

# ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



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กรมส่งเสริมการค้าระหว่างประเทศ / พาณิชย์

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Stack (CDM)	Oxides of Nitrogen	Analyzer, System calibration, Standard gas	-	-	-	-
Stack	Non-Methane Hydrocarbon as Propane	Console Control Unit	BKQ_F50408	12-Jul-22	12-Jan-23	6
Stack	Non-Methane Hydrocarbon as Propane	Console Control Unit	BKQ_F50556	12-Jul-22	12-Jan-23	6
Stack	Non-Methane Hydrocarbon as Propane	Dry Gas	BKQ_F50563	12-Jul-22	12-Jan-23	6
Stack	Non-Methane Hydrocarbon as Propane	Dry Gas	BKQ_F50514	3-Jul-22	3-Jan-23	6
Stack	Non-Methane Hydrocarbon as Propane	Field Rotameter	BKQ_F50199	1-Oct-22	1-Jan-23	3
Stack	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RVS_D80038	14-Jan-22	14-Jan-23	12
Stack	Non-Methane Hydrocarbon as Propane	RD Analyzer	BKQ_F50798	3-Jul-22	1-Jan-23	6
Stack	Total Hydrocarbon as Propane	Console Control Unit	BKQ_F50408	12-Jul-22	12-Jan-23	6
Stack	Total Hydrocarbon as Propane	Console Control Unit	BKQ_F50556	12-Jul-22	12-Jan-23	6
Stack	Total Hydrocarbon as Propane	Dry Gas	BKQ_F50563	12-Jul-22	12-Jan-23	6
Stack	Total Hydrocarbon as Propane	Dry Gas	BKQ_F50514	3-Jul-22	3-Jan-23	6
Stack	Total Hydrocarbon as Propane	Field Rotameter	BKQ_F50199	1-Oct-22	1-Jan-23	3
Stack	Total Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RVS_D80038	14-Jan-22	14-Jan-23	12
Stack	Total Hydrocarbon as Propane	RD Analyzer	BKQ_F50798	3-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKQ_F50797	3-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RVS_F50272	3-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKQ_F50409	3-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKQ_F50403	3-Jul-22	1-Jan-23	6
Ambient	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RVS_D80038	14-Jan-22	14-Jan-23	12
Ambient	1,4 Dichlorobenzene	SCMSD	RVS_D80156	7-Jul-22	7-Jan-23	18
Ambient	Benzene	SCMSD	RVS_D80156	7-Jul-22	7-Jan-23	18
Ambient	n-Heptane	SCMSD	RVS_D80156	7-Jul-22	7-Jan-23	18
Ambient	Toluene	SCMSD	RVS_D80156	7-Jul-22	7-Jan-23	18
Ambient	Propylene	SCMSD	RVS_D80156	7-Jul-22	7-Jan-23	18
Ambient	Ethylene glycol	Field Rotameter	RVS_F50199	1-Jul-22	1-Oct-22	3
Ambient	Ethylene glycol	Field Rotameter	RVS_F50199	1-Oct-22	1-Jan-23	3
Ambient	Ethylene glycol	SCFD	RVS_D80126	21-Oct-21	21-Apr-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50405	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50405	8-Oct-21	8-Apr-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50529	31-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50001	5-Jul-21	3-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50000	13-Jul-21	11-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50402	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50001	3-Jul-21	3-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50408	15-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVS_F50029	31-Jan-22	29-Jul-23	18
Workplace	n-Octane	Field Rotameter	RVS_F50199	3-Jul-22	1-Oct-22	3
Workplace	n-Octane	Field Rotameter	RVS_F50199	1-Oct-22	1-Jan-23	3
Workplace	n-Octane	SCFD	RVS_D80126	21-Oct-21	21-Apr-23	18
Noise	Leq 24 hrs	Sound Calibrator	RVS_F50404	10-Jan-22	10-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	RVS_F50404	10-Jan-22	10-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	RVS_F50017	4-Oct-21	4-Oct-22	12
Noise	Leq 24 hrs	Sound Level Meter	RVS_F50014	11-Jul-22	11-Jul-23	12
Noise	Leq 5 min	Sound Calibrator	RVS_F50404	10-Jan-22	10-Jan-23	12
Noise	Leq 5 min	Sound Level Meter	RVS_F50017	4-Oct-21	4-Oct-22	12
Noise	Leq 5 min	Sound Level Meter	RVS_F50014	11-Jul-22	11-Jul-23	12

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Noise	Leq 8 hrs	Sound Calibrator	RVS_F50404	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RVS_F50024	9-Oct-21	9-Oct-22	12
Noise	Leq 8 hrs	Sound Level Meter	RVS_F50025	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Calibrator	RVS_F50219	26-Apr-22	26-Apr-23	12
Noise	Leq 8 hrs	Sound Level Meter	RVS_F50020	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RVS_F50022	21-Jan-22	21-Jan-23	12
Noise	Octave Band	Sound Calibrator	RVS_F50404	10-Jan-22	10-Jan-23	12
Noise	Octave Band	Sound Level Meter	RVS_F50024	9-Oct-21	9-Oct-22	12
Noise	Octave Band	Sound Level Meter	RVS_F50025	21-Jan-22	21-Jan-23	12
Noise	Octave Band	Sound Calibrator	RVS_F50219	26-Apr-22	26-Apr-23	12
Noise	Octave Band	Sound Level Meter	RVS_F50020	10-Jan-22	10-Jan-23	12
Noise	Octave Band	Sound Level Meter	RVS_F50022	21-Jan-22	21-Jan-23	12
Rayong Lab	pH at 25 °C	pH meter	RVS_D80149	17-Mar-22	17-Mar-23	12
Rayong Lab	BCO	DO meter with Sensor	RVS_D80052	14-Feb-22	15-Aug-23	18
Rayong Lab	BCO	Heubaker	RVS_D80154	22-Apr-22	21-Oct-23	18
Rayong Lab	COB	Spectrophotometer	RVS_D80057	27-Sep-22	27-Mar-24	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RVS_D80002	25-Mar-22	25-Mar-23	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RVS_D80009	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RVS_D80002	25-Mar-22	25-Mar-23	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RVS_D80009	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RVS_D80002	25-Mar-22	25-Mar-23	12
Rayong Lab	Oil & Grease	Hot Air Oven	RVS_D80009	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RVS_D80061	26-Oct-22	26-Apr-24	18
Rayong Lab	Temperature	pH Meter	RVS_F50429	14-Mar-22	14-Mar-23	12
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RVS_D80158	17-Mar-22	17-Mar-23	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RVS_D80152	23-Dec-21	23-Dec-22	12

ALS (S) Ltd.



Lot No. 2227831-1

#### ANALYZER CALIBRATION DATA

Client : Siam Polyethylene Co., Ltd. Location : Furnace 1  
Date : 07 Dec 22 Test Operator : Sathaporn T.

O<sub>2</sub> 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	0.00	0.02	0.08
Low-Level Gas	8.04	8.06	8.06	0.04
Span Gas	16.00	16.00	16.02	0.08

NO<sub>x</sub> 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	0.03	0.02	0.02
Low-Level Gas	54.96	54.95	54.92	0.03
Span Gas	79.42	79.42	79.40	0.02

CO ANALYZER  
Model : TELEDYNE API 300EM Serial No. : 425  
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.03	0.03
Low-Level Gas	54.94	54.92	54.80	0.02
Span Gas	80.16	80.16	80.13	0.03

Calibrated by

Sathaporn Th.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-002 REVISION NO. 2 ISSUE DATE 30/01/19

ALS Laboratory Group



Lot No. 2227831-1

#### SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Siam Polyethylene Co., Ltd. Location : Furnace 1  
Date : 07 Dec 22 Test Operator : Sathaporn T.

O<sub>2</sub> ANALYZER  
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O <sub>2</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.02	0.09	0.02	0.09	0.00
Upscale Gas	16.00	16.02	0.08	16.02	0.08	0.00

NO<sub>x</sub> ANALYZER  
Cylinder Conc. (ppm) : 79.42 Span (ppm) : 100

	NO <sub>x</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.03	0.02	0.02	0.02	0.02	0.00
Upscale Gas	79.42	79.39	0.03	79.38	0.04	0.01

CO ANALYZER  
Cylinder Conc. (ppm) : 80.16 Span (ppm) : 100

	CO Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.03	0.03	0.04	0.04	0.01
Upscale Gas	80.16	80.12	0.04	80.10	0.06	0.02

Calibrated by

Sathaporn Th.

