

Full Name of Signer:	Sulkifli Mama
Logged On User Name:	sulkifli.mama@agilent.com
Signature Creation Date:	June 26, 2023
Reason for Signature:	Executed protocol and published this original version of document

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User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 9:12:05 AM	Audit	SessionCreated	Session	None
June 26, 2023 9:12:05 AM	Start	Configuration	Session	None
June 26, 2023 9:12:05 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 26, 2023 9:18:38 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.53/Gc.02.53.eqp], EQP File Name: [Gc.02.53.eqp], EQP Name: [AgilentRecommended],Protocol Revision :[Gc.02.53] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.54/GcMs.02.54.eqp], EQP File Name: [GcMs.02.54.eqp], EQP Name: [AgilentRecommended]
June 26, 2023 9:38:13 AM	End	Configuration	Session	None
June 26, 2023 9:38:21 AM	Start	Qualification	Session	OQ
June 26, 2023 9:38:21 AM	Start	Execution	CDS Logon Verification - GC - 7890: - Qualitative test	None
June 26, 2023 9:41:55 AM	End	Execution	CDS Logon Verification - GC - 7890: - Qualitative test	Run Count : 1
June 26, 2023 9:41:57 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 9:42:21 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
June 26, 2023 9:42:24 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
June 26, 2023 9:53:27 AM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
June 26, 2023 9:53:37 AM	Start	Execution	Headspace Leak - 7697A with Tray (Sampler 1): - Qualitative Test - No setpoints associated	None
June 26, 2023 10:18:48 AM	End	Execution	Headspace Leak - 7697A with Tray (Sampler 1): - Qualitative Test - No setpoints associated	Run Count : 1
June 26, 2023 10:18:52 AM	Start	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Transferline - S: 115.0°C - L: >= -1.8% setpoint and <= 5.2% setpoint	None
June 26, 2023 10:20:42 AM	Audit	Data	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Transferline - S: 115.0°C - L: >= -1.8% setpoint and <= 5.2% setpoint	Manual Data Entry
June 26, 2023 10:20:44 AM	End	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Transferline - S: 115.0°C - L: >= -1.8% setpoint and <= 5.2% setpoint	Run Count : 1

User Name: sulkifli.mama
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System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 10:20:48 AM	Start	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Sample Loop - S: 110.0°C - L: >= -4.0°C and <= 4.0°C	None
June 26, 2023 10:25:37 AM	Audit	Data	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Sample Loop - S: 110.0°C - L: >= -4.0°C and <= 4.0°C	Manual Data Entry
June 26, 2023 10:25:39 AM	End	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Sample Loop - S: 110.0°C - L: >= -4.0°C and <= 4.0°C	Run Count : 1
June 26, 2023 10:25:41 AM	Start	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Oven - S: 100.0°C - L: >= -4.0°C and <= 4.0°C	None
June 26, 2023 10:32:03 AM	Audit	Data	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Oven - S: 100.0°C - L: >= -4.0°C and <= 4.0°C	Manual Data Entry
June 26, 2023 10:32:05 AM	End	Execution	Headspace Heated Zones Temperature Accuracy - 7697A with Tray (Sampler 1): - Zone : Oven - S: 100.0°C - L: >= -4.0°C and <= 4.0°C	Run Count : 1
June 26, 2023 10:32:06 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 10:37:21 AM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
June 26, 2023 10:37:27 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
June 26, 2023 10:37:29 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
June 26, 2023 10:42:29 AM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
June 26, 2023 10:42:31 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
June 26, 2023 10:42:37 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
June 26, 2023 10:44:35 AM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 10:50:53 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
June 26, 2023 11:18:38 AM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 11:18:42 AM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
June 26, 2023 11:18:49 AM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 11:21:31 AM	Start	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
June 26, 2023 11:25:11 AM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 12:53:12 PM	Start	Execution	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	None
June 26, 2023 12:54:08 PM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 12:54:32 PM	Start	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
June 26, 2023 12:55:07 PM	Start	Execution	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	None

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 12:55:19 PM	Start	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
June 26, 2023 1:00:19 PM	Start	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Inert	None
June 26, 2023 1:17:31 PM	End	Execution	Log Amp - 5975C Inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
June 26, 2023 1:17:38 PM	Start	Execution	RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert	None
June 26, 2023 1:36:49 PM	End	Execution	RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
June 26, 2023 1:36:52 PM	Start	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	None
June 26, 2023 1:42:01 PM	End	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
June 26, 2023 1:42:04 PM	Start	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	None
June 26, 2023 1:46:45 PM	End	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	Run Count : 1
June 26, 2023 1:46:47 PM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 2:01:24 PM	Start	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
June 26, 2023 4:20:32 PM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 4:32:03 PM	Start	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
June 26, 2023 4:33:04 PM	Audit	Data	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Data files Path : D:\OQ2023\HSVSC.D\DATA.MS
June 26, 2023 4:33:02 PM	End	Execution	Scouling Run - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Run Count : 1
June 26, 2023 4:35:05 PM	Start	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
June 26, 2023 4:35:32 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HSVP02.D\DATA.MS

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 4:35:32 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HS\P03.D\DATA.MS
June 26, 2023 4:35:32 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HS\P04.D\DATA.MS
June 26, 2023 4:35:32 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HS\P05.D\DATA.MS
June 26, 2023 4:35:33 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HS\P06.D\DATA.MS
June 26, 2023 4:35:33 PM	Audit	Data	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : D:\OQ2023\HS\P07.D\DATA.MS
June 26, 2023 4:36:00 PM	End	Execution	Injection Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Run Count : 1
June 26, 2023 4:36:04 PM	Start	Execution	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	None

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 4:36:30 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P02.D\DATA.MS
June 26, 2023 4:36:31 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P03.D\DATA.MS
June 26, 2023 4:36:31 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P04.D\DATA.MS
June 26, 2023 4:36:31 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P05.D\DATA.MS
June 26, 2023 4:36:33 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P06.D\DATA.MS
June 26, 2023 4:36:33 PM	Audit	Data	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : D:\OQ2023\HS\P07.D\DATA.MS
June 26, 2023 4:37:26 PM	End	Execution	Mass Ratio Precision - 7697A with Tray Headspace, Front SSL, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Run Count : 1
June 26, 2023 4:37:32 PM	Start	Execution	Injection Carry Over - 7697A with Tray Headspace, Front SSL, SQ: - Headspace Sampler - EI - Inert - L: <= 1.00%	None

BKK_EL0026

User Name: sulkifli.mama
Hostname: ASBKKW7004

System Id: GM-6
Print Date: June 26, 2023 5:00:37 PM

6006258789_ALS_OQ_GM6 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 26, 2023 4:37:53 PM	Audit	Data	Injection Carry Over - 7697A with Tray Headspace, Front SSL, SQ: - Headspace Sampler - EI - Inert - L: <= 1.00%	Data files Path : D:\OQ2023\HS\P07.D\DATA.MS
June 26, 2023 4:37:53 PM	Audit	Data	Injection Carry Over - 7697A with Tray Headspace, Front SSL, SQ: - Headspace Sampler - EI - Inert - L: <= 1.00%	Data files Path : D:\OQ2023\HS\BL.D\DATA.MS
June 26, 2023 4:39:51 PM	End	Execution	Injection Carry Over - 7697A with Tray Headspace, Front SSL, SQ: - Headspace Sampler - EI - Inert - L: <= 1.00%	Run Count : 1
June 26, 2023 4:39:58 PM	End	Qualification	Session	OQ
June 26, 2023 4:39:58 PM	Start	Reporting	Session	None
June 26, 2023 4:59:30 PM	Audit	Reporting	Session	Report Generated : Certificate

7700 Series ICP-MS
Preventive Maintenance Checklist – Standard

Agilent Technologies

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results. Delivered by highly-trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak.

For more information about Agilent Technologies services please visit our web site using the following URL http://www.chem.agilent.com/en-us/products/services/pages/default.aspx

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of additional or special procedures and/or parts for the instrument service, then these must be ordered separately and charged as a repair, which may incur additional costs.

Service Engineer's Responsibilities

- Only complete/printout pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

REVIEW BY .....
APPROVED BY .....
NEXT CAL. DATE .....

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Agilent Technologies

System Information

Instrument system name and ID	7800x ICP-MS
Instrument system site and location	ALS Laboratory Group (Thailand) Co.,Ltd
List system component product numbers	**List the serial numbers of each component**
1. G3281A	1. JP12091612
2. G3292A	2. 4N1220700
3. ASX 500	3. US02129A5E0
4.	4.
5.	5.
6.	6.
7.	7.

ICP-MS configuration table	Circle the type or write in the type if other
Nebulizer	MicroMist | Micro Flow | Mira Mist | other
Spray Chamber	Quartz | PFA | other
Torch	Quartz | Demountable | other
Sampling Cone	Ni | Pt | other
Skimmer Cone	Ni | Pt | Ni plated | other

Preparation

- ☑ Discuss any specific issues with the customer prior to starting.
- ☑ Review the instrument logbook.
- ☑ Save instrument control settings before starting the procedure.
- ☑ Perform general inspection of system for cleanliness
- ☑ Check for proper installation of safety-related parts, assemblies , sensors etc
- ☑ Check for required firmware updates and verify with customers if they would like it installed.
- ☑ Begin system vent.

Inspect and clean system while venting

- ☑ Perform a general inspection of the system.
- ☑ Look for any obvious external damage or problems.
- ☑ Check mechanical pumps for evidence of excessive fluid leaks.
- ☑ Inspect vacuum hoses, pump exhaust tubes and power cord for excessive wear.
- ☑ Inspect Shield plate contacts. Clean if needed.
- ☑ Inspect the tape lining on the peristaltic pump clamp: replace the tape if worn (5043-0030).
- ☑ Check electronics for dust accumulation, clean if necessary.

Mechanical vacuum pumps

- ☑ Drain and replace mechanical pump fluid.
- ☑ Verify proper oil recycling function of mechanical pumps, the gas ballast valve must be open.
- ☑ Replace the oil mist filter.
- ☑ Inspect and clean or replace the inlet filter (P/N 5190-0145 for E2M18. P/N SR03700237 for DS402)
- ☑ Verify proper oil recycling function of mechanical pumps, the gas ballast valve must be open when connected to an Edwards E2M18.

Cooling water system

- ☑ Drain cooling fluid
- ☑ Remove, clean and reinstall metal mesh filter.
- ☑ Re fill Polyclear cooling fluid (G3292-80010)
- ☑ Clean the Air filter and the Condenser by compressed air or vacuum cleaner

Ion lens cleaning

- ☑ Remove extraction/omega lenses and clean all lenses.
- ☑ Remove ORS cell, plate bias and deflect lens, clean all lenses.
- ☑ Replace octopole. Reinstall all lenses and the ORS cell and close analyzer.

Auto Sampler ASX500 Series

- ☑ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns
- ☑ Z-Axis Inspection Inspect the Z-axis PEEK drive cable for kinks or slight bends. Power off the autosampler and manually move the Z-drive up and down using the rotor on the rear of the instrument. Inspect the Z-axis drive cable for kinks or slight bends o If the movement is rough and hard to move then replace Z-axis drive cable (P/N G3286-80331) or Z-axis drive assembly (P/N G3286-80330)

- ☑ Pump Tubing Replacement
  Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☑ QC Testing
  Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and ensure that the probe is centered in the vial
- ☑ Final Inspection
  Check that all components are tight

Auto Sampler I-AS N/A

- ☐ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns
- ☐ Pump Tubing Replacement
  Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.
- ☐ QC Testing
  Using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial.

ISIS

- ☑ Replace ISIS valve seal (P/N G3138-65117)
- ☑ Inspect the tape lining on the peristaltic pump clamp; replace the tape if worn (5043-0030).
- ☑ QC test
  Verify the function of valve and Peripump. Make sure that there is no leak from the valve and pump tubing connections.

Restore Instrument

- ☑ Pump system down.
- ☑ Perform the system post check.
  - ☑ Check quadrupole matching.
  - ☑ Perform octopole matching.
  - ☑ Verify good gas control function by changing the flow and observing the meter readings, perform an automatic offset adjustment for the MFC's.
  - ☑ Verify in Tune (using the customer's last tune) that changes in lens voltage result in the expected sensitivity change.
  - ☑ Perform Startup including performance report and an Autotune. Print the Autotune report and attach it to this checklist.
  - ☑ Check the instrument status and record the measurements in the status table. (Use "Record Log" in "Maintenance LogBook" with G7200B software. Use Performance report with G7201A/B software)
  - ☑ Record the EM and discriminator Voltages in the results table.
  - ☑ Run 10 minute stability test with tune solution. Check the result of RSD is below 4%.

Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☑ Attach available reports/printouts of all tests to this documentation.
- ☑ Make an entry in the MassHunter Maintenance Log Book recording the PM activities.
- ☑ Update/reset instrument maintenance counters as appropriate
- ☑ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☑ Complete the Service Engineer Comments section below if there are additional comments
- ☑ Review the service and any test results with the customer.
- ☑ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

7700 Series ICP-MS Status Results Table

☐ Check this box if you have run a performance report to record the meter readings. Print out the report and attach it to this checklist, instead of completing the table.

Measurement	Standby Mode	Analysis Mode No Gas Mode	Analysis Mode H_2 Gas @ 4ml/min	Analysis Mode He Gas @ 4ml/min
IF/BK Press	2.65 Pa	242 Pa	– Pa	247 Pa
TMP Revolution	100 %	100 %	– %	100 %
Analyzer Press	8.5×10^{-5} Pa	2.35×10^{-4} Pa	– Pa	3.25×10^{-4} Pa
Water RF WC/IF	❶	1.50 L/min		
Water Temperature		22.1 °C		
Inlet Temp	25.0 °C	29.9 °C		
Internal Temp	26.0 °C	46.0 °C		
RF Power		1551 Watts		
RF Reflect		5 Watts		
Plasma Freq.		2678 MHz		
Carrier Gas (BP)		441 kPaG		
Ar Gas Tank Press		519 kPaG		
Carrier Gas		1.00 L/min		
MU/Dil. Gas		0.10 L/min		
Plasma Gas		15.00 L/min		
Aux Gas		0.90 L/min		
S/C Temperature		2.0 °C		
OP Gas Tank Press*1	– kPaG	– kPaG		
Optional Gas *1		– %		

❶ Do not fill in the shaded cells in the table. There are no measurements for these combinations.

Notes:

7700 Series ICP-MS Test Results Table

Test Description	Expected Test Result	Actual Test Result
Analog HV Voltage	Not applicable	1761 V
Pulse HV Voltage	Not applicable	1446 V
Discriminator Voltage	Not applicable	4.5 mV

7700 Series ICP-MS Parts List Table

Part Description	Part Number	Product/Model # where used	Quantity Consumed
1L Rough Pump Oil	6040-0834	7700 ICP-MS	2
Oil Mist Filter Kit for E2M18	3162-1056	7700 ICP-MS	1
Oil Mist Filter for DS402	9499342M002	7700 ICP-MS	–
Graphite Gasket for Sample Cone (3pk)	G3280-67009	7700 ICP-MS	1
7700 Octopole	G3280-67045	7700 ICP-MS	1
Polyclear cooling fluid	G3292-80010	G1879B/G3292A	1
Rinse / Drain tubing	G3286-80117	ASX-500	1
Tubing / connection kit for drain	G3286-80118	ASX-500	1
Peristaltic pump tubing set	G3160-65326	I-AS	–
Drain tubing to rinse bottle and drain bottle	G3160-65328	I-AS	–
Rotor seal for Valve (ISIS)	G3138-65117	ISIS	1
Additional parts may be required from engineers stock:			
Inlet Filter E2M18	5190-0145	7700 ICP-MS	–
Inlet Filter DS402	SR03700237	7700 ICP-MS	–
Peristaltic pump tape (30m roll)	5043-0030	7700 ICP-MS	–
Polishing Paper Kit (#400/#1200, 5 sheets each)	G1833-65404	7700 ICP-MS	–
Cotton Swabs, ultra-fine conical bud shape at both ends (100/pk)	9300-2574	7700 ICP-MS	–
Alumina Powder	8660-0791	7700 ICP-MS	–
lint-free-paper	05980-60051	7700 ICP-MS	–
Z-Axis Drive PEEK Cable (Anti-Kink)	G3286-80331	ASX-500	–
Z-Axis Drive Assembly (PEEK, Anti-Kink)	G3286-80330	ASX-500	–

Service Engineer Comments (optional)

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

Other Important Customer Web Links

- ☐ How to get information on your product: Literature Library - http://www.agilent.com/chem/library
- ☐ Need to know more? - www.agilent.com/chem/education
- ☐ Need technical support, FAQs? - www.agilent.com/chem/techsupp
- ☐ Need supplies? - www.agilent.com/chem/supplies

Service Completion

Service request number 600 6142623 Date service completed 12 June 2023

Agilent signature Customer signature Supakwan M

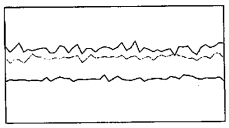
Document part number: G3280-90078

Tune Report

Operator Name	Supakwan Mak
Acq/Data Batch	C:\Agilent\ICPMH\1\User\Tune.b
Acq. Date-Time	6/12/2023 4:05:12 PM
Report Comment	PM 12 June 2023
Instrument Name	G3281A JP12091612

[No Gas]

Sensitivity



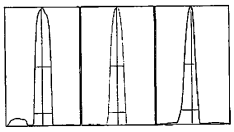
Mass	Range	Count	RSD%	Background
7	10000	6340	4.494	2.100
89	50000	27817	3.328	3.600
205	50000	18565	3.537	9.600

Sampling Period [sec] 0.311
Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.492 %
Doubly Charged 70 / 140 1.508 %

Resolution/Axis



Mass	Peak Height	Axis	W-50%	W-10%
7	6337.66	7.00	0.64	0.730
89	27561.94	89.00	0.55	0.710
205	19016.73	205.00	0.46	0.726

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	1.80 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	8.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	6.4 V	Deflect	11.8 V
Extract 2	-145.0 V	Cell Entrance	-30 V	Plate Bias	-40 V
Omega Bias	-90 V	Cell Exit	-50 V		

Cell Parameters

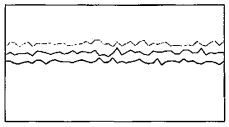
Use Gas	No	3rd Gas Flow	—	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		

Tune Report

H2 Flow	—	OctP RF	190 V		
QP Parameters					
Mass Gain	145	Axis Gain	1.0021	QP Bias	-3.0 V
Mass Offset	124	Axis Offset	0.12		
Hardware Settings					
Torch					
Torch H	-0.4 mm	Torch V	0.0 mm		
EM					
Discriminator	4.5 mV	Analog HV	1748 V	Pulse HV	1496 V

[He]

Sensitivity



Mass	Range	Count	RSD%	Background
59	20000	11826	2.752	7.200
89	20000	13367	2.527	5.800
205	50000	25671	2.706	13.300

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide	156 / 140 1.166 %
Doubly Charged	70 / 140 1.586 %

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	1.80 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	8.0 mm	S/C Temp	2 °C		
Lens Parameters					
Extract 1	0.0 V	Omega Lens	7.4 V	Deflect	3.6 V
Extract 2	-200.0 V	Cell Entrance	-90 V	Plate Bias	-115 V
Omega Bias	-90 V	Cell Exit	-70 V		
Cell Parameters					
Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	3.0 V
He Flow	4.5 mL/min	OctP Bias	-21.0 V		
H2 Flow	—	OctP RF	200 V		
QP Parameters					
Mass Gain	145	Axis Gain	1.0021	QP Bias	-18.0 V
Mass Offset	124	Axis Offset	0.12		
Hardware Settings					
Torch					
Torch H	-0.4 mm	Torch V	0.0 mm		

Tune Report

EM					
Discriminator	4.5 mV	Analog HV	1748 V	Pulse HV	1496 V

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. T231676

Certificate of Calibration

Equipment : **HEATING BLOCK**

Manufacturer : **Environmental Express**

Model : **SC 196**

Serial No. : **6974CECW3285**

Customer Code : **BKK_EL0054**

ID No. : **T5306A3**

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

Customer Location : **Acid Digestion Lab**

Date of Receipt : **13 September 2023**

Calibrated By : **Sanee Musikawan (Site Calibration Manager)**

Approved By : _____ / **Sujjar Naknakred (Site Calibration Manager)**

Date of Issue : 26 SEP 2023

REVIEW BY Tattaporn C.
APPROVED BY Sanee N.
NEXT CAL. DATE 22/03/25

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

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

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Calibration Report

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

Condition of this results of calibration :

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

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 20 Minute At 95 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By_____

Metrological Center

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

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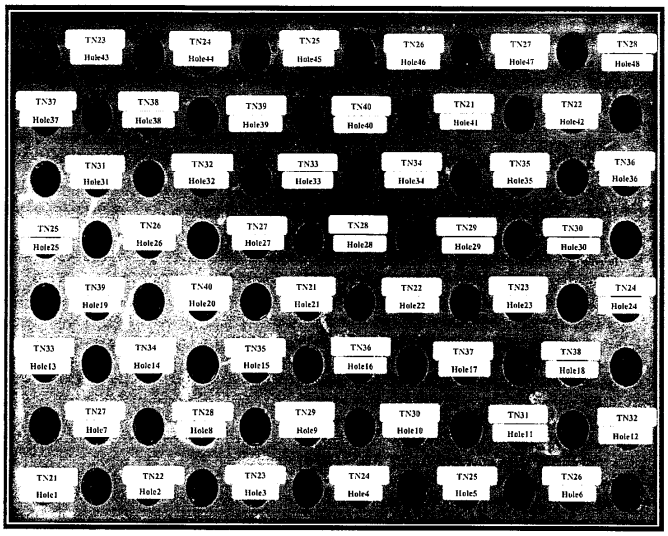
Calibration Report



FRONT CONTROL

Approved By. _____

Metrological Center

SCI ECO Services Company Limited

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

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

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

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51	95.17
95	Min	94.57	93.95	94.75	94.92	94.00	94.72
	Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
	Max	95.36	95.43	95.19	95.16	95.35	94.97
	Min	94.94	94.95	94.72	94.71	94.90	94.57
	Average	95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
	Max	95.37	95.50	95.22	95.21	95.33	95.31
	Min	94.99	95.09	94.78	94.82	94.88	94.96
	Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.59	94.42	94.52	94.24	94.63	94.67
	Min	95.21	94.06	94.13	93.88	94.28	94.27
	Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.93	95.30	95.14	95.03
	Min	94.83	95.03	92.56	94.95	94.79	94.70
	Average	95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35	TN36
	Max	94.63	94.90	94.77	94.31	94.24	93.87
	Min	94.24	94.55	94.44	93.98	93.92	93.56
	Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
	Max	94.30	94.44	94.04	93.81	94.89	95.35
	Min	93.95	94.05	93.67	93.48	94.39	94.90
	Average	94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27	TN28
	Max	95.99	95.63	95.28	95.29	95.45	94.87
	Min	95.57	95.15	94.82	94.84	94.99	94.48
	Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By. _____

Metrological Center

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44	105.27
105	Min	104.94	103.95	105.15	105.04	104.11	104.96
	Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
	Max	105.30	105.12	105.18	105.22	105.12	105.16
	Min	105.11	104.92	104.96	105.00	104.92	104.97
	Average	105.20	105.02	105.07	105.11	105.02	105.06
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
	Max	105.37	105.63	105.02	104.80	104.69	105.19
	Min	105.17	105.37	104.75	104.59	104.50	105.00
	Average	105.27	105.50	104.88	104.69	104.60	105.09
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
	Max	105.31	104.43	106.41	104.71	105.63	105.82
	Min	105.08	104.22	106.15	104.41	105.37	105.56
	Average	105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
	Max	104.95	106.26	103.34	105.78	105.59	105.87
	Min	104.67	105.96	103.08	105.56	105.36	105.68
	Average	104.81	106.11	103.21	105.67	105.48	105.77
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35	TN36
	Max	104.75	104.86	104.80	105.20	104.50	104.39
	Min	104.54	104.63	104.59	105.00	104.32	104.18
	Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
	Max	104.30	104.90	104.85	104.65	104.88	104.85
	Min	104.09	104.72	104.66	104.49	104.63	104.52
	Average	104.19	104.81	104.75	104.57	104.76	104.68
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27	TN28
	Max	105.71	105.85	105.39	105.61	105.42	105.19
	Min	105.45	105.61	105.14	105.27	105.18	104.94
	Average	105.58	105.73	105.27	105.44	105.30	105.07

Approved By. _____

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

Calibration Report

Measurement Results:

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

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

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

Approved By. _____

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate of Calibration

Equipment	:	**Chamber (Cold Room)**
Manufacturer	:	**KOLDTECH**
Model	:	**KM 320**
Serial No.	:	**TBN-1012061/05**
Customer Code	:	**BKK_EN0167**
ID No.	:	**T2463A3**
Customer	:	**ALS Laboratory Group (Thailand) Co.,Ltd.**
		104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
		Khet Suan Luang, Bangkok 10250
Customer Location	:	**Environmental Laboratory**
Date of Receipt	:	**27 June 2022**
Calibrated By	:	**Sujjar Naknakred (Site Calibration Manager)**
Approved By	:	/ **Boonchai Suriyawong (Site Calibration Manager)**
Date of Issue	:	04 JUL 2022

REVIEW BY Sirilak P.
APPROVED BY
NEXT CAL. DATE 30/12/22

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

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

Metrological Center

SCI ECO Services Company Limited

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report

Equipment	:	**Chamber (Cold Room)**
Date of Calibration	:	**30 June - 1 July 2022**
Environment	:	**Temperature : 18.9-23.7 °C**
		Line Voltage : 222.9-226.5 V
		Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 3 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By.