(Mr. Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-002 REVISION NO. 2 ISSUE DATE 30/01/19

ALS Laboratory Group



## EMISSION TEST RESULT

Client	Siam Polyethylene Co.,Ltd.	Run #	1
Date	07 Dec 22	Location	Furnace 1
Start Time	12:30	Test Operator	Sathaporn T.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	12:50
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:30	4.87	9.79	14.28	-	1.91	
12:31	4.54	9.52	14.28	-	1.77	
12:32	4.99	9.55	14.17	-	1.88	
12:33	4.72	9.26	14.07	-	1.77	
12:34	5.03	9.48	14.58	-	1.88	
12:35	5.12	9.73	14.12	-	1.78	
12:36	4.94	9.59	14.22	-	1.80	
12:37	5.33	9.49	14.28	-	1.78	
12:38	4.89	9.94	14.37	-	1.72	
12:39	4.76	9.75	14.81	-	1.74	
12:40	4.78	10.00	14.83	-	1.87	
12:41	4.38	9.99	14.47	-	1.78	
12:42	4.72	9.66	14.28	-	1.75	
12:43	4.48	10.10	14.57	-	1.78	
12:44	4.97	9.47	14.15	-	1.81	
12:45	5.00	9.81	14.43	-	1.71	
12:46	4.76	9.79	14.50	-	1.71	
12:47	4.80	9.75	14.55	-	1.76	
12:48	4.77	9.57	14.43	-	1.78	
12:49	4.79	9.72	14.42	-	1.74	
12:50	4.83	10.08	14.42	-	1.88	
Average	4.82	9.80	14.32	-	1.77	

Sathaporn Th.

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-022 REVISION NO.: 2 ISSUE DATE: 30/6/19

ALS Laboratory Group



## EMISSION TEST RESULT

Client	Siam Polyethylene Co.,Ltd.	Run #	2
Date	07 Dec 22	Location	Furnace 1
Start Time	12:51	Test Operator	Sathaporn T.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:11
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:51	4.51	9.92	14.27	-	1.77	
12:52	4.54	10.04	14.29	-	1.85	
12:53	4.58	10.00	14.38	-	1.83	
12:54	4.80	9.79	14.45	-	1.75	
12:55	4.88	9.79	14.27	-	1.72	
12:56	4.89	9.79	14.14	-	1.78	
12:57	4.88	9.82	14.37	-	1.70	
12:58	5.08	9.68	14.30	-	1.78	
12:59	4.71	9.79	14.33	-	1.88	
13:00	5.04	9.67	14.18	-	1.72	
13:01	4.76	9.85	14.23	-	1.85	
13:02	5.03	9.59	14.20	-	1.87	
13:03	5.09	9.74	14.18	-	1.88	
13:04	4.57	9.91	14.15	-	1.85	
13:05	4.70	9.72	13.95	-	1.71	
13:06	4.42	10.12	13.88	-	1.83	
13:07	4.55	9.77	13.50	-	1.83	
13:08	4.42	10.07	13.85	-	1.88	
13:09	4.54	9.69	13.80	-	1.85	
13:10	5.13	9.47	13.93	-	1.78	
13:11	4.84	9.84	13.99	-	1.80	
Average	4.74	9.81	14.11	-	1.68	

Sathaporn Th.

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-022 REVISION NO.: 2 ISSUE DATE: 30/6/19

ALS Laboratory Group



## EMISSION TEST RESULT

Client	Siam Polyethylene Co.,Ltd.	Run #	3
Date	07 Dec 22	Location	Furnace 1
Start Time	13:12	Test Operator	Sathaporn T.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:32
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	735
		Serial No.	425

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
13:12	4.83	9.64	14.01	-	1.61	
13:13	4.57	9.85	14.19	-	1.66	
13:14	4.32	9.75	14.15	-	1.89	
13:15	4.70	10.02	14.13	-	1.74	
13:16	4.42	10.04	14.33	-	1.72	
13:17	4.54	9.79	14.51	-	1.91	
13:18	5.14	9.57	14.29	-	1.41	
13:19	4.83	9.88	14.21	-	1.88	
13:20	5.19	9.50	14.26	-	1.67	
13:21	5.15	9.75	14.33	-	1.71	
13:22	4.57	9.91	14.29	-	1.73	
13:23	4.57	9.71	14.17	-	1.73	
13:24	4.56	9.99	14.05	-	1.75	
13:25	5.12	9.40	13.88	-	1.52	
13:26	5.28	9.71	13.82	-	1.72	
13:27	4.57	9.80	14.08	-	1.80	
13:28	5.19	9.42	14.44	-	1.67	
13:29	5.23	9.79	14.45	-	1.71	
13:30	4.52	9.85	14.48	-	1.82	
13:31	4.90	9.82	14.83	-	1.97	
13:32	5.07	9.77	14.28	-	1.68	
Average	4.88	9.78	14.24	-	1.67	

Sathaporn Th.

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-022 REVISION NO.: 2 ISSUE DATE: 30/6/19

ALS Laboratory Group



## ANALYZER CALIBRATION DATA

Lot No. 2227831-1

Client	Siam Polyethylene Co.,Ltd.	Location	Furnace 1
Date	07 Dec 22	Test Operator	Sathaporn T.
O <sub>2</sub> 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	0.00	0.02	0.08
Low-Level Gas	8.04	8.05	8.06	0.04
Span Gas	16.00	16.00	16.02	0.08

NO <sub>x</sub> 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	0.00	0.02	0.02
Low-Level Gas	54.56	54.55	54.82	0.03
Span Gas	79.42	79.42	79.40	0.02

CO ANALYZER			
Model	TELEDYNE API 300EM	Serial No.	425
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.03	0.03
Low-Level Gas	54.84	54.82	54.80	0.02
Span Gas	80.16	80.16	80.13	0.03

Calibrated by

Sathaporn Th.

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO.: F-06-184 REVISION NO.: 1 ISSUE DATE: 30/6/19

ALS Laboratory Group





## SYSTEM CALIBRATION BIAS AND DRIFT DATA

O<sub>2</sub> ANALYZER  
Cylinder Conc. (%) : 16.00                      Span (%) : 25

	O <sub>2</sub> Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.02	0.08	0.02	0.08	0.00
Urethane Gas	16.00	16.02	0.08	16.02	0.08	0.00

**NO<sub>x</sub> ANALYZER**

Cylinder Conc. (ppm)	: 79.42	Span (ppm) :	100
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	NO <sub>x</sub> Analyzer Calibration Response	Initial Values		Final Values		Diff (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.02	0.02	0.02	0.02	0.00
Upstream Gas	79.42	79.39	0.03	79.38	0.04	0.01

CO ANALYZER  
Cylinder Conc. (ppm) : 80.16 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.03	0.03	0.03	0.04	0.04	0.01
Upstream Gas	80.16	80.12	0.04	80.10	0.06	0.02

Calibrated by  
Sathaporn Th.  
( Mr Sathaporn Thakaw )

Environmental Field Scientist

FORM NO. E 06.104 REVISION NO. 1 ISSUE DATE 3/2011

Al 3 (aluminum) Group



Client Name	Siam Polyethylene Co., Ltd.	Date	07 Dec 22
Plant Name	Map Ta Phut PE (SPE)	Location	Furnace 1

Run No: 1 Time Base: 21 min Rat No: 2 Time Base: 21 min

Run No. 1							Run No. 2						
Time Base: 21 km							Time Base: 21 km						
Date	Time	PCZ	PCZ	PCZ	GO	GOZ	Date	Time	PCZ	PCZ	PCZ	GO	GOZ
		FEET	FEET	FEET	FEET	FEET			FEET	FEET	FEET	FEET	FEET
07 Dec 22	12:30	13:30	13:30	13:30	13:30	13:30	07 Dec 22	12:31	13:30	13:30	13:30	13:30	13:30
07 Dec 22	12:31	13:31	13:31	13:31	13:31	13:31	07 Dec 22	12:32	13:31	13:31	13:31	13:31	13:31
07 Dec 22	12:32	13:32	13:32	13:32	13:32	13:32	07 Dec 22	12:33	13:32	13:32	13:32	13:32	13:32
07 Dec 22	12:33	13:33	13:33	13:33	13:33	13:33	07 Dec 22	12:34	13:33	13:33	13:33	13:33	13:33
07 Dec 22	12:34	13:34	13:34	13:34	13:34	13:34	07 Dec 22	12:35	13:34	13:34	13:34	13:34	13:34
07 Dec 22	12:35	13:35	13:35	13:35	13:35	13:35	07 Dec 22	12:36	13:35	13:35	13:35	13:35	13:35
07 Dec 22	12:36	13:36	13:36	13:36	13:36	13:36	07 Dec 22	12:37	13:36	13:36	13:36	13:36	13:36
07 Dec 22	12:37	13:37	13:37	13:37	13:37	13:37	07 Dec 22	12:38	13:37	13:37	13:37	13:37	13:37
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07 Dec 22	14:22	15:22					07 Dec						