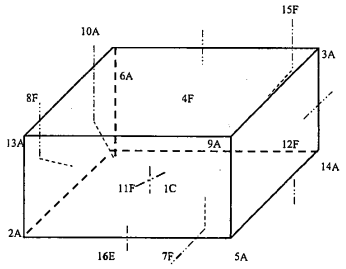
Metrological Center

SCI ECO Services Company Limited

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report



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

1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7F	=	TN167
8F	=	TN168
9A	=	TN169
10A	=	TN170

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By.

Metrological Center

SCI ECO Services Company Limited

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.68	3.02	2.96	3.03	2.85
	TN171	TN172	TN173	TN174	TN175	TN176				
	2.97	3.02	2.89	3.04	2.97	3.33				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor *k*
	Min , Max	Average					
3.0	2.9 , 4.0	3.2	2.99	1.05	1.30	1.66	2.00

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

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

Approved By.

BKK_EL0023

analytikjena

REVIEW BY Oawan T.
APPROVED BY Sauth N
NEXT CAL. DATE 24/05/24

Maintenance Protocol

Atomic Fluorescence Spectrometer

mercur DUO / mercur DUO plus

analytikjena

Serial-No.: K170A0143 Customer-No.:

Date: 24 May 2023 Carried out by: Srichai Fak-on

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

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

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Maintenance works basic unit

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

Maintenance works Autosampler Serial No.: 701 739

lubricate the dosing-winding (Teflon-grease-spray)	☑
clean the dosing cylinder, if necessary exchange it	☑
lubricate the winding system of the height drive with some drops of oil	☑
check the toothed belt	☑
check the position of the mechanical stopper (height: 13mm)	☑
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	☑
check the pump rate of washing cup	☑
check the electrical hose connections for good contact	☑
check the connectors of the magnetic valves	☑
check the dosing hose for buckling, if necessary exchange it	☑

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Device parameter		**nominal value**	**actual value**
visual check general tightness inside the Mercur		o.k.: ☑	changed: ☐
visual check Goldtraps		o.k.: ☑	changed: ☐
visual check spectrometer			
	Fluorescence cell	o.k.: ☑	changed: ☐
	Absorption cell, incl. window	o.k.: ☑	changed: ☐
	lens	o.k.: ☑	changed: ☐
	Swivel drive (SEV)	o.k.: ☑	changed: ☐
check pump hoses		o.k.: ☑	changed: ☐
check hoses and hose connectors		o.k.: ☑	changed: ☐
check and clean reactor		o.k.: ☑	changed: ☐
check drying hose output Gas-liquid-seperator		o.k.: ☑	changed: ☐
check bubble-sensor		o.k.: ☑	not o.k.: ☐
Check gasflow			
	Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
	Valve 1	10 Nl/h or 0.166 NL/min	0.163 NL/min
	Valve 2	50 Nl/h or 0.833 NL/min	0.403 NL/min
	Valve 3	5 Nl/h or 0.083 NL/min	0.140 NL/min
	Valve 4	10 Nl/h or 0.166 NL/min	0.108 NL/min
Check liquidflow			
	Acid	2.5ml/min ± 1 ml	2.5 ml/min
	Red.-agent	2.5ml/min ± 1 ml	2.5 ml/min
	Sample	10ml/min ± 2 ml	10 ml/min
Adventitious light - values	**(V)**	**from file**	
	100	0	0
	200	0	0
	300	0	0
	350	0	0
	400	0	0
	450	2	2
	500	5	5
	550	10	10
	575	15	14
	600	20	20

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Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: 360 V		
Blank-solution		Int 0.00024
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int$_1$ 0.00172 RSD 0.45 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 352 V		
Blank-solution		Int 0.00370
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int$_2$ 0.01060 RSD 2.38 %
Fok.- factor (Int$_2$ / Int$_1$)	> 3.5	6.16
Analytical parameters Absorption cell		
Blank-solution		Ext. 0.00093
without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext. 0.00449 RSD 2.58 %
Comments		

Srichan Pakan.
Signature Technician

24 May 2023
Place, Date (DD/MM/YYYY)

Oranan T.
Signature Customer

24 May 2023
Place, Date (DD/MM/YYYY)

analytikjena
An Endress+Hauser Company

35 Moo 5, 345 Road, Khlong Khoi, Pak Kret,
Nonthaburi 11120 Thailand
Phone: +66(2) 1062970-72
Fax: +66(2) 1062973
www.analytikjena.com

Service Report

Customer's address : สถาบันวิทยาศาสตร์ทางทะเล มธบ (ปทุมธานี) อาคาร 100 ชั้น 4D กรมวิทยาศาสตร์บริการ กระทรวงอุตสาหกรรม (ปลอง)

E-mail : Phone : Fax

Job No. 23052824 PM User : Service Engineer : Date : 24/5/2023 Page : 1/1

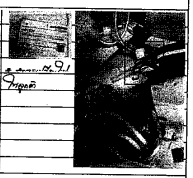
Instrument model : Mercur Serial No. K170A0143 Software Version No. 4.7.10.0

☐ Repair (RE) ☑ Maintenance (PM) ☐ Installation (IN) ☐ Warranty ☐ Application (AP) ☐ Site Prep.(SP) ☐ Visit(VI)

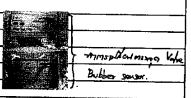
Fault / Claim – การบำรุงรักษาเครื่องวิเคราะห์ปรอท PO No. 23001112 / (INV2308-037) ☐☐☐ Error Code
– การบำรุงรักษา PM Contract Year 2023 (1 Time / Year 2023)

Action taken : – Maintenance Mark Basic Unit
– Check Device parameter.
– Check gas flow
– Check liquid flow
– Check Adventitious light – Valves

Test run Analytical parameter Fluorescence cell
Test run Analytical parameter Absorption cell



Action Pending / Recommendation : การบำรุงรักษาเครื่องวิเคราะห์.



การเปลี่ยนไส้กรอง Valve
Bubbler sensor.

☐ Spare Part ☐ Instrument Configuration :

Item No.	Name	Quantity	Unit Price
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Herewith the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.	Date / Signature of Customer	Date / Signature of Service Engineer	Work completed?
	Oranan T.		☑ Yes ☐ No

Services are subject to the General Terms and Conditions of Analytik Jena AG, which will be sent on request.

Mercur

Report file:	C:\WinAAS\TMP\2023\May\Pro_032		
Program version:	4.7.10.0	Printed on:	5/24/2023 12:46
		Recording started on	5/24/2023 12:35 GMT+7.0
Operator:	PSU,OTA		
Laboratory:	ALS-BKK		
Code:	II_Hg095_2023		

Remarks:
Food,water

Method parameters Hg

Method	Without enrichment / FBR 30ng/L_PM24052023
Created on	5/24/2023 Time 12:27
Program	---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	30 s
PMT	360 V		
AZ time	5 s	Peak smoothing	8/5
Delay	0 s		

Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 NL/h

Autosampler

Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		
Dilution	---		

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	1(30.000 ng/L)
QC std 1 limit	± 50.00%	QC std.2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards Hg

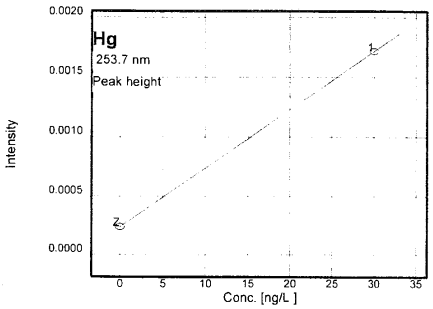
No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	79	0.000	H: **0.000249** A: 0.004274	**0.000132** 0.001698	**53.13** 39.72
2	Cal-Std1	(--)	80	30.000	H: **0.001720** A: 0.02172	**0.000007** 0.000023	**0.459** 0.107

Calibration function 1 **5/24/2023 12:44 Calibration (Peak height)**

Ints=k1+k2*conc

k1=0.000249 k2=0.000049 Recal. factor: ---

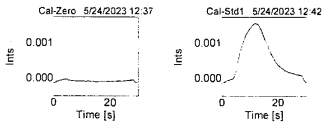
Slope	0.00005 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg	Without enrichment / FBR 30ng/L_PM 24052023					5/24/2023	12:35
ID	**Conc.**	**Ints**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.000143				PkH	12:37
		0.000397					12:38
		0.000207					12:40
	0ng/L	0.000249		0.0001324	53.13		12:40
Cal-Std1		0.001720				PkH	12:42
		0.001712					12:43
		0.001728					12:44
	30.00ng/L	0.001720		0.000007897	0.459		12:44
Calibration	Calibration function: 01						12:44

Peak plots **Hg**



Mercur

Report file:	C:\WinAAS\TMP\2023\May\Pro_033			
Program version:	4.7.10.0	Printed on:	5/24/2023	14:01
		Recording started on	5/24/2023	13:37 GMT+7.0
Operator:	PSU.OTA			
Laboratory:	ALS-BKK			
Code:	II_Hg095_2023			

Remarks:

Food,water

Method parameters **Hg**

Method	Enrichment / FER 30ng/L PM_24052023		
Created on	5/24/2023 Time 13:36		
Program	---		

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V		
AZ time	5 s	Peak smoothing	12/11
Delay	0 s		

Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	off	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	10 s	Gas AZ wait	10 NL/h
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	20 s		
Heat.time coll.1	20 s	Cool. time coll.1	30 s

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	1(30.000 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards **Hg**

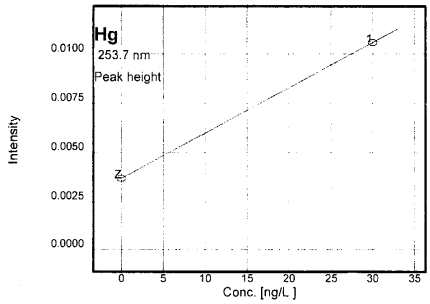
No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: **0.003700**	**0.000081**	**2.192**
					A: 0.02531	0.000153	0.607
2	Cal-Std1	(--)	##	30.000	H: **0.01060**	**0.000253**	**2.386**
					A: 0.06689	0.002766	4.136

Calibration function 1 **5/24/2023 14:00 Calibration (Peak height)**

Ints=k1+k2*conc

k1=0.003700 k2=0.000230 Recal. factor: ---

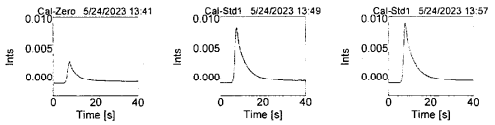
Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg	Enrichment / FER 30ng/L PM_24052023					5/24/2023	13:37
ID	**Conc.**	**Ints**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.003792				PkH	13:41
		0.003666					13:43
		0.003640					13:44
	0ng/L	0.003700		0.000081090	2.192		13:44
Cal-Std1		0.009498				PkH	13:49
		0.008333					13:50
		0.008961					13:52
	30.00ng/L	0.008931		0.0005830	6.528		13:52
Cal-Std1		0.01031				PkH	13:57
		0.01074					13:58
		0.01076					14:00
	30.00ng/L	0.01060		0.0002530	2.386		14:00
Calibration	Calibration function: 01						14:00

Peak plots **Hg**



Mercur

Report file:	C:\WinAAS\TMP\2023\May\Pro_034			
Program version:	4.7.10.0	Printed on:	5/24/2023	14:33
		Recording started on	5/24/2023	14:19 GMT+7.0
Operator:	PSU,OTA			
Laboratory:	ALS-BKK			
Code:	II_Hg095_2023			