Run No. 4							Time Base: 20 min							Run No. 4							Time Base: 20 min						
Date	Time	SS	SS	SS	SS	SS	Date	Time	SS	SS	SS	SS	SS	Date	Time	SS	SS	SS	SS	SS	Date	Time	SS	SS	SS	SS	SS
		100	100	100	100	100			100	100	100	100	100			100	100	100	100	100			100	100	100	100	100
07 Dec 02	1312	1381	7.37	438			07 Dec 02	1338		1380	774	1.27		07 Dec 02	1312	1381	7.37	438			07 Dec 02	1338		1380	774	1.27	
07 Dec 02	1313	1374	7.34	436			07 Dec 02	1339		1381	775	1.28		07 Dec 02	1313	1374	7.34	436			07 Dec 02	1339		1381	775	1.28	
07 Dec 02	1314	1407	7.31	450			07 Dec 02	1340		1382	781	1.30		07 Dec 02	1314	1407	7.31	450			07 Dec 02	1340		1382	781	1.30	
07 Dec 02	1315	1432	7.30	426			07 Dec 02	1341		1383	783	1.32		07 Dec 02	1315	1432	7.30	426			07 Dec 02	1341		1383	783	1.32	
07 Dec 02	1316	1458	7.29	430			07 Dec 02	1342		1384	785	1.33		07 Dec 02	1316	1458	7.29	430			07 Dec 02	1342		1384	785	1.33	
07 Dec 02	1317	1445	7.25	487			07 Dec 02	1343		1385	787	1.35		07 Dec 02	1317	1445	7.25	487			07 Dec 02	1343		1385	787	1.35	
07 Dec 02	1318	1482	7.26	490			07 Dec 02	1344		1386	789	1.37		07 Dec 02	1318	1482	7.26	490			07 Dec 02	1344		1386	789	1.37	
07 Dec 02	1319	1511	7.27	521			07 Dec 02	1345		1387	791	1.37		07 Dec 02	1319	1511	7.27	521			07 Dec 02	1345		1387	791	1.37	
07 Dec 02	1320	1534	7.34	501			07 Dec 02	1346		1388	792	1.37		07 Dec 02	1320	1534	7.34	501			07 Dec 02	1346		1388	792	1.37	
07 Dec 02	1321	1571	7.37	541			07 Dec 02	1347		1389	794	1.37		07 Dec 02	1321	1571	7.37	541			07 Dec 02	1347		1389	794	1.37	
07 Dec 02	1322	1601	7.41	524			07 Dec 02	1348		1390	795	1.38		07 Dec 02	1322	1601	7.41	524			07 Dec 02	1348		1390	795	1.38	
07 Dec 02	1323	1534	7.44	490			07 Dec 02	1349		1391	796	1.39		07 Dec 02	1323	1534	7.44	490			07 Dec 02	1349		1391	796	1.39	
07 Dec 02	1324	1487	7.47	546			07 Dec 02	1350		1392	798	1.39		07 Dec 02	1324	1487	7.47	546			07 Dec 02	1350		1392	798	1.39	
07 Dec 02	1325	1500	7.50	520			07 Dec 02	1351		1393	799	1.40		07 Dec 02	1325	1500	7.50	520			07 Dec 02	1351		1393	799	1.40	
07 Dec 02	1326	1493	7.53	510			07 Dec 02	1352		1394	800	1.41		07 Dec 02	1326	1493	7.53	510			07 Dec 02	1352		1394	800	1.41	
07 Dec 02	1327	1451	7.58	517			07 Dec 02	1353		1395	802	1.41		07 Dec 02	1327	1451	7.58	517			07 Dec 02	1353		1395	802	1.41	
07 Dec 02	1328	1438	7.59	510			07 Dec 02	1354		1396	804	1.42		07 Dec 02	1328	1438	7.59	510			07 Dec 02	1354		1396	804	1.42	
07 Dec 02	1329	1450	7.62	475			07 Dec 02	1355		1397	806	1.43		07 Dec 02	1329	1450	7.62	475			07 Dec 02	1355		1397	806	1.43	
07 Dec 02	1330	1490	7.55	494			07 Dec 02	1356		1398	808	1.43		07 Dec 02	1330	1490	7.55	494			07 Dec 02	1356		1398	808	1.43	
07 Dec 02	1331	1502	7.49	516			07 Dec 02	1357		1399	810	1.42		07 Dec 02	1331	1502	7.49	516			07 Dec 02	1357		1399	810	1.42	
07 Dec 02	1336	1491	7.71	472			07 Dec 02	1358		1400	812	1.38		07 Dec 02	1336	1491	7.71	472			07 Dec 02	1358		1400	812	1.38	
Men		1487	7.71	574			Men		1425	794				Men		1425	794				Men		1425	794			

Run No: 5							Time Base: 21.950							Ref No: 8							Time Base: 21.950						
Date	Time	POS	W/O	DO	CO	DOZ	Date	Time	POS	W/O	DO	CO	DOZ	Date	Time	POS	W/O	DO	CO	DOZ	Date	Time	POS	W/O	DO	CO	DOZ
		FEET				VOLE			FEET				VOLE			FEET				VOLE			FEET				VOLE
07 Dec 22	13:04		55.80	7.22	8.60		07 Dec 22	14:18		13.62	7.04	4.81		07 Dec 22	14:19		13.62	7.04	4.81		07 Dec 22	14:19		13.62	7.04	4.81	
07 Dec 22	13:05		52.85	7.22	8.60		07 Dec 22	14:19		13.70	7.03	5.80		07 Dec 22	14:19		13.70	7.03	5.80		07 Dec 22	14:19		13.70	7.03	5.80	
07 Dec 22	13:06		53.81	7.24	8.27		07 Dec 22	14:17		13.70	7.03	5.80		07 Dec 22	14:17		13.70	7.03	5.80		07 Dec 22	14:17		13.70	7.03	5.80	
07 Dec 22	13:07		55.82	7.22	8.60		07 Dec 22	14:18		13.60	7.04	4.80		07 Dec 22	14:18		13.60	7.04	4.80		07 Dec 22	14:18		13.60	7.04	4.80	
07 Dec 22	13:08		55.82	7.22	8.60		07 Dec 22	14:18		13.60	7.04	4.80		07 Dec 22	14:18		13.60	7.04	4.80		07 Dec 22	14:18		13.60	7.04	4.80	
07 Dec 22	13:09		54.77	7.33	4.45		07 Dec 22	14:20		13.70	7.00	4.80		07 Dec 22	14:20		13.70	7.00	4.80		07 Dec 22	14:20		13.70	7.00	4.80	
07 Dec 22	14:00		53.79	7.36	5.10		07 Dec 22	14:21		13.61	7.06	4.80		07 Dec 22	14:21		13.61	7.06	4.80		07 Dec 22	14:21		13.61	7.06	4.80	
07 Dec 22	14:01		54.74	7.38	5.10		07 Dec 22	14:21		13.61	7.06	4.80		07 Dec 22	14:21		13.61	7.06	4.80		07 Dec 22	14:21		13.61	7.06	4.80	
07 Dec 22	14:02		54.79	7.40	4.80		07 Dec 22	14:22		13.61	7.06	4.80		07 Dec 22	14:22		13.61	7.06	4.80		07 Dec 22	14:22		13.61	7.06	4.80	
07 Dec 22	14:03		55.80	7.40	4.84		07 Dec 22	14:23		13.61	7.06	4.80		07 Dec 22	14:23		13.61	7.06	4.80		07 Dec 22	14:23		13.61	7.06	4.80	
07 Dec 22	14:04		55.74	7.36	5.10		07 Dec 22	14:24		13.70	7.03	4.81		07 Dec 22	14:24		13.70	7.03	4.81		07 Dec 22	14:24		13.70	7.03	4.81	
07 Dec 22	14:05		55.80	7.42	5.20		07 Dec 22	14:25		13.70	7.03	4.81		07 Dec 22	14:25		13.70	7.03	4.81		07 Dec 22	14:25		13.70	7.03	4.81	
07 Dec 22	14:06		55.80	7.42	5.20		07 Dec 22	14:26		13.70	7.03	4.81		07 Dec 22	14:26		13.70	7.03	4.81		07 Dec 22	14:26		13.70	7.03	4.81	
07 Dec 22	14:07		55.80	7.42	5.20		07 Dec 22	14:27		13.70	7.03	4.81		07 Dec 22	14:27		13.70	7.03	4.81		07 Dec 22	14:27		13.70	7.03	4.81	
07 Dec 22	14:08		55.74	7.34	5.55		07 Dec 22	14:28		13.70	7.03	4.81		07 Dec 22	14:28		13.70	7.03	4.81		07 Dec 22	14:28		13.70	7.03	4.81	
07 Dec 22	14:09		55.74	7.34	5.55		07 Dec 22	14:29		13.70	7.03	4.81		07 Dec 22	14:29		13.70	7.03	4.81		07 Dec 22	14:29		13.70	7.03	4.81	
07 Dec 22	14:10		55.74	7.34	5.55		07 Dec 22	14:30		13.70	7.03	4.81		07 Dec 22	14:30		13.70	7.03	4.81		07 Dec 22	14:30		13.70	7.03	4.81	
07 Dec 22	14:11		55.82	7.34	5.20		07 Dec 22	14:31		13.70	7.03	4.81		07 Dec 22	14:31		13.70	7.03	4.81		07 Dec 22	14:31		13.70	7.03	4.81	
07 Dec 22	14:11		55.82	7.34	5.20		07 Dec 22	14:32		13.70	7.03	4.81		07 Dec 22	14:32		13.70	7.03	4.81		07 Dec 22	14:32		13.70	7.03	4.81	
07 Dec 22	14:12		55.82	7.34	5.20		07 Dec 22	14:33		13.70	7.03	4.81		07 Dec 22	14:33		13.70	7.03	4.81		07 Dec 22	14:33		13.70	7.03	4.81	
07 Dec 22	14:13		55.74	7.34	4.80		07 Dec 22	14:34		13.70	7.03	4.81		07 Dec 22	14:34		13.70	7.03	4.81		07 Dec 22	14:34		13.70	7.03	4.81	
07 Dec 22	14:14		55.77	7.34	5.20		07 Dec 22	14:35		13.70	7.03	4.81		07 Dec 22	14:35		13.70	7.03	4.81		07 Dec 22	14:35		13.70	7.03	4.81	
User			54.78	7.36	6.00		User		14.20	7.04	4.84					14.20	7.04	4.84									



Client Name	Siam Polyethylene Co., Ltd.	Date	07 Dec 22
Plant Name	Meo Ta Phu, PE (SPE)	Location	France 1

Run No: T	Time Base: 21 min	Run No: S	Time Base: 21 min
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Date	Time	SSC	SSC	SSC	SSC	Date	Time	SSC	SSC	SSC	SSC	SSC	SSC
		1000	1000	1000	1000			1000	1000	1000	1000	1000	1000
07 Dec 12	14:30	-	13:35	740	512	-	07 Dec 12	14:37	-	14:35	732	528	-
07 Dec 12	14:37	-	13:38	744	518	-	07 Dec 12	14:43	-	14:35	740	530	-
07 Dec 12	14:38	-	13:36	743	475	-	-	-	-	13:02	746	506	-
07 Dec 12	14:39	-	14:31	1386	510	-	-	-	-	13:59	743	510	-
07 Dec 12	14:40	-	14:30	1386	510	-	-	-	-	13:57	740	510	-
07 Dec 12	14:41	-	14:06	138	528	-	07 Dec 12	15:07	-	14:35	697	504	-
07 Dec 12	14:42	-	14:36	138	528	-	07 Dec 12	15:10	-	14:34	515	510	-
07 Dec 12	14:43	-	15:01	527	410	-	07 Dec 12	15:16	-	13:02	695	438	-
07 Dec 12	14:44	-	13:36	734	508	-	07 Dec 12	15:20	-	13:06	698	437	-
07 Dec 12	14:45	-	14:30	1386	510	-	07 Dec 12	15:22	-	13:59	741	528	-
07 Dec 12	14:46	-	13:59	729	511	-	07 Dec 12	15:37	-	12:36	744	543	-
07 Dec 12	14:47	-	14:30	1386	510	-	07 Dec 12	15:40	-	12:36	748	538	-
07 Dec 12	14:48	-	13:58	729	528	-	07 Dec 12	15:59	-	13:06	711	543	-
07 Dec 12	14:49	-	14:36	1377	528	-	07 Dec 12	16:16	-	13:02	714	522	-
07 Dec 12	14:50	-	14:36	1378	510	-	07 Dec 12	16:17	-	14:37	717	545	-
07 Dec 12	14:51	-	13:06	729	522	-	07 Dec 12	16:22	-	13:26	720	438	-
07 Dec 12	14:52	-	13:26	729	480	-	07 Dec 12	16:19	-	13:02	723	434	-
07 Dec 12	14:53	-	13:36	729	480	-	07 Dec 12	16:26	-	13:59	723	434	-
07 Dec 12	14:54	-	14:34	721	100	-	07 Dec 12	16:35	-	12:45	723	437	-
07 Dec 12	14:55	-	14:31	718	100	-	07 Dec 12	16:37	-	13:23	723	436	-
07 Dec 12	14:56	-	14:02	718	436	-	07 Dec 12	16:41	-	13:02	723	500	-
Mean		-	14:36	746	518	-	Mean		14:35	723	530	-	

[illegible]

Run No. 11		Time Base: 21 min						Run No. 12						Time Base: 21 min					
Date	Time	SIG	MCs	GO	GO2	GO2	Date	Time	SIG	MCs	GO	GO2	GO2						
		ppm		ppm	ppm	ppm			ppm		ppm	ppm	ppm						
07 Dec 22	16:01	-	1504	698	400	50%	07 Dec 22	16:21	-	1504	723	518	-						
07 Dec 22	16:02	-	1504	698	400	50%	07 Dec 22	16:22	-	1504	723	518	-						
07 Dec 22	16:02	-	1504	698	400	50%	07 Dec 22	16:22	-	1504	723	518	-						
07 Dec 22	16:03	-	1370	698	400	50%	07 Dec 22	16:22	-	1504	723	518	-						
07 Dec 22	16:04	-	1364	698	400	50%	07 Dec 22	16:22	-	1504	723	518	-						
07 Dec 22	16:05	-	1328	702	400	50%	07 Dec 22	16:22	-	1504	723	444	-						
07 Dec 22	16:06	-	1271	706	410	50%	07 Dec 22	16:22	-	1472	723	444	-						
07 Dec 22	16:07	-	1328	706	410	50%	07 Dec 22	16:22	-	1472	723	444	-						
07 Dec 22	16:08	-	1422	711	400	50%	07 Dec 22	16:22	-	1501	723	444	-						
07 Dec 22	16:09	-	1362	714	400	50%	07 Dec 22	16:22	-	1506	723	444	-						
07 Dec 22	16:10	-	1314	717	410	50%	07 Dec 22	16:22	-	1506	723	444	-						
07 Dec 22	16:11	-	1328	726	410	50%	07 Dec 22	16:22	-	1510	723	470	-						
07 Dec 22	16:12	-	1314	723	400	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:13	-	1306	723	400	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:14	-	1307	723	500	50%	07 Dec 22	16:22	-	1509	723	400	-						
07 Dec 22	16:15	-	1307	723	500	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:16	-	1306	723	500	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:17	-	1301	723	400	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:18	-	1301	723	400	50%	07 Dec 22	16:22	-	1418	723	528	-						
07 Dec 22	16:19	-	1273	723	400	50%	07 Dec 22	16:22	-	1504	723	470	-						
07 Dec 22	16:20	-	1304	723	410	50%	07 Dec 22	16:22	-	1507	723	511	-						
07 Dec 22	16:21	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:22	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:23	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:24	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:25	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:26	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:27	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:28	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:29	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:30	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:31	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:32	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:33	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:34	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:35	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:36	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:37	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:38	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:39	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:40	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:41	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:42	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:43	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:44	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:45	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:46	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:47	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:48	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:49	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:50	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:51	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:52	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:53	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:54	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:55	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:56	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:57	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:58	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	16:59	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						
07 Dec 22	17:00	-	1307	723	410	50%	07 Dec 22	16:22	-	1442	723	528	-						



Client Name	Siam Polyethylene Co., Ltd.	Date	07 Dec 22
Plant Name	Map Ta Phut, PE (SPE)	Location	Furnace 1

Run No: 1 Time Base: 21 min Run No: 2 Time Base: 21 min

Date	Time	POST	9/24	9/25	9/26	9/27	9/28	9/29	9/30	Date	Time	POST	9/30	10/1	10/2	10/3	10/4	10/5
		9/24	9/25	9/26	9/27	9/28	9/29	9/30	10/1			9/30	10/1	10/2	10/3	10/4	10/5	10/6
07 Dec 22	12:30	-	14:28	2:02	4:02	4:07	9:10	-	-	07 Dec 22	12:31	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:31	-	14:28	1:57	4:04	4:07	9:10	-	-	07 Dec 22	12:32	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:32	-	-	-	-	-	-	9:06	-	07 Dec 22	12:33	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:33	-	-	-	-	-	-	-	-	07 Dec 22	12:34	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:34	-	-	-	-	-	-	-	-	07 Dec 22	12:35	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:35	-	14:12	1:58	4:12	4:13	9:13	-	-	07 Dec 22	12:36	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:36	-	14:12	1:58	4:12	4:13	9:13	-	-	07 Dec 22	12:37	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:37	-	14:27	1:52	4:12	4:13	9:13	-	-	07 Dec 22	12:38	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:38	-	14:27	1:51	4:14	4:14	9:14	-	-	07 Dec 22	12:39	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:39	-	14:28	1:58	4:14	4:14	9:14	-	-	07 Dec 22	12:40	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:40	-	14:28	1:58	4:15	4:15	9:15	-	-	07 Dec 22	12:41	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:41	-	14:28	1:58	4:15	4:15	9:15	-	-	07 Dec 22	12:42	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:42	-	14:28	1:54	4:17	4:17	9:17	-	-	07 Dec 22	12:43	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:43	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:44	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:44	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:45	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:45	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:46	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:46	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:47	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:47	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:48	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:48	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:49	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:49	-	14:28	1:54	4:18	4:18	9:18	-	-	07 Dec 22	12:50	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:50	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:51	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:51	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:52	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:52	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:53	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:53	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:54	-	~207					
07 Dec 22	12:54	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:55	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:55	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:56	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:56	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:57	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:57	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:58	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:58	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	12:59	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	12:59	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:00	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:00	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:01	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:01	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:02	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:02	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:03	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:03	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:04	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:04	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:05	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:05	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:06	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:06	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:07	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:07	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:08	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:08	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:09	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:09	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:10	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:10	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:11	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:11	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:12	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:12	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:13	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:13	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:14	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:14	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:15	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:15	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:16	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:16	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:17	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:17	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:18	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:18	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:19	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:19	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:20	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:20	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:21	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:21	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:22	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:22	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:23	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:23	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:24	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:24	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:25	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:25	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:26	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:26	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:27	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:27	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:28	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:28	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:29	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:29	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:30	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:30	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:31	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:31	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:32	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:32	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:33	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:33	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:34	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:34	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:35	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:35	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:36	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:36	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:37	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:37	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:38	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:38	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:39	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:39	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:40	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:40	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:41	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:41	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:42	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:42	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:43	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:43	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:44	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:44	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:45	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:45	-	14:28	1:52	4:18	4:18	9:18	-	-	07 Dec 22	13:46	-	~207	1:01	4:51	10:00	-	-
07 Dec 22	13:46	-	14:28	1:52	4:18	4:18												