Remarks:

Food,water

Method parameters **Hg**

Method	Without enrichment / Abs / FBR 100ng/L_PM 24052023		
Created on	5/24/2023 Time 14:18		
Program	---		

Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	225 V		
AZ time	5 s	Peak smoothing	2/5
Delay	8 s		

Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	5 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Delay	10 s		
Purge time1	50 s		
Purge time2	10 s	Gas wash time2	10 NL/h

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(100.00 ng/L)	QC std.2 no.	1(100.00 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 0.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards **Hg**

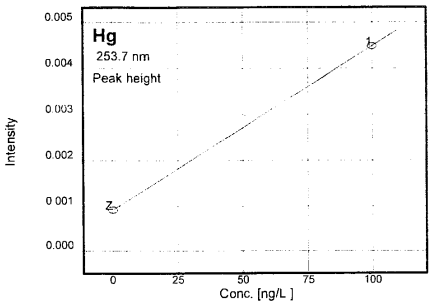
No	Name	State	Pos	Conc./ ng/L	Abs	SD	RSD/%
1	Cal-Zero	(--)	##	0.00	H: **0.000932**	**0.000138**	**14.88**
					A: 0.035926	0.006208	17.28
2	Cal-Std1	(--)	##	100.00	H: **0.004494**	**0.000116**	**2.586**
					A: 0.061286	0.001275	2.082

Calibration function 1 **5/24/2023 14:33 Calibration (Peak height)**

Abs=k1+k2*conc

k1=0.000932 k2=0.000036 Recal. factor: ---

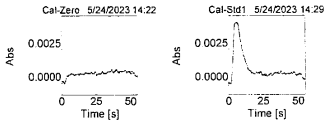
Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%I
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg	Without enrichment / Abs / FBR 100ng/L_PM 24052023					5/24/2023	14:19
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.001039				PkH	14:22
		0.000775					14:23
		0.000981					14:25
	0ng/L	0.000932		0.00013872	14.88		14:25
Cal-Std1		0.004528				PkH	14:29
		0.004364					14:31
		0.004589					14:33
	100.ng/L	0.004494		0.00011623	2.586		14:33
Calibration	Calibration function: 01						14:33

Peak plots **Hg**



SCG CEMENT-BUILDING MATERIALS
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220730 Page 1 of 6

Certificate of Calibration

Equipment	: HEATING BLOCK
Manufacturer	: Environmental Express
Model	: SC 196
Serial No.	: 6974CECW3285
Customer Code	: BKK_EL0054
ID No.	: T5306A3
Customer	: ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	: Acid Digestion Lab
Date of Receipt	: 30 March 2022
Calibrated By	: Watcharapon Sangtong (Technician)
Approved By	: _____ / Sujjar Naknakred (Site Calibration Manager)
Date of Issue	: 12 APR 2022

REVIEW BY Tatthapon C.
APPROVED BY Sanchan
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.

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Certificate No. T220730 Page 2 of 6

Calibration Report

Equipment	: HEATING BLOCK
Date of Calibration	: 7 April 2022
Environment	: Temperature : 21.8-23.1 °C
	Line Voltage : 221.6-226.3 V
	Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 25 Minute At 95 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By_____

Metrological Center

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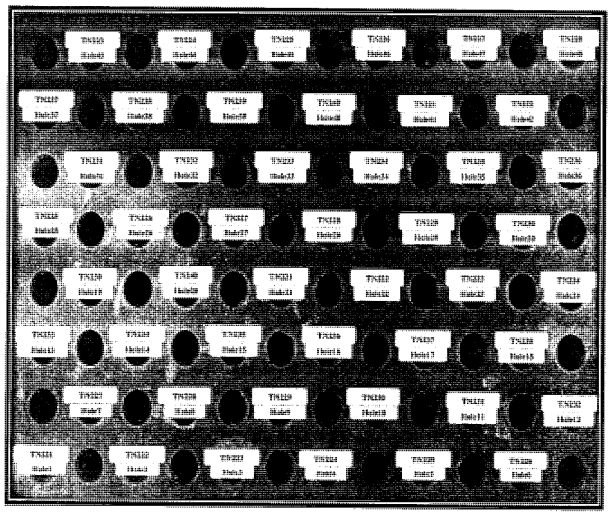
Calibration Report



FRONT CONTROL

Approved By. _____

Metrological Center

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	93.60	93.82	94.05	94.20	94.36	94.26
95	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.46	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73	96.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	96.01	96.10	96.02	96.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95	97.09
	Min	96.13	95.84	95.85	95.72	96.64	96.78
	Average	96.30	95.99	96.02	95.89	96.80	96.93
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By. _____

Metrological Center

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	104.47	104.65	104.79	105.31	105.47	105.46
105	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.68	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.90	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

Approved By. _____

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Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min , Max	Average		
100.0	100.0 , 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. _____

Certificate of System Qualification

GC-OQ

REVIEW BY
APPROVED BY
NEXT CAL. DATE 28/10/21

System ID: GC-6
Organization Name: ALS Laboratory Groups (Thailand)
Organization Location: 104 Phatthanakan 40, Phatthanakan Rd., Suan Luang, Bangkok 10250

Date: April 29, 2020 8:57:51 AM
EQP Name: AgilentRecommended
EQP Revision: GC.01.94
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890
Front SSL

Setpoint Status: Pass
Pressure: 25.0 psi
Pressure Change: 0.1 psi /5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL

Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.2	psi

Accuracy: 0.2 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7890
Back SSL

Setpoint Status: Pass
Pressure: 25.0 psi
Pressure Change: 0.1 psi /5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Back SSL

Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.1	psi

Accuracy: 0.1 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front FID

Setpoint Status: Pass
Flow Type: Fuel
Setpoint: 30.0 ml/min Measured Flow: 30.5 ml/min
Accuracy: 0.5 ml/min
Agilent Recommended: <= 10.0 % of setpoint (3.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Oxidizer
Setpoint: 400.0 ml/min Measured Flow: 401.5 ml/min
Accuracy: 1.5 ml/min
Agilent Recommended: <= 10.0 % of setpoint (40.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Makeup
Setpoint: 25.0 ml/min Measured Flow: 25.4 ml/min
Accuracy: 0.4 ml/min
Agilent Recommended: <= 10.0 % of setpoint (2.5 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Back FID

Setpoint Status: Pass
Flow Type: Fuel
Setpoint: 30.0 ml/min Measured Flow: 29.6 ml/min
Accuracy: 0.4 ml/min
Agilent Recommended: <= 10.0 % of setpoint (3.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Oxidizer
Setpoint: 400.0 ml/min Measured Flow: 399.3 ml/min
Accuracy: 0.7 ml/min
Agilent Recommended: <= 10.0 % of setpoint (40.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Makeup
Setpoint: 25.0 ml/min Measured Flow: 25.0 ml/min
Accuracy: 0.0 ml/min
Agilent Recommended: <= 10.0 % of setpoint (2.5 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass
Zone: Oven

	Setpoint	Actual	
Temperature:	230.0	231.8	°C
Accuracy:		1.8	°C
Agilent Recommended:	>= -1.0	% of setpoint in K	(-5.0 °C)
	<= 1.0	% of setpoint in K	(5.0 °C)

Setpoint Status: Pass
Zone: Oven

	Setpoint	Actual	
Temperature:	100.0	100.3	°C
Accuracy:		0.3	°C
Agilent Recommended:	>= -1.0	% of setpoint in K	(-3.7 °C)
	<= 1.0	% of setpoint in K	(3.7 °C)

Overall GC Oven Temperature Accuracy Test Status
Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass

	Setpoint	Average	
Temperature:	100.0	100.1833	°C
Stability:		0.2	°C
Agilent Recommended:	<=	0.5	

Overall GC Oven Temperature Stability Test Status
Pass

Scouting Run

Tested Combination1 Front SSL / Front FID
Injection Tower
Name: 7693A

Setpoint Status: Completed
Injection Volume on Column: 1.0 ul

Overall Scouting Run Status
Completed

Noise and Drift

Tested Combination1 Front SSL / Front FID
Name: 7890
Setpoint Status: Pass
Base Signal: 15.8 pA

	ASTM Noise pA	Drift pA/Hr
	0.06	0.04
Agilent Recommended:	<= 0.10	<= 2.50
Status:	Pass	Pass

Overall Noise and Drift Test Status
Pass

Injection Precision

Tested Combination1 Front SSL / Front FID
Injection Tower
Name: 7693A
Setpoint Status: Pass
Injection Volume on Column: 1.0 ul

Area RSD:	0.28 %	Retention Time RSD:	0.14 %
Agilent Recommended:	<= 3.00		<= 1.00

Overall Injection Precision Test Status
Pass

Signal to Noise

Tested Combination1 Front SSL / Front FID
Injection Tower
Name: 7890
Setpoint Status: Pass
Signal to Noise: 553420
Agilent Recommended: >= 300000

Overall Signal to Noise Test Status
Pass

Scouting Run

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7693A
Setpoint Status: Completed
Injection Volume on Column: 1.0 ul

Overall Scouting Run Status
Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID
Name: 7890
Setpoint Status: Pass
Base Signal: 21.0 pA

	ASTM Noise pA	Drift pA/Hr
	0.07	0.55
Agilent Recommended:	<= 0.10	<= 2.50
Status:	Pass	Pass

Overall Noise and Drift Test Status
Pass

Injection Precision

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7693A
Setpoint Status: Pass
Injection Volume on Column: 1.0 ul

Area RSD:	0.32 %	Retention Time RSD:	0.15 %
Agilent Recommended:	<= 3.00		<= 1.00

Overall Injection Precision Test Status
Pass

Signal to Noise

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7890
Setpoint Status: Pass
Signal to Noise: 576934
Agilent Recommended: >= 300000

Overall Signal to Noise Test Status
Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	GC-6
Manufacturer	Agilent Technologies

Tested Combination1

Injection Technique	Injection Tower
Sampler Identifier	Sampler 1
Inlet	Front
Detector	Front
LTM Included?	No

Tested Combination2

Injection Technique	Injection Tower
Sampler Identifier	Sampler 2
Inlet	Back
Detector	Back
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7893A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Front
Syringe Volume (ul)	10

Sampler 2

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN10340103
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (ul)	10

Sampler 3

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN15380030
Firmware Revision	A.11.01
Vial Heater	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	A.01.16

Inlet 1

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

Inlet 2

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

Detector 1

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Detector 2

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

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.)

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Full Name of Signer:	Sompop Tevaseksan
Logged On User Name:	sompop.tevaseksan@non.agilent.com
Signature Creation Date:	April 29, 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.

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Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

  A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of additional or special procedures and/or parts for the instrument service, then these must be ordered separately and charged as a repair, which may incur additional

Service Engineer's Responsibilities

- Only complete/printout pages that relate to the system being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

REVIEW BY Chancett Z
APPROVED BY Saunders N.
NEXT CAL DATE 2/2/2022

System Information

Instrument system name and ID	ICP 5100 / G 8010A.
Instrument system site and location	ALS / Laboratory 2nd Floor
List system component product numbers	**List the serial numbers of each component**
1. G 8010A	1. MY16010005
2. G8410A	2. AU15440764
3. G3292	3. 2008-00159
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

ICP-OES Configuration table	Circle the type or write in the type if other
Nebulizer Type	SeaSpray | OneNeb | other
Spray Chamber	Cyclonic Single Pass | Cyclonic Double Pass | other
Torch	Radial | Dual View | other
Injector Diameter	2.4mm | 1.8mm | 1.4mm | 0.8mm | other
Injector Material	Quartz | Ceramic | other

General Preparation

- ☑ Discuss any specific questions or issues with the customer prior to starting.
- ☑ Review the instrument logbook.
- ☑ Perform general external inspection of system for cleanliness.
- ☑ Check for proper installation of safety-related parts, assemblies, sensors etc.
- ☑ Check for required firmware/software updates and verify with customers if they would like it installed.
- ☑ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. N/A
- ☑ Run Instrument Performance test and record results in Instrument Performance Test Results Table - Pre PM.

Inspect and clean the system

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

G8481A Cooling water system

- ☐ **Section NOT Applicable**
- ☑ Drain cooling fluid and remove any particles from the chiller reservoir
- ☑ Remove, clean and reinstall water inlet metal mesh filter.
- ☑ Re fill with Polyclear cooling fluid.
- ☑ Clean the cooling system Air filter and the condenser by compressed air or vacuum cleaner.