Date No. 2							Date No. 4						
Date	Time	GO	MO	GO	MO	Time	Date	Time	GO	MO	GO	MO	Time
Time:Sec. 21.191							Time:Sec. 21.191						
		GO	MO	GO	MO				GO	MO	GO	MO	
07 Dec 22	13.12	-	16.03	1.28	4.08	9.84	07 Dec 22	13.33	-	16.08	2.02	4.48	
07 Dec 22	13.19	-	16.10	4.57	9.88		07 Dec 22	13.40	-	16.15	2.06		
07 Dec 22	13.16	-	16.16	1.87	4.02	9.75	07 Dec 22	13.39	-	16.08	1.94	4.73	8.88
07 Dec 22	13.14	-	16.18	1.93	4.03	9.82	07 Dec 22	13.36	-	16.06	1.86	4.47	8.99
07 Dec 22	13.16	-	16.14	1.91	4.02	9.84	07 Dec 22	13.37	-	16.10	1.93	4.75	8.93
07 Dec 22	13.17	-	16.11	1.78	4.06	9.76	07 Dec 22	13.39	-	16.08	1.90	4.83	8.87
07 Dec 22	13.16	-	16.23	1.88	5.14	9.87	07 Dec 22	13.39	-	16.09	1.90	5.02	8.88
07 Dec 22	13.18	-	16.08	-	-	-	07 Dec 22	13.41	-	16.15	1.91	-	-
07 Dec 22	13.20	-	16.28	1.84	5.19	9.90	07 Dec 22	13.41	-	16.17	1.96	4.99	8.78
07 Dec 22	13.21	-	16.14	-	-	-	07 Dec 22	13.41	-	16.17	1.96	4.87	8.78
07 Dec 22	13.22	-	16.28	1.93	4.07	9.91	07 Dec 22	13.43	-	16.30	1.91	4.95	8.79
07 Dec 22	13.23	-	16.11	1.92	4.08	9.71	07 Dec 22	13.44	-	16.30	2.06	4.42	10.07
07 Dec 22	13.24	-	16.08	-	-	-	07 Dec 22	13.44	-	16.37	1.98	-	-
07 Dec 22	13.25	-	13.98	1.87	5.12	9.40	07 Dec 22	13.46	-	16.38	2.13	4.43	8.98
07 Dec 22	13.26	-	13.62	1.90	5.20	9.71	07 Dec 22	13.47	-	16.19	1.92	4.99	8.86
07 Dec 22	13.27	-	13.67	1.89	4.87	9.88	07 Dec 22	13.48	-	16.30	2.09	4.98	8.86
07 Dec 22	13.28	-	13.64	1.88	5.13	9.42	07 Dec 22	13.49	-	16.11	2.10	4.89	8.79
07 Dec 22	13.29	-	16.45	1.90	5.28	9.70	07 Dec 22	13.50	-	16.37	2.11	4.60	10.06
07 Dec 22	13.30	-	16.22	1.82	4.96	9.88	07 Dec 22	13.50	-	16.26	1.98	4.93	8.86
07 Dec 22	13.31	-	16.48	1.73	4.06	9.82	07 Dec 22	13.52	-	16.28	2.09	4.52	8.86
07 Dec 22	13.31	-	16.25	1.84	5.07	9.71	07 Dec 22	13.53	-	16.38	2.08	4.81	8.87
Mar	-	-	14.93	2.22	9.29	9.94	Mar	-	-	14.42	2.11	9.06	-
			14.80	2.20	9.29	9.94				14.21	2.10	9.05	-

Run No. #		Time Base: 21 min						Run No. #		Time Base: 21 min					
Date	Time	GOZ	MOZ	GOZ	MOZ	GOZ	MOZ	Date	Time	GOZ	MOZ	GOZ	MOZ	GOZ	MOZ
		ppm	ppm	ppm	ppm	ppm	ppm			ppm	ppm	ppm	ppm	ppm	ppm
07 Dec 22	03:04	-	-	14021	2.13	455	9.67	07 Dec 22	14:05	-	1048	2001	4.08	8.89	10.70
07 Dec 22	03:05	-	-	1384	4.67	455	9.67	07 Dec 22	14:06	-	1170	2120	4.10	8.90	10.70
07 Dec 22	03:06	-	-	1388	2.13	450	10.00	07 Dec 22	14:07	-	1037	2115	4.17	8.81	10.69
07 Dec 22	03:07	-	-	1307	1.60	458	9.78	07 Dec 22	14:08	-	816	2109	4.06	8.90	10.69
07 Dec 22	03:08	-	-	1318	3.58	458	9.78	07 Dec 22	14:09	-	817	2149	3.97	8.89	10.69
07 Dec 22	03:09	-	-	1371	0.88	458	10.04	07 Dec 22	14:10	-	817	2147	4.82	9.72	10.69
07 Dec 22	03:10	-	-	1388	1.60	458	9.52	07 Dec 22	14:11	-	817	2163	4.83	9.68	10.69
07 Dec 22	03:11	-	-	1404	5.07	458	9.52	07 Dec 22	14:12	-	817	2167	4.81	9.62	10.69
07 Dec 22	03:12	-	-	1402	13.84	458	9.50	07 Dec 22	14:13	-	821	2170	4.83	9.62	10.69
07 Dec 22	03:13	-	-	1394	2.11	457	9.60	07 Dec 22	14:14	-	862	2229	4.05	10.11	10.69
07 Dec 22	03:14	-	-	1402	4.02	456	9.76	07 Dec 22	14:15	-	862	2236	4.05	10.06	10.69
07 Dec 22	03:15	-	-	1412	3.80	457	9.56	07 Dec 22	14:16	-	868	2226	4.01	10.00	10.69
07 Dec 22	03:16	-	-	1408	1.22	459	9.67	07 Dec 22	14:17	-	868	2227	4.31	10.00	10.69
07 Dec 22	03:17	-	-	1422	2.21	458	10.20	07 Dec 22	14:18	-	868	2211	4.10	9.81	10.69
07 Dec 22	03:18	-	-	1405	1.41	454	10.50	07 Dec 22	14:19	-	868	2221	4.14	9.95	10.69
07 Dec 22	03:19	-	-	1404	3.55	454	9.50	07 Dec 22	14:20	-	868	2227	4.10	9.95	10.69
07 Dec 22	03:20	-	-	1404	1.55	451	10.30	07 Dec 22	14:21	-	868	2238	4.59	9.88	10.69
07 Dec 22	03:21	-	-	1419	2.20	454	9.81	07 Dec 22	14:22	-	868	2229	4.05	9.78	10.69
07 Dec 22	03:22	-	-	1411	5.08	454	9.81	07 Dec 22	14:23	-	868	2227	4.05	9.78	10.69
07 Dec 22	03:23	-	-	1439	3.23	446	10.21	07 Dec 22	14:24	-	868	2232	4.52	9.80	10.69
07 Dec 22	03:24	-	-	1438	1.24	452	10.04	07 Dec 22	14:25	-	868	2236	4.10	9.88	10.69
07 Dec 22	03:25	-	-	1402	2.24	455	9.21	07 Dec 22	14:26	-	868	2230	4.09	9.88	10.69
07 Dec 22	03:26	-	-	1414	2.14	454	9.21	07 Dec 22	14:27	-	868	2230	4.09	9.88	10.69







## EMISSION TEST RESULT

Client	Siam Polyethylene Co., Ltd.	Run #	2
Date	07 Dec 22	Location	Furnace 2
Start Time	12:21	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	12:41
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:21	4.86	9.87	18.58	-	0.30	
12:22	4.87	9.91	18.54	-	0.03	
12:23	4.78	9.91	18.53	-	0.43	
12:24	4.88	9.75	18.52	-	0.47	
12:25	4.87	9.86	18.57	-	0.18	
12:26	4.85	9.88	18.83	-	0.28	
12:27	4.73	9.95	18.73	-	0.20	
12:28	4.78	9.95	18.70	-	0.82	
12:29	4.91	9.88	18.87	-	0.76	
12:30	4.88	9.85	18.83	-	0.95	
12:31	4.88	9.91	18.87	-	0.59	
12:32	4.89	9.85	18.84	-	1.37	
12:33	4.89	9.85	18.57	-	0.98	
12:34	4.87	9.87	18.87	-	0.86	
12:35	4.88	9.85	18.82	-	0.58	
12:36	4.82	9.88	18.83	-	0.57	
12:37	4.91	9.87	18.86	-	0.38	
12:38	4.81	9.85	18.72	-	0.22	
12:39	4.82	9.81	18.78	-	0.80	
12:40	4.89	9.84	18.72	-	0.13	
12:41	4.82	9.86	18.78	-	0.22	
Average	4.88	9.87	18.83	-	0.50	

*Sakait P.*

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO.: F-05-002 REVISION NO.: 2 ISSUE DATE: 30/05/19