SPS 3 Auto Sampler

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

SPS 4 Auto Sampler

- ☐ **Section NOT Applicable**
- ☑ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☑ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner
- ☑ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☑ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☑ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles

AVS 4, 6, 7 (AVS 8)

- ☐ **Section NOT Applicable**
- ☑ Replace valve rotor seal cleaned rotor seal.
- ☑ Check fittings for signs of leaks
- ☑ Check tubing including autosampler tubing for kinks or excessive wear
- ☑ Check high flow pump for signs of leaks

Instrument Adjustment

- ☑ Check position of Zn peak, adjust if required.
- ☑ Check Argon Ratio, adjust to specified value if required.
- ☑ Perform Detector Calibration.
- ☑ Perform Instrument Calibration.
- ☑ Run Instrument Performance Test and record results in Instrument Performance Test Results Table - Post PM.
- ☑ For systems using ICP Expert version 7.3 and above run the following Instrument tests and record the result in the Instrument Test Results Table
  - ☑ Subsystem Communications Test
  - ☑ Air Flow

- ☑ Water Flow
- ☑ Gas Flows
- ☑ RF Generator
- ☑ Camera Test
- ☑ Optics Test
- ☑ Nebulizer Test

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	3499.3	7519.6	4698.5	9248.3
Mn 257.610 nm SRBR	10549.1	82751.3	15474.9	86056.4
Al 396.152 nm SBR	7.8	14.8	14.5	18.0
K 766.491 nm SBR	3.8	30.8	6.6	35.6

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	pass
Air Flow	pass
Water Flow	pass
Gas Flows	pass
RF Generator	pass
Camera Test	pass
Optics Test	pass
Nebulizer test	pass

ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	213.5	VAC	213.5	VAC
Mains Current	0.100	A	0.114	A
Instrument Temperature	25.0	°C	25.0	°C
RF Air Flow (sensor speed)	9.0	Hz	17.0	Hz
Plasma Exhaust Temperature	No measurement		71.2	°C
Water Flow Oscillator	No measurement		1.37	L/min
Water Flow Detector	1.31	L/min	1.88	L/min
Water Inlet Temperature	18.8	°C	18.8	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-39.9	°C	-39.9	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	630.51	kPa	584.30	kPa
Purge Gas Supply Pressure*1	670.70	kPa	615.13	kPa
Option Gas Supply Pressure*1	8.23	kPa	8.88	kPa
Nebulizer Flow	No measurement		0.65	L/min
Nebulizer Back Pressure	No measurement		873	kPa
Plasma Gas Flow	No measurement		11.95	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1297	W
RF Supply Current	No measurement		8.49	A
RF Supply Voltage	No measurement		804	V

*1 If option installed

ICP-OES Parts List Table

Part description	Part Number	Product /Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8016A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Cooling Fluid	G3292-80010	G8481A	
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing,8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineers stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	

Restore system

For HF applications, ask the customer to reinstall their sample introduction system.

Leave system in an idle state: on and purging.

Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☑ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☑ Complete the Service Engineer Comments section below if there are additional comments.

- ☑ Review the service and any test results with the customer.
- ☑ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

Service Engineer Comments (optional)

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

Other Important Customer Web Links

How to get information on your product:

- ☑ Literature Library - http://www.agilent.com/en-us/products/icp-oes/icp-oes-systems/5110-icp-oes#literature
- ☑ Need to know more? - http://www.agilent.com/crosslab/university/
- ☑ Need technical support, FAQs? - http://www.agilent.com/en-us/support/landing/icp-oes
- ☑ Need supplies? - www.agilent.com/chem/supplies

Service Completion

Service request number 6004944009 Date service completed 3 MAR. 2021

Agilent signature Wiwanit T. Customer signature Titiwan B.

Document part number: G8014-90075

Report Summary

Instrument Model	Agilent 5100/5110 SVDV ICP-OES
Instrument ID	G8010A/G8014A
Instrument Serial Number	MY16010005
Software Version	7.3.0.8799
Firmware Version	3354
Tested By	Khunphol Test
Test Completed On	2/26/2020 1:54:10 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	Pass
Sensitivity Test	Pass
Precision Test	Pass

Subsystem Communications Test — Pass

Air Flow Test — Pass

30% Air Flow (relative speed)	75% Air Flow (relative speed)
12.00	17.00

Water Flow Test — Pass

RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.37	1.23	16.56

Gas Flows Test — Pass

Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.71	268.83	2.00	1.99	129.22

Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	1.99	129.75	18.00	17.89	25.93

RF Generator Test — Pass

RF Power Supply Test	Passed
RF Power Supply (V)	147.047
RF Oscillator Test	Passed
RF Oscillator Frequency (MHz)	25.739
Work Coil Current (A)	45.707
RF Power Supply Current (A)	2.000

Camera Test — Pass

	Integration Time (ms)	Standard Deviation	Status
Electronic Offset Test	1000	6.826	Passed
Dark Current Test	6000	0.907	Passed
Array Test	5	0.021	Passed
Linearity Test		0.019	Passed

Optics Test — Pass

	Radial	Axial	SVDV
Intensity	2511179	3116480	2761652
Wavelength	737.212	737.212	737.212

Resolution Test — Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.81
As (188.980 nm)	≤ 8.20	6.43
C (193.027 nm)	≤ 11.50	8.89
Mo (202.032 nm)	≤ 8.20	6.57
Cr (206.158 nm)	≤ 13.40	10.30
Zn (213.857 nm)	≤ 8.70	7.30
Pb (220.353 nm)	≤ 9.50	7.46
Co (228.615 nm)	≤ 17.20	12.45
Ba (230.424 nm)	≤ 9.40	7.80
Mn (257.610 nm)	≤ 13.30	9.84
Mn (260.568 nm)	≤ 20.30	14.96
Cr (267.716 nm)	≤ 11.00	8.59
Cu (324.754 nm)	≤ 25.00	18.91
Cu (327.395 nm)	≤ 14.20	11.71
Sr (338.071 nm)	≤ 33.50	24.92
Ba (455.403 nm)	≤ 44.00	33.60
Sr (460.733 nm)	≤ 36.00	22.33
Ba (493.408 nm)	≤ 36.00	25.84
Ba (614.171 nm)	≤ 42.00	28.46
Ar (675.283 nm)	≤ 74.00	62.25
K (766.491 nm)	≤ 80.00	62.92

Sensitivity Test — Pass

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	140.3	1345.0	81.1
Se (196.026 nm)	≥ 41.0	SRBR	93.8	1002.9	94.0
Zn (213.857 nm)	≥ 1421.0	SRBR	3088.3	41760.0	181.3
Pb (220.353 nm)	≥ 46.0	SRBR	152.2	1912.7	136.2
Mn (257.610 nm)	≥ 3518.0	SRBR	9845.4	176791.9	321.3
Al (396.152 nm)	≥ 3.4	SBR	11.6	28224.8	2241.9
Ba (493.408 nm)	≥ 34.0	SBR	174.8	1519375.4	8640.4
K (766.491 nm)	≥ 1.8	SBR	5.5	77052.1	11908.3

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 206.0	SRBR	414.4	7602.5	309.7
Se (196.026 nm)	≥ 159.0	SRBR	293.9	5929.0	359.1
Zn (206.200 nm)	≥ 234.0	SRBR	1170.3	17869.8	227.3
Zn (213.857 nm)	≥ 1743.0	SRBR	6593.5	185102.7	781.5
Cd (214.439 nm)	≥ 4227.0	SRBR	5666.0	118353.0	433.1
Pb (220.353 nm)	≥ 320.0	SRBR	405.7	10183.0	557.9
Mn (257.610 nm)	≥ 10625.0	SRBR	21673.9	776712.2	1280.0
Cr (267.716 nm)	≥ 1048.0	SRBR	4387.7	186495.1	1772.4
Cu (324.754 nm)	≥ 19.0	SBR	44.6	208221.0	4563.9
Al (396.152 nm)	≥ 6.0	SBR	18.2	161098.6	8401.5
Ba (493.408 nm)	≥ 60.0	SBR	216.7	7047159.1	32366.9
K (766.491 nm)	≥ 24.0	SBR	43.4	1586217.0	35725.8

Precision Test **Pass**

Radial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.67
Se (196.026 nm)	≤ 2.60	0.92
Zn (213.857 nm)	≤ 1.50	0.45
Pb (220.353 nm)	≤ 2.60	0.76
Mn (257.610 nm)	≤ 1.50	0.49
Al (396.152 nm)	≤ 1.50	0.38
Ba (493.408 nm)	≤ 1.50	0.58
K (766.491 nm)	≤ 1.50	0.38

Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.36
Se (196.026 nm)	≤ 1.50	0.53
Zn (206.200 nm)	≤ 1.50	0.30
Zn (213.857 nm)	≤ 1.50	0.55
Cd (214.439 nm)	≤ 1.50	0.54
Pb (220.353 nm)	≤ 1.50	0.53
Mn (257.610 nm)	≤ 1.50	0.83
Cr (267.716 nm)	≤ 1.50	0.59
Cu (324.754 nm)	≤ 1.50	0.52
Al (396.152 nm)	≤ 1.50	0.50
Be (493.408 nm)	≤ 1.50	1.04
K (766.491 nm)	≤ 1.50	1.21

Metrological Center
SCG CEMENT-BUILDING MATERIALS
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. T202398

Certificate of Calibration

Equipment : **Hot 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 : **12 November 2020**

Calibrated By : **Watcharapon Songthong (Technician)**

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

Date of Issue : 27 NOV 2020

REVIEWED BY Chanatt S.
APPROVED BY Saranitan N
NEXT CAL. DATE 18/05/22

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

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SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
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Certificate No. T202398

Calibration Report

Equipment : **Hot Block**
Date of Calibration : **17 November 2020**
Environment : **Temperature 20.0-20.3 °C**
Line Voltage 224.2-227.8 V

Condition of this results of test. :

1. This instrument was calibrated by insert 20 standard thermocouples type T into its chamber and test according to WI-T20. All data show below were final values and the initial data may be obtained upon request. The temperature scale used was based on ITS - 90.
2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T202319	30 October 2021
TC	TYPE T	TN31-TN40	T202319	30 October 2021
DATA LOGGER	34970A	T151	T202319	30 October 2021

3. This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
UUC Description :
Time Constant 1 Hour 30 Minute At 95 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
5. Result of test :
(X) without adjustment ( ) after adjustment

Approved By.

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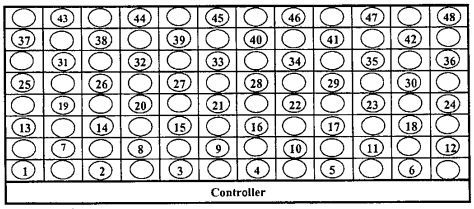
Certificate No. T202398

Calibration Report



○ STANDARD THERMOCOUPLE TYPE T

No.1	=	TN21	No.13	=	TN33	No.25	=	TN25	No.37	=	TN37
No.2	=	TN22	No.14	=	TN34	No.26	=	TN26	No.38	=	TN38
No.3	=	TN23	No.15	=	TN35	No.27	=	TN27	No.39	=	TN39
No.4	=	TN24	No.16	=	TN36	No.28	=	TN28	No.40	=	TN40
No.5	=	TN25	No.17	=	TN37	No.29	=	TN29	No.41	=	TN21
No.6	=	TN26	No.18	=	TN38	No.30	=	TN30	No.42	=	TN22
No.7	=	TN27	No.19	=	TN39	No.31	=	TN31	No.43	=	TN23
No.8	=	TN28	No.20	=	TN40	No.32	=	TN32	No.44	=	TN24
No.9	=	TN29	No.21	=	TN21	No.33	=	TN33	No.45	=	TN25
No.10	=	TN30	No.22	=	TN22	No.34	=	TN34	No.46	=	TN26
No.11	=	TN31	No.23	=	TN23	No.35	=	TN35	No.47	=	TN27
No.12	=	TN32	No.24	=	TN24	No.36	=	TN36	No.48	=	TN28

Approved By.

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Certificate No. T202398

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)									
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29	TN30
95	Max	95.30	95.46	96.02	96.07	96.19	95.57	95.82	95.79	96.10	95.84
	Min	95.10	95.24	95.78	95.82	96.02	95.42	95.66	95.64	95.93	95.66
	Average	95.20	95.35	95.90	95.94	96.10	95.50	95.74	95.71	96.02	95.75
		TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39	TN40
	Max	95.66	95.57	95.73	96.04	96.14	95.91	95.88	95.71	95.54	95.16
	Min	95.50	95.40	95.60	95.88	95.97	95.69	95.70	95.53	95.36	95.03
	Average	95.58	95.49	95.67	95.96	96.06	95.80	95.79	95.62	95.45	95.10
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.30	94.97	95.35	95.24	96.11	95.86	95.92	96.00	95.82	95.67
	Min	94.91	94.61	94.99	94.84	95.75	95.51	95.55	95.64	95.47	95.34
	Average	95.10	94.79	95.17	95.04	95.93	95.68	95.73	95.82	95.65	95.51
		TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39	TN40
	Max	95.83	96.10	96.06	95.66	95.44	95.00	95.18	95.56	95.13	94.90
	Min	95.44	95.75	95.73	95.33	95.12	94.69	94.83	95.17	94.76	94.57
	Average	95.63	95.92	95.89	95.50	95.28	94.85	95.01	95.36	94.95	94.74
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28		
	Max	95.82	95.67	95.83	96.10	96.06	95.66	95.44	95.00		
	Min	95.47	95.34	95.44	95.75	95.73	95.33	95.12	94.69		
	Average	95.65	95.51	95.63	95.92	95.89	95.50	95.28	94.85		

Approved By. _____

FM-L13 I08/30-05-57

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. T202398

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)									
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29	TN30
105	Max	105.68	105.33	105.67	105.39	106.20	106.04	106.14	105.91	105.85	105.30
	Min	105.40	105.12	105.48	105.20	105.94	105.69	105.84	105.73	105.64	105.15
	Average	105.54	105.22	105.57	105.29	106.07	105.86	105.99	105.82	105.74	105.23
		TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39	TN40
	Max	105.82	106.16	106.09	105.87	105.70	105.27	105.77	106.00	105.50	105.00
	Min	105.43	105.82	105.91	105.68	105.49	105.05	105.36	105.66	105.24	104.83
	Average	105.62	105.99	106.00	105.78	105.60	105.16	105.57	105.83	105.37	104.92
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29	TN30
	Max	105.82	105.67	106.18	105.67	106.27	105.77	106.33	106.50	106.49	106.45
	Min	105.60	105.52	106.01	105.47	106.13	105.65	106.16	106.34	106.32	106.29
	Average	105.71	105.59	106.09	105.57	106.20	105.71	106.25	106.42	106.40	106.37
		TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39	TN40
	Max	105.70	105.81	106.66	106.40	106.38	105.97	105.50	105.39	105.45	105.32
	Min	105.51	105.66	106.36	106.22	106.17	105.75	105.32	105.25	105.26	105.15
	Average	105.60	105.73	106.51	106.31	106.28	105.86	105.41	105.32	105.36	105.24
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28		
	Max	106.49	106.45	105.70	105.81	106.66	106.40	106.38	105.97		
	Min	106.32	106.29	105.51	105.66	106.36	106.22	106.17	105.75		
	Average	106.40	106.37	105.60	105.73	106.51	106.31	106.28	105.86		

Approved By. _____

FM-L13 I08/30-05-57

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Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T202398

Calibration Report

Hot Block			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min , Max	Average		
100.0	100.3 , 100.5	100.4	0.20	1.12
105.0	105.1 , 105.3	105.2	0.21	1.04

* The quoted uncertainty exclude "stability" and "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=2 , providing a level of confidence of approximately 95 % .

Approved By. _____

FM-L13 I08/30-05-57

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

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T211009

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 (Site Calibration Manager)

Date of Issue : 20 MAY 2021

REVIEW BY Sinlak P.
APPROVED BY
NEXT CAL. DATE 16/11/22

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

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

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	8 January 2022
TC	TYPE T	TN171-TN180	T210009	8 January 2022
DATA LOGGER	34970A	T149	T210009	8 January 2022

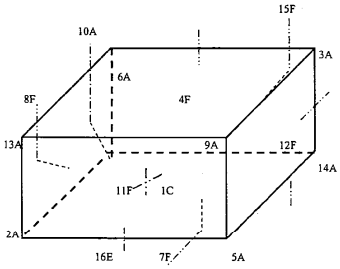
3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 1 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   (X) without adjustment ( ) after adjustment

Approved By.

SCG
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T211009

Calibration Report



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

1C = TN161	12F = TN172
2A = TN162	13A = TN173
3A = TN163	14A = TN174
4F = TN164	15F = TN175
5A = TN165	16E = TN176
6A = TN166	
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	
11F = TN171	

Approved By.

SCG
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T211009

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) Min , Max	Reading (°C) Average	Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor *k*
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 multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.

ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ เขตราชเทวี
กรุงเทพมหานคร ๑๐๔๐๐

๒๘ มกราคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๓๐ กรกฎาคม ๒๕๖๓

สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น
๓. ซอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๕ ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย ตามสิ่งที่ส่งมาด้วย ๒

ค. ซอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๕๙ รายการ น้ำใต้ดิน จำนวน ๑๒๖ รายการ อากาศเสีย ๑๖ รายการ สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน ๑๕ รายการ และดิน จำนวน ๑๒๕ รายการ รวมทั้งสิ้นจำนวน ๓๖๑ รายการ ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๖ หากประสงค์จะต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อกรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายศิระ จันทร์เฉิด)
นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเตือนภัยมลพิษโรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ
โทร. ๐ ๒๒๐๒ ๔๑๔๖ ๐ ๒๒๐๒ ๔๐๐๒
โทรสาร ๐ ๒๓๕๔ ๓๒๐๘ ๐ ๒๓๕๔ ๓๔๑๕

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย

๑) นางสาวยุพาพร จันทร์เปล่ง	ทะเบียนเลขที่ ว-๒๐๔-ศ-๔๗๐๐
๒) นางสาวชัชนัย โกมารกุล ณ นคร	ทะเบียนเลขที่ ว-๒๐๔-ศ-๔๗๐๑
๓) นายศรายุทธ จิตราบนท์	ทะเบียนเลขที่ ว-๒๐๔-ศ-๔๗๐๒
๔) นางสาวกนกกร เอนก	ทะเบียนเลขที่ ว-๒๐๔-ศ-๖๑๑๑
๕) นายสุริยา สอนแก้ว	ทะเบียนเลขที่ ว-๒๐๔-ศ-๖๑๑๒
๖) นายวิชาญ ชุณหรัต	ทะเบียนเลขที่ ว-๒๐๔-ศ-๖๑๑๓

(นายศิระ จันทร์เฉิด)
นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย

๑) นางสาวจินดา โขจุลธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๘
๒) นางสาวสาวิตรี น้อยเสงี่ยม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๙
๓) นางสาวขณัฐกาญจน์ อิ่มชม	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๐
๔) นางสาวนรินทร์ สายเส็ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๕
๕) นางสาวนันทวดี สมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๖
๖) นางสาวศรัณยา เฉลิมอำรงค์	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๗
๗) นางสาวสรารัตน์ มงคลจิรวุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๙
๘) นางสาวศิริลักษณ์ พึ่งแพง	ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๒๐
๙) นายนพพงศ์ จันทรุพันธุ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๐๘
๑๐) นายนรเศรษฐ์ โกมาลย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๑
๑๑) นายธันวา จริยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๑๔
๑๒) นางสาวเกศรินทร์ แก้วมั่น	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 ภู่นภาอำพร	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) นางจิลดา คำภูแก้ว	ทะเบียนเลขที่ ว-๒๐๔-จ-๕๔๓๑
๒๒) นางสาวอรวรรณ รักยง	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๑๕
๒๓) นางสาวนพรัตน์ แย้มกรานต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๑๙
๒๔) นายจุลเดช วาริบทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๐
๒๕) นางสาวดายุรัตน์ ร้องคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๑
๒๖) นายนคร สุขเจริญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๒
๒๗) นายบัญชา นามเขตต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๓
๒๘) นายพรมมี ศรีปัตเนตร	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๕
๒๙) นายยุทิศ ยุ่นสิม	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-๖๒๔๒
๓๔) นางสาวจารุวรรณ พิมพ์อภิกฤติยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๗๖

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๓๕) นางสาวปรางค์ทิพย์...

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๓๕) นางสาวปรางค์ทิพย์ กิจไพศาลศักดิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๗๘
๓๖) นางสาวเดือนใจ ทางกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๐
๓๗) นางสาวจิราพร ศิริเวช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๒
๓๘) นายวรากร ผูกรักษ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๓
๓๙) นายหนง วิริยะสหกิจ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๔
๔๐) นายธนิต เจนจบ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๕
๔๑) นายคณิศร ขำเพชร	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๖
๔๒) นายอรรคพล นิยมวิทยาพัน	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 ศรีเสน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๑
๔๗) นายเจษดินทร์ คงศักดิ์ไทย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๒
๔๘) นายจรัส บุญยิ่ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๕
๔๙) นายธนาณัติ เอนก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๖
๕๐) นายอภิวัฒน์ ทุมหนู	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๗
๕๑) นางสาวสุภาพวัญ มาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๘
๕๒) นางสาวทัดพร ขวาลสมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๐
๕๓) นางสาวธิดิมา บุญเพ็ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๑
๕๔) นางสาวกนกอร เข็มเพ็ชร	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๒
๕๕) นางสาวพัชรียา หงษ์สมดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๓
๕๖) นางสาวภานิดา สุรวงศ์ตระกูล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๔
๕๗) นางสาวภานุมาศ นามวัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๕
๕๘) นางสาวอุไรรัตน์ ทึงสร้างแป้น	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๖
๕๙) นายธีรวัฒน์ ปวงสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๗
๖๐) นายอิทธิพล ยะโส	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๘
๖๑) นายประพจน์ 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) นางศิลาวรรณ ใจบุญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๕
๖๗) นางสาวพรรณธิดา พุ่มคง	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๘
๖๘) นางสาวศรวณีย์ ยิ่งดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๙
๖๙) นายนวภัทร ศรีวิริยะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๐
๗๐) นายสุวิชา ทองอ่อน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๑
๗๑) นายวิญญู บุญตะนัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๓

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๗๒) นายสมบูรณ์...

๗๒) นายสมบูรณ์ บุตรจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๔
๗๓) นายวิรัตน์ ไชยนะธรา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๕
๗๔) นายนฤเบศน์ เพิ่มพูน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๖
๗๕) นายจิรณัฐ ขวาละออ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๗
๗๖) นายสมโภช วันสา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๙
๗๗) นายอัสรี นามบุรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๑๗
๗๘) นายณัฐนันท์ ปานประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๑๙
๗๙) นายอัศวเรศ จ่อสาว	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๐
๘๐) นายประเสริฐ สุระขันธ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๑
๘๑) นายนุกูล จันทร์เนียม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๒
๘๒) นายพีรพงษ์ ทองคุณปรีดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๓
๘๓) นายนฤพล ทองนุช	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๔
๘๔) นายอนุวัฒน์ ม่วงแพร	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๕
๘๕) นายเจตศราวุฒิ ปัตตะมะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๖
๘๖) นายกฤษณะ สายวรรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๗
๘๗) นายพิชัย บุญยงค์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๘
๘๘) นายภานุพงศ์ โฮมวงศ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๒๙
๘๙) นายสามารถ คุ้มปลี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๐
๙๐) นายสัญชัย โกศรีนาม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๑
๙๑) นายณัฐวุฒิ ศรีประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๒
๙๒) นายชวัลธัช นาคพนม	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๓
๙๓) นายพงศธร ชัยทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๕
๙๔) ว่าที่ร้อยตรี ภานุพงศ์ แสนศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๖
๙๕) นายสิทธิโชค ทาสีดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๗
๙๖) นายธนากร อินสุดา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๘
๙๗) นางสาววรณิชชา ชาติวันชัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๙
๙๘) นางสาวพิมพ์ผะวัน มินากูล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๔๑
๙๙) นางสาวเพชรัตน์ สิงห์สมบุญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๔๒
๑๐๐) นางสาวชญานิน พรหมจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๔๓
๑๐๑) นายกีรติ ทวีราช	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๘๖
๑๐๒) นายจักริน หมั่นวิชา	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๘๗
๑๐๓) นายฉัตรชัย สุขเปีย	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๘๘
๑๐๔) นายณรนนท์ ตัะทองคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๘๙
๑๐๕) นายตุลยพล สนนอก	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๐
๑๐๖) นายทักษ์ตนัย อุบลศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๑
๑๐๗) นายธนศวร นามะกุณญา	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๒
๑๐๘) นายธิติพงศ์ บัวแดง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๓

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ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

๑๐๙) นายนนทชัย...