ALS Laboratory Group



## EMISSION TEST RESULT

Client	Siam Polyethylene Co., Ltd.	Run #	3
Date	07 Dec 22	Location	Furnace 2
Start Time	12:42	Test Operator	Sakait P.
SO <sub>2</sub> Analyzer Model	TELEDYNE API 100EH	Finish Time	13:02
NO <sub>x</sub> /O <sub>2</sub> Analyzer Model	TELEDYNE API 200EH	Serial No.	437
CO/CO <sub>2</sub> Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	451

Time (min)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	NO <sub>x</sub> (ppm)	SO <sub>2</sub> (ppm)	CO (ppm)	Remark
12:42	4.83	9.89	18.83	-	0.22	
12:43	4.80	9.89	18.33	-	0.18	
12:44	4.78	9.91	18.81	-	0.47	
12:45	4.83	9.90	18.79	-	0.60	
12:46	4.84	9.86	18.73	-	0.28	
12:47	4.80	9.89	18.70	-	0.13	
12:48	4.84	9.89	18.67	-	0.21	
12:49	4.85	9.85	18.63	-	0.87	
12:50	4.79	9.89	18.62	-	0.78	
12:51	4.79	9.85	18.66	-	0.31	
12:52	4.81	9.91	18.60	-	0.33	
12:53	4.91	9.87	18.57	-	0.08	
12:54	4.81	9.91	18.51	-	0.78	
12:55	4.75	9.93	18.50	-	0.79	
12:56	4.84	9.87	18.55	-	0.17	
12:57	4.84	9.85	18.56	-	0.69	
12:58	4.77	9.90	18.61	-	0.11	
12:59	4.83	9.90	18.86	-	0.08	
13:00	4.88	9.89	18.84	-	0.06	
13:01	4.83	9.88	18.88	-	0.71	
13:02	4.81	9.89	18.86	-	0.39	
Average	4.82	9.88	18.65	-	0.38	

*Sakait P.*

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO.: F-06-003 REVISION NO.: 3 ISSUE DATE: 30/05/19

ALS Laboratory Group



Lot No.: 2227836-1

## ANALYZER CALIBRATION DATA

Client	Siam Polyethylene Co., Ltd.	Location	Furnace 2
Date	07 Dec 22	Test Operator	Sakait P.

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.03	-0.01	0.08
Low-Level Gas	7.93	7.90	7.82	0.08
Span Gas	16.00	15.97	15.99	0.08

NO <sub>x</sub> ANALYZER		Serial No.	774
Model	TELEDYNE API 200EH		
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	-0.03	-0.01	0.05
Low-Level Gas	50.41	50.35	50.40	0.05
Span Gas	80.27	80.21	80.26	0.05

CO ANALYZER		Serial No.	451
Model	TELEDYNE API 300EM		
Span (ppm)	100		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.00	0.05
Low-Level Gas	50.31	50.38	50.31	0.05
Span Gas	80.53	80.58	80.53	0.05

Calibrated by

*Sakait P.*

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO.: F-06-104 REVISION NO.: 1 ISSUE DATE: 30/05/19

ALS Laboratory Group



Lot No.: 2227836-1

## SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	Siam Polyethylene Co., Ltd.	Location	Furnace 2
Date	07 Dec 22	Test Operator	Sakait P.

O <sub>2</sub> ANALYZER		Span (%)	25
Cylinder Conc. (%)	16.00		

	O <sub>2</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.03	-0.03	0.00	-0.01	0.05	0.08
Upscale Gas	15.97	15.97	0.00	15.99	0.08	0.08

NO <sub>x</sub> ANALYZER		Span (ppm)	100
Cylinder Conc. (ppm)	80.27		

	NO <sub>x</sub> Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.06	-0.05	0.00	-0.01	0.05	0.05
Upscale Gas	80.21	80.21	0.00	80.26	0.05	0.05

CO ANALYZER		Span (ppm)	100
Cylinder Conc. (ppm)	80.53		

	CO Analyzer Calibration Response	System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.06	0.05	0.00	0.00	0.05	0.05
Upscale Gas	80.58	80.58	0.00	80.53	0.05	0.05

Calibrated by

*Sakait P.*

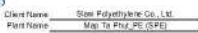
(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

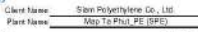
FORM NO.: F-06-104 REVISION NO.: 1 ISSUE DATE: 30/05/19

ALS Laboratory Group

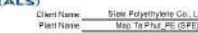




Client Name	Slom Polyethylene Co., Ltd.
Plant Name	Map Ta Phut PE (SPE)



Client Name:	Siam Polyethylene Co., Ltd.
Plant Name:	Map To Phu, PE (SPE)



Client Name: Giant Polyethylene Co., L  
Plant Name: Mai Ta Phu, PE (SPE)



Client Name: Siam Polyethylene Co., Ltd.  
Plant Name: Map Ta Phut, PE (SPE)



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A0440 Reference Number: 160-401977167-1  
Cylinder Number: E01140237 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG  
PGVP Number: A12020 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Dec 23, 2020

Expiration Date: Dec 23, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder before 100 ppm, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	79.42 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
CARBON MONOXIDE	80.00 PPM	80.16 PPM	G1	+/- 0.5% NIST Traceable	12/14/2020
NITRIC OXIDE	80.00 PPM	79.41 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
SULFUR DIOXIDE	80.00 PPM	80.22 PPM	G1	+/- 1.1% NIST Traceable	12/14/2020, 12/23/2020
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	87.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D855025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	E80079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
QMS	124208986	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15010203	KAL003190	87.66 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Dec 10, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Dec 16, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Dec 02, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Dec 02, 2020

Triad Data Available Upon Request

NOTES:  
Gross Weight: 27.8 Kg  
Net Weight: 4.7 Kg



*Michael A. Miller*  
Approved for Release

Page 1 of 160-401977167-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A021C Reference Number: 160-402020199-1  
Cylinder Number: CC709008 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-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder before 100 ppm, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.56 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.94 PPM	G1	+/- 0.7% NIST Traceable	02/15/2021
NITRIC OXIDE	55.00 PPM	54.89 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14060753	CC434465	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D855025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-14	CC709008	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
QMS	124208986	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	48.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

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



*Michael A. Miller*  
Approved for Release

Page 1 of 160-402020199-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A0023 Reference Number: 82-401123195-1  
Cylinder Number: ND33083 Cylinder Volume: 247.2 CF  
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2215 PSIG  
PGVP Number: B52018 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 25, 2018

Expiration Date: Feb 25, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder before 100 ppm, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.41 PPM	G1	+/- 1.0% NIST Traceable	02/19/2018, 02/25/2018
CARBON MONOXIDE	80.00 PPM	80.21 PPM	G1	+/- 0.7% NIST Traceable	02/19/2018
NITRIC OXIDE	80.00 PPM	80.30 PPM	G1	+/- 1.0% NIST Traceable	02/19/2018, 02/25/2018
SULFUR DIOXIDE	80.00 PPM	81.61 PPM	G1	+/- 1.2% NIST Traceable	02/19/2018, 02/25/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14060753	CC434383	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 22, 2020
PRM	12387	APX1088327	9.88 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 05, 2017
NTRM	16050807	CC425564	80.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
QMS	011031084	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.0%	Mar 15, 2019
NTRM	16011025	CC473218	48.62 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 07, 2022

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 670 APW100291 CO	FTIR	Feb 05, 2018
Nicolet 670 APW100291 NO	FTIR	Feb 15, 2018
Nicolet 670 APW100291 NO2	FTIR	Feb 15, 2018
Nicolet 670 APW100291 SO2	FTIR	Feb 05, 2018

Triad Data Available Upon Request

NOTES:  
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/031. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All concentrations are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

Page 1 of 82-401123195-1

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A0440 Reference Number: 160-401907847-1  
Cylinder Number: E01137377 Cylinder Volume: 144.4 Cubic Feet  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG  
PGVP Number: A12020 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Oct 06, 2020

Expiration Date: Oct 06, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder before 100 ppm, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	80.27 PPM	G1	+/- 1.4% NIST Traceable	09/29/2020, 10/06/2020
CARBON MONOXIDE	80.00 PPM	80.53 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020
NITRIC OXIDE	80.00 PPM	80.27 PPM	G1	+/- 1.4% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	80.00 PPM	79.00 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	87.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D855025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	E80079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
QMS	124208986	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	07060227	E80079116	100.6 PPM NO/NITROGEN	+/- 1.0%	Jul 23, 2023
NTRM	16010203	KAL004418	87.66 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.9%	Dec 23, 2021
NTRM	11010416	KAL004502	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.9%	Jul 28, 2023

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg, Net Weight: 4.8 Kg



*Michael A. Miller*  
Approved for Release

Page 1 of 160-401907847-1

## CERTIFICATE OF ANALYSIS

Customer Details:  
ALS Laboratory Group (Thailand)Production Order Number: 90145553  
Material Number: 478100-J-44  
Certification Date: 07-Dec-2017  
Expiry Date: 07-Dec-2025Cylinder Description:  
STEEL 47 L

The measurement of this reference material is traceable to SI through the reference standard which is traceable to the National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-400/0-12/03 for the Assay and Certified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number:

3982/17

Analyst:

Anissara T.