๑๐๙) นายนนทชัย อุปถัมภ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๔
๑๑๐) นายนัฐพล คุณสุทธิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๕
๑๑๑) นายนันทวัฒน์ สาริน	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๖
๑๑๒) นายปิยะนัฐ พลมะศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๗
๑๑๓) นายพงศ์สิริ โสมเขียว	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๘
๑๑๔) นายพีรพัฒน์ กำคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๕๙๙
๑๑๕) นายภาณุพงศ์ มานิตย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๐
๑๑๖) นายมงคล ผลาทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๑
๑๑๗) นายมุนินทร์ พูลศิริ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๒
๑๑๘) นายสิรินนท์ ทองอั่น	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๓
๑๑๙) นายอเนชา หันสมัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๔
๑๒๐) นายอดิศักดิ์ ผมไผ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๕
๑๒๑) นายอนันตชัย วีสม	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๖
๑๒๒) นายณัฐดนัย เจือละออง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๗
๑๒๓) นายวรวุธ ดีนัก	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๘
๑๒๔) นายแสงตะวัน นะตะสัต	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๙
๑๒๕) นายยุทธพงศ์ รัตนะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๐
๑๒๖) นายชยัณวุฒิ ไชยฮะนิจ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๑
๑๒๗) นายวิศรุต ศรีธรรมมา	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๑๒
๑๒๘) นายนนทกร 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) นายไพรวัลย์ เปรื่องพิมาย	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๓
๑๓๕) นางสาวศุภมาศ ทองมาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๔
๑๓๖) นางสาวลลิตา จิตรสว่าง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๕
๑๓๗) นางสาวขไมพร เสิกภู่เขียว	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๖
๑๓๘) นางสาวกฤติมาพร คำมีแก่น	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๗
๑๓๙) นางสาวสกุลรัตน์ ภาคภูมิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๘
๑๔๐) นางสาวกาญจนา คงคูณ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๙
๑๔๑) นางสาวไพรินทร์ ศรีรูปี	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๐
๑๔๒) นางสาวทิพเนตร ผุยปัญญา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๑
๑๔๓) นางสาวสาธิตา ปานทอง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๒
๑๔๔) นางสาวอริสา ทองนวล	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๓
๑๔๕) นางสาวอรยา ค้าคล่อง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๔

(นายศิระ จันทร์เฉิด)
นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

๑๔๖) นางสาวชุดาภรณ์...

๑๔๖) นางสาวชุดาภรณ์ สุนทรสนาน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๕
๑๔๗) นางสาวสุดารัตน์ นนท์ประสาท	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๖
๑๔๘) นางสาวรัชนีกร เนียมกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๗
๑๔๙) นางสาวกัญญารัตน์ ศรีนิลหา	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 ปั้นมยุรา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๒
๑๕๔) นางสาวพาฤดี คุณนาน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๓
๑๕๕) นางสาวจิราเจต พ่องตา	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) นางสาววิชชุตา นาคผจญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๙
๑๖๑) นางสาวพนิดา ยอดอินทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๐
๑๖๒) นางสาวนันทิยา จันทะลุน	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๑

(นายศิระ จันทร์เฉิด)
นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔
ที่ อก ๐๓๑๐(๑)/ ๑๐๖๕ ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๖๑ รายการ

<u>น้ำเสีย จำนวน 59 รายการ</u>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldicarb	High-Performance Liquid Chromatographic Method[4]
2	Aldicarb Sulfone	High-Performance Liquid Chromatographic Method[4]
3	Aldicarb Sulfoxide	High-Performance Liquid Chromatographic Method[4]
4	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
5	Arsenic	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
6	Barium	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
7	α-BHC	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
8	β-BHC	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
9	δ-BHC	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
10	γ-BHC	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
11	Biochemical Oxygen Demand	1) 5-Day BOD Test, Azide Modification Method[4] 2) 5-Day BOD Test, Membrane Electrode Method[4]
12	Carbaryl	High-Performance Liquid Chromatographic Method[4]
13	Carbofuran	High-Performance Liquid Chromatographic Method[4]
14	Cadmium	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
15	Chemical Oxygen Demand	1) Closed Reflux, Colorimetric Method[4] 2) Closed Reflux, Tritimetric Method[4]
16	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic Method[4]
17	Chromium	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[4]
18	Color	ADMI Weighted-Ordinate Spectrophotometric Method

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

19 Copper...

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

44 Methomyl...

(นางริกาญจน์ ฉัตรสกุลวิไล)
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แทนอธิบดีกรมควบคุมมลพิษ

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

<u>น้ำใต้ดิน จำนวน 126 รายการ</u>

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

3 Aldrin...

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
แทนอธิบดีกรมควบคุมมลพิษ

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

18 Bis(2-ethylhexyl)phthalate...

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
แทนอธิบดีกรมควบคุมมลพิษ

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

34 Chromium (III)...

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

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

(นางริกาญจน์ ฉัตรสกุลวิไล)
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และทะเบียนห้องปฏิบัติการ

51 cis-1,2-Dichloroethylene...

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

(นางริกาญจน์ ฉัตรสกุลวิไล)
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และทะเบียนห้องปฏิบัติการ

68 Fluorene...

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

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84 Methanol...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method[4]
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
86	Methyl Bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
87	Methylene Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
89	2-Methylnapthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
90	Methyl tert-Butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
91	Naphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
92	Nickel	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
95	N-Nitrosodi-n-Propylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
96	Polychlorinated Biphenyls - PCB 1016 - PCB 1221 - PCB 1232 - PCB 1242 - PCB 1248 - PCB 1254 - PCB 1260	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]

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97 Pentachlorophenol...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
98	pH	Electrometric Method[4]
99	Phenanthrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
100	Phenol	1) Distillation, Direct Photometric Method[4] 2) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
101	Pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
102	Selenium	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
103	Silver	1) Digestion, Inductively Coupled Plasma Method[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4]
104	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
105	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
106	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
107	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
108	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4]
109	TPH (C_5-C_8)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[13,24]
110	TPH ($C_{>8}$-C_{16})	Solvent Extraction, Gas Chromatographic Method[9,21]
111	TPH ($C_{>16}$-C_{35})	Solvent Extraction, Gas Chromatographic Method[9,21]
112	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]
113	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]

114 1,1,2-Trichloroethane...

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

<u>อากาศเสีย (ปล่องระบาย) จำนวน 16 รายการ</u>

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

3 Carbon Monoxide...

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

สิ่งปฏิกูล...

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<u>สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน 35 รายการ</u>

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

6 Cadmium...

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

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11 Cobalt...

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

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2) Soxhlet...

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

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2) Waste Extraction...

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

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27 Polychlorinated...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
27	Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5',6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method[1,9,23] 2) Soxhlet Extraction, Gas Chromatographic Method[10,23] 3) Automated Soxhlet Extraction, Gas Chromatographic Method[22,31]

28 Pentachlorophenol...

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

4) Digestion...

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

<u>ดิน จำนวน 125 รายการ</u>

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

9 Benz(a)anthracene...

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

26 Carbon tetrachloride...

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

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40 DDE...

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

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57 Dieldrin...

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

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71 Hexachlorobenzene...

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

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

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- Aroclor 1242...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
	- Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5',6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	
97	Pentachlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]
98	Phenanthrene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]
99	Phenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]
100	Pyrene	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]

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101 Selenium...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
101	Selenium	1) Digestion, Inductively Coupled Plasma Method[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16]
102	Silver	1) Digestion, Inductively Coupled Plasma Method[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16]
103	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
106	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
107	Toxaphene	1) Soxhlet Extraction, Gas Chromatographic Method[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]
108	TPH (C_5–C_8)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
109	TPH ($C_{>8}$– C_{16})	1) Solvent Extraction, Gas Chromatographic Method[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method[21,31]
110	TPH ($C_{>16}$ – C_{35})	1) Solvent Extraction, Gas Chromatographic Method[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method[21,31]
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24]
115	2,4,5-Trichlorophenol	Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31]

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116 2,4,6-Trichlorophenol...

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

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และทะเบียนห้องปฏิบัติการ

ที่ อก ๐๓๑๐(๑)/ ๕ ๓ ๗ ๙

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๐ ๙ มีนาคม ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๔ กุมภาพันธ์ ๒๕๖๖

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๔ ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้ยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๙ ราย

๑) นายนคร ลุขเจริญ	ทะเบียนเลขที่ ว-๒๐๔ จ-๖๑๒๒
๒) นายบัญชา นามเชตต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๒๓
๓) นายอรรคพล นิยมวิทยาพัน	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๗
๔) นางสาวพัชรียา หงษ์สมดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๓
๕) นางสาวภานิดา สุรวงศ์ตระกูล	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๐๔
๖) นางสาวศรวณีย์ ยิ่งดี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๐๙
๗) นายสมโภช วันสา	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๕๑๙
๘) นายณัฐนันท์ ปานประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๑๙
๙) ว่าที่ร้อยตรีภาณุพงศ์ แสนศรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๗๘๓๖
๑๐) นายมุนินทร์ พูลศิริ	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๒
๑๑) นายณัฐดนัย เจือละออง	ทะเบียนเลขที่ ว-๒๐๔-จ-๘๖๐๗
๑๒) นางสาวกาญจนา คงคูณ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๒๙
๑๓) นางสาวรัชนีกร เนียมกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๗
๑๔) นางสาวกัญญารัตน์ ศรีนิลทา	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๘
๑๕) นายศิริวัฒน์ พานิชย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๑
๑๖) นางสาวกนกภรณ์ อุระ	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๕
๑๗) นางสาวจิตสุภา ประเทืองสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๗
๑๘) นางสาวอริสา วิริยะชัยธิธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๘
๑๙) นางสาวพนิดา เอกอินทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๐

๒. ให้เพิ่มเจ้าหน้าที่...

๒. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ ราย

๑) นายกาจบัณฑิต กิตติศุภวณิชย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๑
๒) นายภัทรพล สว่างใจธรรม์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๒
๓) นายนราธิบ เทือกชัยคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๓
๔) นายศิริโชค พงษ์ประสม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๔
๕) นายณัฐวุฒิ ด้วงแพง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๕

อนึ่ง หนังสือฉบับนี้จะหมดอายุพร้อมหนังสือต่ออายุรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ที่ อก ๐๓๑๐(๑)/๑๐๖๙ ลงวันที่ ๒๘ มกราคม ๒๕๖๔ คือในวันที่ ๒ กันยายน ๒๕๖๖ ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ท้ายหนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นางริกาญจน์ ฉัตรสกุลวิไล)
นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาราชการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเตือนภัยมลพิษโรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ
โทร. ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๐๗-๕
โทรสาร ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๐๗
ไปรษณีย์อิเล็กทรอนิกส์ saraban@diw.mail.go.th

ที่ อก ๐๓๑๐(๓)/ ๖๑๒๕

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๒๓ มีนาคม ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๑๐ มีนาคม ๒๕๖๖

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๔ ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้เปลี่ยนแปลงชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จากเดิม นางสาวสรารัตน์ มงคลจิรวุฒิ ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๙ เป็น นางสาวธัญญธร มงคลจิรวุฒิ ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๑๙

ทั้งนี้ หากท่านมีความประสงค์จะยื่นคำขอใดๆ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ท้ายหนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายประสม คำรงพงษ์)
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเตือนภัยมลพิษโรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ
โทร. ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๐๓-๕
โทรสาร ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๙๙
ไปรษณีย์อิเล็กทรอนิกส์ saraban@diw.mail.go.th

ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

Green Industry
อุตสาหกรรมสีเขียว ประเทศไทยก้าวไกล ร่วมกันพัฒนา อุตสาหกรรมสีเขียว

แบบ ปอ.1

คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน

วันที่ 4 เดือน สิงหาคม พ.ศ. 2566

ข้าพเจ้า ( ) ผู้รับใบอนุญาตประกอบกิจการโรงงาน .....

(√) บริษัท/ห้างหุ้นส่วนจำกัด เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

ตั้งอยู่ที่เลขที่ 104 หมู่ที่ - ตรอก/ซอย พัฒนาการ 40

ถนน พัฒนาการ ตำบล/แขวง พัฒนาการ

อำเภอ/เขต สวนหลวง จังหวัด กรุงเทพมหานคร รหัสไปรษณีย์ 10250

โทรศัพท์ 02 760-3040 โทรสาร 0 2 760-3197

ได้รับทราบระเบียบกรมโรงงานอุตสาหกรรมว่าด้วยการขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน พ.ศ. 2560 โดยตลอดแล้วและยินยอมปฏิบัติตามระเบียบฯทุกประการ และได้แนบเอกสารต่างๆ ตามรายการเอกสารประกอบการพิจารณา (แบบ ปอ.1-1) มาพร้อมนี้

รายการขอดำเนินการ

การดำเนินการ	รายละเอียด (รายการ)				
	น้ำเสีย/น้ำทิ้ง	น้ำใต้ดิน	อากาศเสีย	สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว	ดิน
[ ] ขอขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน					
[√] ต่ออายุห้องปฏิบัติการวิเคราะห์เอกชน	59	126	16	35	125
[√] เปลี่ยนแปลงสารมลพิษที่วิเคราะห์ (√) เพิ่มสารมลพิษ ( ) ยกเลิกสารมลพิษ	-	-	12	-	-
[√] เปลี่ยนแปลงบุคลากร (√) เพิ่มบุคลากร (√) ยกเลิกบุคลากร	จำนวน 38 ราย (รายละเอียดตาม แบบ ปว.1) จำนวน 2 ราย (รายละเอียดตาม แบบ ปว.1)				
[ ] ยกเลิกห้องปฏิบัติการวิเคราะห์เอกชน					
[ ] อื่นๆ ..โปรดระบุ.....					

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
มส. ผ.ขึ้นทะเบียนห้องปฏิบัติการ
รับที่ 5555-65
รับที่ 7 ส.ค. 66
เวลา 8.30 น.

จึงเรียนมาเพื่อโปรดพิจารณา

เรียน กวท.
เพื่อโปรดพิจารณา

(นายประสม คำรงพงษ์)
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน

ลงชื่อ .....
(นางทัศนีย์ เลขากุลพร)
ผู้มีอำนาจลงนามแทนนิติบุคคล
ประทับตรา (ถ้ามี)

ALS Laboratory Group (Thailand) Co., Ltd.

F-ED-LR-01- 1/1

ที่ อก ๐๓๑๐(๓)/ ๖๔๗๐

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๒๘ มิถุนายน ๒๕๖๔

เรื่อง ขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๒๙ เมษายน ๒๕๖๔

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด จำนวน ๒ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน พร้อมรายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ และรายการสารมลพิษที่จะทำการวิเคราะห์ ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน มีเลขทะเบียน ว-๓๒๓ สถานที่ตั้งเลขที่ ๖๓๖/๑๐ หมู่ที่ ๕ ตำบลแม่น้ำคู้ อำเภอบลวกแดง จังหวัดระยอง โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์

๑) นายเดช ช้างชน ทะเบียนเลขที่ ว-๓๒๓-ค-๙๔๔๒
๒) นางวิลาวัณย์ บริรักษ์ ทะเบียนเลขที่ ว-๓๒๓-ค-๙๔๔๓
๓) นายสุพจน์ สลามเต๊ะ ทะเบียนเลขที่ ว-๓๒๓-ค-๙๔๔๔

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์

๑) นางสาวนฤมล บรรจงกิจ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๔๕
๒) นางพจนา สีดา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๔๖
๓) นางสาวธนิดา กุลสุริวงศ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๔๗
๔) นายพิทยา หองแดง ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๔๘
๕) นางชลธิชา สุบงกช ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๔๙
๖) ว่าที่ ร.ต.รณชัย ม่วงมา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๐
๗) นายวรวุฒิ พับพา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๑
๘) นายศักดิ์นรินทร์ จรัสกาย ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๒
๙) นายสุรศักดิ์ สาชิน ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๓
๑๐) นางสาวเพชรคุณ ภวภูตานนท์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๔
๑๑) นายสถาพร ถาแก้ว ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๕
๑๒) นายสุพธิ์ศรัณย์ โชคปิติพันธ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๖

๓๓) นายวัลลภ...

๑๓) นายวัลลภ หันไชยเนาว์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๗
๑๔) นางสาววนาลี เหรียญตระกูล ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๘
๑๕) นางสาววนิดา ผดุงจิตต์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๙
๑๖) นายธนะสิทธิ์ วงศ์ษาไชย ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๐
๑๗) นายชัยบุสรณ์ เลิศนันทกุลชัย ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๑
๑๘) นายสังจา เพ็ชรแสวง ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๒
๑๙) นายกันตภณ มณีสัมพันธ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๓
๒๐) นางสาวจันทนีย์ โกเมนขนะ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๔
๒๑) นายธารินทร์ อ๊อกจินดา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๕
๒๒) นายศุภณัฐ พิสัยพันธ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๖
๒๓) นายศุภชัย วงศ์สุริย์ฉาย ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๗
๒๔) นายปฐมพงศ์ กรสวัสดิ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๘
๒๕) นายไสว ต้นโพธิ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๖๙
๒๖) นางสาวกิตติยา สัญญาอริยาภรณ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๐
๒๗) นางสาวเจษฎาพร ศรีบุญเรือง ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๑
๒๘) นางสาวมรุรินทร์ สิงห์เงา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๒
๒๙) นางสาวธิดารัตน์ ศิริมังคะโร ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๓
๓๐) นายพิพัฒน์ นิภัทร์เศรษฐ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๔
๓๑) นายศิริวิทย์ เรืองสม ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๕
๓๒) นายปราเมศ สัตยาคุณ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๖
๓๓) นายณฤนาท ธรรมสะโร ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๗
๓๔) นางสาวศุภวัตน์ ไสจันทร์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๘
๓๕) นายพชรกร อินทรเสนา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๙
๓๖) นายทิวากร เชื้อมาก ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๐
๓๗) นายอนุรักษ์ ทองขจรศักดา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๑
๓๘) นายอภิชาติ วิลาศ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๒
๓๙) นายจรัสระวี ศรีรักษา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๓
๔๐) นายประสานมิตร เชื่อนเพชร ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๔
๔๑) นายกานุวัฒน์ วังบง ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๕
๔๒) นายสันติ ชัยชนะ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๖
๔๓) นายสิทธิชัย แก้วเกตุ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๗
๔๔) นายทินกร กุลชาติ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๘

ค. รายการน้ำเสียมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๑๔ รายการ อากาศเสีย (ปล่องระบาย) จำนวน ๗ รายการ และน้ำใต้ดิน จำนวน ๓ รายการ รวมทั้งสิ้นจำนวน ๒๔ รายการ ตามสิ่งที่ส่งมาด้วย

หนังสือฉบับนี้มีอายุ ๓ ปี นับจากวันที่กรมโรงงานอุตสาหกรรมออกหนังสือ หากประสงค์จะต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อกรมโรงงานอุตสาหกรรมภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นางจินดา เตชะศรินทร์)
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

๒ ๘ มิ.ย. ๒๕๖๔

กองวิจัยและเตือนภัยมลพิษโรงงาน
ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
โทร. ๐ ๓๘๐๕ ๗๒๖๑-๓
ไปรษณีย์อิเล็กทรอนิกส์ eirw@diw.mail.go.th

เอกสารแนบท้ายหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๓๒๓
ที่ อก ๐๓๑๐(๓)/ ๖๔๗๐ ลงวันที่ ๒๘ มิถุนายน ๒๕๖๔

ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๒๔ รายการ

<u>น้ำเสีย จำนวน 14 รายการ</u>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Biochemical Oxygen Demand	1) 5-Day BOD Test, Membrane Electrode Method[2] 2) 5-Day BOD Test, Azide Modification Method[2]
2	Chemical Oxygen Demand	1) Open Reflux, Titrimetric Method[2] 2) Closed Reflux, Colorimetric Method[2] 3) Closed Reflux, Titrimetric Method[2]
3	Color	ADMI Weighted – Ordinate Spectrophotometric Method[2]
4	Cyanide	Distillation, Colorimetric Method[2]
5	Formaldehyde	Distillation, Colorimetric Method[1]
6	Free Chlorine	DPD-Ferrous Titrimetric Method[2]
7	Oil and Grease	Liquid-Liquid Partition-Gravimetric Method[2]
8	pH	Electrometric Method[2]
9	Phenols	1) Distillation, Chloroform Extraction Method[2] 2) Distillation, Direct Photometric Method[2]
10	Sulfide	ZnS Precipitation, Iodometric Method[2]
11	Temperature	Laboratory and Field Method[2]
12	Total Dissolved Solids	Dried at 180 °C[2]
13	Total Kjeldahl Nitrogen	Semi-Micro Kjeldahl Method[2]
14	Total Suspended Solids	Dried at 103-105 °C[2]

<u>อากาศเสีย (ปล่องระบาย) จำนวน 7 รายการ</u>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Carbon Monoxide	1) Sampling Bag, Non-Dispersive Infrared Method[5] 2) Instrumental Analyzer Method[8]
2	Hydrogen Sulfide	Absorption Sampling, Iodometric Method[5]
3	Opacity	Ringelmann's Method[3,4]
4	Oxide of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method[6] 2) Instrumental Analyzer Method[9]
5	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Method[5] 2) Instrumental Analyzer Method[10]

(นางสาววิชุดา สัมฤทธิ์ผล)
ผู้อำนวยการ
ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

Sulfuric Acid...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
6	Sulfuric Acid	Isokinetic Sampling, Barium – Thorin Titrimetric Method[6]
7	Total Suspended Particulate	Isokinetic Sampling, Gravimetric Method[7]

<u>น้ำใต้ดิน จำนวน 3 รายการ</u>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Cyanide	Distillation, Colorimetric Method[2]
2	pH	Electrometric Method[2]
3	Phenols	Distillation, Direct Photometric Method[2]

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(นางสาววิชุดา สัมฤทธิ์ผล)
ผู้อำนวยการ
ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

สำเนา

ที่ อก ๐๓๒๐/ ๖๐๕๓

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๒๒ มี.ค. ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอเปลี่ยนแปลงบุคลากร ของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๑๔ มีนาคม ๒๕๖๖

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๓๒๓ สถานที่ตั้งเลขที่ ๖๑๖/๑๐ หมู่ที่ ๕ ตำบลแม่น้ำคู้ อำเภอปลวกแดง จังหวัดระยอง ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

ก. ให้ยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ ราย

๑) นางสาวเจษฎาพร ศรีบุญเรือง ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๑
๒) นางสาวมธุรินทร์ ลิงห์เงา ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๗๒
๓) นางสาววนิดา ผดุงจิตต์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๕๙
๔) นายศุภณัฐ พิสัยพันธ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๕๖๖
๕) นายสิทธิชัย แก้วเกตุ ทะเบียนเลขที่ ว-๓๒๓-จ-๙๔๘๗

ข. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๒ ราย

๑) นายณัฐพงษ์ เพ็งขาวนา ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๑
๒) นางสาวกัลยทรรศน์ รักดี ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๒
๓) นางสาวจุฑารัตน์ สีทองหลาง ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๓
๔) นางสาวจิตสุภา ประเทืองสุข ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๔
๕) นายสรรเสริญ คุ้ยยกสุย ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๕
๖) นายณัฐวุฒิ อณมพรมราช ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๖
๗) นายจิตกร สีวะสา ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๗
๘) นายสิทปวิชญ์ สุวรรณรัตน์ ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๘
๙) นายสิทธิพันธ์ เสนาชิว ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๐๙
๑๐) นายอนุเวศน์ เดมา ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๑๐
๑๑) นายสุรวิทย์ นราพงษ์ ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๑๑
๑๒) นายอดิศักดิ์ ตะริศูนย์ ทะเบียนเลขที่ ว-๓๒๓-จ-๐๐๑๒

อนึ่ง...

อนึ่ง หนังสือฉบับนี้จะหมดอายุพร้อมหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ที่ อก ๐๓๑๐(๓)/๖๔๗๐ ลงวันที่ ๒๘ มิถุนายน ๒๕๖๔ คือในวันที่ ๒๘ มิถุนายน ๒๕๖๗ ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรมด้วย QR Code ท้ายหนังสือนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายทวี อำพาพันธ์)
ผู้อำนวยการศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
โทร. ๐ ๓๓๓๓ ๖๐๕๙ ต่อ ๕๐๐๑-๒
ไปรษณีย์อิเล็กทรอนิกส์ eirw@diw.mail.go.th

ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

bangkok@alsglobal.com

ALS Line Official
ID: @alsthailand

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