ARISSARA THONGNURI

Cylinder Number:

14465

Approve:

SUKANYA KAMUTHARAT

Nominal Cylinder Content:

6.520 M<sup>3</sup>

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 25% 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 ลินด์ (ประเทศไทย) จำกัด (มหาชน)

15/1 หมู่ 10 ต.บางพลีใหญ่ อ.บางพลี จ.สมุทรปราการ

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

Linde (Thailand) Public Company Limited

15/1 หมู่ 10 ต.บางพลีใหญ่ อ.บางพลี จ.สมุทรปราการ

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

## CERTIFICATE OF ANALYSIS

## Analytical Result

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

## Reference Standard used in Assay

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

## 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 Analyzer  
3. Electrochemical Oxygen Analyzer  
4. Electrochemical Nitrogen Analyzer  
5. Total Hydrocarbon Analyzer  
6. Other specified

Cylinder Number 14465  
Production Order Number 90145553Certification Date: 07-Dec-2017  
Expiration Date: 07-Dec-2025

Page 2 of 2

บริษัท ลินด์ (ประเทศไทย) จำกัด (มหาชน)

15/1 หมู่ 10 ต.บางพลีใหญ่ อ.บางพลี จ.สมุทรปราการ

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Linde (Thailand) Public Company Limited

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เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

## CERTIFICATE OF ANALYSIS

Customer Details:  
ALS Laboratory Group (Thailand)Production Order Number: 90145554  
Material Number: 557200-J-44  
Certification Date: 07-Dec-2017  
Expiry Date: 07-Dec-2025Cylinder Description:  
STEEL 47 L

The measurement of this reference material is traceable to SI through the reference standard which is traceable to the National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-400/0-12/03 for the Assay and Certified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number:

3977/17

Analyst:

Anissara T.

ARISSARA THONGNURI

Cylinder Number:

94892

Approve:

SUKANYA KAMUTHARAT

Nominal Cylinder Content:

6.560 M<sup>3</sup>

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 25% 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 ลินด์ (ประเทศไทย) จำกัด (มหาชน)

15/1 หมู่ 10 ต.บางพลีใหญ่ อ.บางพลี จ.สมุทรปราการ

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

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เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

## CERTIFICATE OF ANALYSIS

## Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen	16.0 %	16.0 %	± 1% relative	(2) I-PB-354	04-Dec-2017
In Nitrogen					

## Reference Standard used in Assay

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

## 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 Analyzer  
3. Electrochemical Oxygen Analyzer  
4. Electrochemical Nitrogen Analyzer  
5. Total Hydrocarbon Analyzer  
6. Other specified

Cylinder Number 94892  
Production Order Number 90145554Certification Date: 07-Dec-2017  
Expiration Date: 07-Dec-2025

Page 2 of 2

บริษัท ลินด์ (ประเทศไทย) จำกัด (มหาชน)

15/1 หมู่ 10 ต.บางพลีใหญ่ อ.บางพลี จ.สมุทรปราการ

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

Linde (Thailand) Public Company Limited

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เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32

เบอร์โทร: 02-570-479-33 โทรสาร: 02-570-479-32



## CERTIFICATE OF ANALYSIS

Customer Detail:  
ALS Laboratory Group (Thailand)Production Order Number: 90132928  
Material Number: 478100-J-44  
Certification Date: 20-Jan-2016  
Expiry Date: 20-Jan-2024Cylinder Description:  
Steel 47 L

The measurement of this reference material is traceable to 3rd through 5th reference standard which is traceable to Swiss National Standard of Metals. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-8000-12-051 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a multi-basis basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number:

467615

Analyst:

THIRAT LOYRAT

Cylinder Number:

S50730

Approver:

SUKANYA KAMUTHARAT

Nominal Cylinder Content:

6.520 M<sup>3</sup>

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 150psi.
- 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

USDA Rural (สำนักงาน) อำเภอ (กรม)

สำนักงานเกษตรกรรม

No. 15 หมู่ 1 ตำบล 12/3 หมู่ 14, บางนา กรุงเทพฯ 10700, 6.5 Bar, Bangkok

Contact: 02-238-4100 (Tel) 02-238-4100 (Fax) 02-238-4100

E-mail: als@als.co.th

Website: www.als.co.th

Linde (Thailand) Public Company Limited

15 หมู่ 14, บางนา กรุงเทพฯ 10700, 6.5 Bar, Bangkok

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Website: www.als.co.th

Linde (Thailand) Public Company Limited

## CERTIFICATE OF ANALYSIS

## Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen in Nitrogen	8.00 %	7.93 %	± 1% relative	(2) I-PB-354	20-Jan-2015

## Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expired Date
Oxygen in Nitrogen	24362SSG	25.08 ± 0.13 %	19-Aug-2017

## Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
Servomex 4100 O2 Analyzer	Paramagnetic	23-Dec-2015

Method of Analysis:

- Gas Chromatography
- Paramagnetic Oxygen Analyzer
- Electrochemical Oxygen Analyzer
- Photochemical Moisture Analyzer
- Total Hydrocarbon Analyzer
- Other specified

Cylinder Number: S50730  
Production Order Number: 90132928Certification Date: 20-Jan-2016  
Expiration Date: 20-Jan-2024

Page 2 of 2

USDA Rural (สำนักงาน) อำเภอ (กรม)

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E-mail: als@als.co.th

Website: www.als.co.th

Linde (Thailand) Public Company Limited

## CERTIFICATE OF ANALYSIS

Customer Detail:  
ALS Laboratory Group (Thailand)Production Order Number: 90137389  
Material Number: 557200-J-44  
Certification Date: 24-Sep-2016  
Expiry Date: 24-Sep-2024Cylinder Description:  
Steel 47 L

The measurement of this reference material is traceable to 3rd through 5th reference standard which is traceable to Swiss National Standard of Metals. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-8000-12-051 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a multi-basis basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number:

285716

Analyst:

THIRAT LOYRAT

Cylinder Number:

S63075

Approver:

SUKANYA KAMUTHARAT

Nominal Cylinder Content:

6.560 M<sup>3</sup>

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 150psi.
- 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

USDA Rural (สำนักงาน) อำเภอ (กรม)

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E-mail: als@als.co.th

Website: www.als.co.th

Linde (Thailand) Public Company Limited

## 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	24-Sep-2016

## Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expired Date
Oxygen in Nitrogen	24362SSG	25.08 ± 0.13 %	19-Aug-2017

## Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
Servomex 4100 O2 Analyzer	Paramagnetic	24-Sep-2016

Method of Analysis:

- Gas Chromatography
- Paramagnetic Oxygen Analyzer
- Electrochemical Oxygen Analyzer
- Photochemical Moisture Analyzer
- Total Hydrocarbon Analyzer
- Other specified

Cylinder Number: S63075  
Production Order Number: 90137389Certification Date: 24-Sep-2016  
Expiration Date: 24-Sep-2024

Page 2 of 2

USDA Rural (สำนักงาน) อำเภอ (กรม)

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E-mail: als@als.co.th

Website: www.als.co.th

Linde (Thailand) Public Company Limited





# CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 12 Jul 22  
 Next Cal. Date : 12 Jan 23  
 Console Control Meter Data:  
 Calibration No. : C-120722-BKK\_FS0488  
 Dry Gas Meter No. : BKK\_FS0488  
 Console Serial No. : 1302005  
 Console Model No. : XC-572-V  
 Biometric Pressure (mm Hg) : 755  
 Relative Humidity (%) : 70.0  
 Temperature (°C) : 30.0  
 Reference Dry Gas Meter Data:  
 Serial No. : 1687099  
 Model No. : SK25EXSR-QC8  
 Correction Factor (V) : 1.0060  
 Next Calibration Date : 7 Oct 22

ΔH (mm H <sub>2</sub> O)	Θ Min/Sec	Reference Dry Gas Meter Calibration						Console Control Dry Gas Meter						Dry Gas Meter Correction Factor (V)	Calibration Factor (V)	ΔVg (V)
		Vt (L test)			Tt (°C)			Vm (L test)			Tt (°C)					
		Final	Initial	Total	Final	Initial	Total	Final	Initial	Total	Final	Initial	Total			
15	12.80	150.00	0.00	150.00	31.0	150.00	31.0	344.0	191.0	535.00	30.0	30.0	30.0	0.9816	50.7861	40.7861
25	9.60	150.00	0.00	150.00	31.0	150.00	31.0	511.4	358.0	869.40	30.0	30.0	30.0	0.9751	47.8138	38.2138
50	6.68	150.00	0.00	150.00	31.0	150.00	31.0	673.4	520.0	1193.40	31.0	31.0	31.0	0.9759	48.9660	39.4660
100	4.62	150.00	0.00	150.00	32.0	150.00	32.0	842.0	690.0	1532.00	31.0	31.0	31.0	0.9726	44.2543	34.2543
150	3.77	150.00	0.00	150.00	32.0	150.00	32.0	1065.5	913.0	1978.50	32.0	32.0	32.0	0.9756	44.6575	34.6575
														Avg	0.9776	44.6389

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average.  
 ΔVg : -Orifice pressure differential that equates to 21.24 in or air @ 35°C and 750 mm of mercury, mm-H<sub>2</sub>O. Tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 16.40 APP A METH SEC 6.3 & 7

Calibrated by:

Saksit Phaisanphit  
 (Mr Saksit Phaisanphit)  
 Field Scientist (4)

Approved by:

Nattapon Jangwongwong  
 (Mr Nattapon Jangwongwong)  
 Field Specialist (1)

Form 2017-048 (04/10/102)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 12-Jul-22	Ambient Temperature (°C) : 30
Calibration sheet No. : C-120722-BKK_FS0488	Relative Humidity (%) : 70
Digital Temperature ID : BKK_FS0488	Reference Temperature ID : BKK_FS0009
Serial No. : 1300005	Serial No. : 7688004
Model : XC-572-V	Model : FUJITE 714
	Next Calibrate : 26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	24	-1	
	50	49	-1	
	100	98	-2	
	150	148	-2	
	200	197	-3	
	250	247	-3	
	300	297	-3	
	500	497	-3	
	1000	997	-3	
	1200	1197	-3	
Probe	100	99	-1	
	125	124	-1	
	150	149	-1	
Ovens	100	99	-1	
	125	124	-1	
	150	149	-1	
Filter	100	100	0	
	125	125	0	
	150	149	-1	
Exit	0	0	0	
	10	11	1	
	20	21	1	
Meter	0	0	0	
	25	25	0	
	50	50	0	
AUX	0	0	0	
	25	25	0	
	50	50	0	

Calibrated by:

Saksit Phaisanphit  
 (Mr Saksit Phaisanphit)  
 Field Scientist (4)

Approved by:

Nattapon Jangwongwong  
 (Mr Nattapon Jangwongwong)  
 Manager

Form 2017-048 (04/10/102)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0472  
 Lab test duct Number : 258-1-13-01  
 Calibration Sheet No. : C-120722-BKK\_FS0472  
 Calibration Date : 12 Jul 22  
 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 <sub>2</sub> O)	Type s pitot tube (ΔP, mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
	Cp			0.842	0.842

$$C_p(S) = C_{p(st)} \sqrt{\frac{\Delta P(st)}{\Delta P(s)}}$$

$$\left[ \bar{C}_{p(A)} - \bar{C}_{p(B)} \right] \text{ must BE } < 0.01$$

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

Calibrated by:

Saksit Phaisanphit  
 (Mr Saksit Phaisanphit)  
 Field Scientist (4)

Approved by:

Nattapon Jangwongwong  
 (Mr Nattapon Jangwongwong)  
 Field Specialist (1)

Form 2017-048 (04/10/102)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0473  
 Lab test duct Number : 258-1-13-01  
 Calibration Sheet No. : C-120722-BKK\_FS0473  
 Calibration Date : 12 Jul 22  
 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 <sub>2</sub> O)	Type s pitot tube (ΔP, mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
	Cp			0.842	0.842

$$C_p(S) = C_{p(st)} \sqrt{\frac{\Delta P(st)}{\Delta P(s)}}$$

$$\left[ \bar{C}_{p(A)} - \bar{C}_{p(B)} \right] \text{ must BE } < 0.01$$

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

Calibrated by:

Saksit Phaisanphit  
 (Mr Saksit Phaisanphit)  
 Field Scientist (4)

Approved by:

Nattapon Jangwongwong  
 (Mr Nattapon Jangwongwong)  
 Field Specialist (1)

Form 2017-048 (04/10/102)



PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

Calibration Date	12 Jul 22	Nozzle Set ID :	BKK_FS0474
Calibration Sheet No. :	C-120722-BKK_FS0474	Vernier Caliper ID. :	BKK_FS0626

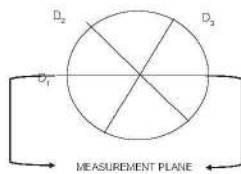
Nozzle ID #	Nozzle Diameter (mm)			Hi - Lo $\Delta D$	$(D_1 + D_2 + D_3) / 3$ $D_{avg}$
	$D_1$	$D_2$	$D_3$		
1	0.300	0.300	0.300	0.000	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.600	0.600	0.600	0.000	0.600
4	0.780	0.780	0.780	0.000	0.780
5	0.932	0.932	0.932	0.000	0.932
6	1.094	1.094	1.094	0.000	1.094
7	1.264	1.264	1.264	0.000	1.264

Where:

$D_1, D_2, D_3$  = Three different nozzle diameters at 80 degrees to each other, each measured the nearest 0.025 mm.

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

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



Calibrated by

Saksit Phaisangphut

(Mr Saksit Phaisangphut)

Field Scientist (4)

Approved by

Nattapon Jengwawong

(Mr Nattapon Jengwawong)

Field Specialist(1)

Form 16, 02/2011-025 (12/02/02)

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mm Hg) : 75.5

Relative Humidity (%) : 70.0

Temperature (°C) : 30.0

Reference Dry Gas Meter Data

Serial No. : 1607009

Model No. : SK25EXR-OC6

Correction Factor (VF) : 1.0060

Next Calibration Date : 7 Oct 22

Console Control Meter Data

Calibration No. : C-120722-BKK\_FS0556

Dry Gas Meter No. : BKK\_FS0556

Console Serial No. : 1809041

Console Model No. : XC-572-V

Calibration of Date : 12 Jul 22

Next Cal. Date : 12 Jan 23



$\Delta H$ (mm H <sub>2</sub> O)	$\Phi$ Minutes	Reference Dry Gas Meter Calibration						Console Control - Dry Gas Meter						Dry Gas Meter Correction Factor	Calibre Calibration Factor	$\Delta V$	
		Vol (L/sec)			Tr (°C)			Vol (L/sec)			Tr (°C)						
		Initial		Total	Initial		Total	Initial		Total	Initial		Total				
		Final	Initial	Total	Final	Initial	Total	Final	Initial	Total	Final	Initial	Total				
15	12.56	150.00	0.00	150.00	26.0	1750085.0	1750085.0	147.80	26.0	26.0	26.0	1.0263	1.0263	47.7721			
25	9.67	150.00	0.00	150.00	26.0	1750406.0	1750406.0	147.00	26.0	26.0	26.0	1.0309	1.0309	47.0461			
50	6.78	150.00	0.00	150.00	26.0	1750399.2	1750399.2	146.20	26.0	26.0	26.0	1.0340	1.0340	46.2542			
100	4.68	150.00	0.00	150.00	26.0	1750602.5	1750602.5	146.45	26.0	26.0	26.0	1.0349	1.0349	44.0771			
150	3.82	150.00	0.00	150.00	26.0	1750719.0	1750719.0	146.00	26.0	26.0	26.0	1.0390	1.0390	43.9055			
										Avg.			1.0320			45.8104	

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

$\Delta V$  = Office pressure differential that equates to 21.24 in of air @ 25°C and 760 mm of mercury, mm H<sub>2</sub>O tolerance for individual values  $\pm 5.08$  from average.

Procedure: 40 CFR 60 APP A METH, SEC 6.3 & 7

Calibrated by

Saksit Phaisangphut

(Mr Saksit Phaisangphut)

Field Scientist (4)

Approved by

Nattapon Jengwawong

(Mr Nattapon Jengwawong)

Field Specialist(1)

Form 16, 02/2011-025 (12/02/02)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	12-Jul-22	Ambient Temperature (°C) :	30
Calibration sheet No. :	C-120722-BKK_FS0557	Relative Humidity (%) :	70
Digital Temperature ID :	BKK_FS0557	Reference Temperature ID :	BKK_FS0009
Console Serial No. :	1606041	Serial No. :	7688004
Console Model :	XC-572-V	Model :	FLUXE 714
		Next Calibrate :	26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	1	1	
	25	26	1	
	50	51	1	
	100	102	2	
	150	153	3	
	200	202	2	
Probe	250	251	1	
	300	302	2	
	350	353	3	
	400	403	3	
	1200	1201	1	
	1200	1201	1	
Oven	100	102	2	
	125	128	3	
	150	159	9	
Filter	100	102	2	
	125	128	3	
	150	159	9	
Exit	100	102	2	
	125	128	3	
	150	159	9	
Meter	0	1	1	
	25	26	1	
	50	51	1	
AUX	0	1	1	
	25	26	1	
	50	51	1	

Calibrated by

Saksit Phaisangphut

(Mr Saksit Phaisangphut)

Field Scientist (4)

Approved by

Nattapon Jengwawong

(Mr Nattapon Jengwawong)

Field Specialist(1)

Form 201-448 (12/02/02)



Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0561	Calibration Date :	12 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-120722-BKK_FS0561	Op Standard :	0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Cp				0.842	0.842

$$C_p(S) = C_{p,ref} \sqrt{\frac{\Delta P(S)}{\Delta P(Ref)}}$$

$$\left| C_{p(A)} - C_{p(B)} \right| \text{ must BE } < 0.01$$

$$\text{Average deviation (A or B)} = \frac{\sum (C_p(S) - C_{p(A \text{ or } B)})}{3} \text{ must BE } \leq 0.01$$

Calibrated by

Saksit Phaisangphut

(Mr Saksit Phaisangphut)

Field Scientist (4)

Approved by

Nattapon Jengwawong

(Mr Nattapon Jengwawong)

Field Specialist(1)

Form 201-1-048 (12/02/02)



### Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0560 Calibration Date : 12 Jul 22  
Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK\_FS0441  
Calibration Sheet No. : C-120722-BKK\_FS0560 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type S pitot tube Leg A/B	Standard pitot tube ( $\Delta P$ , mm H <sub>2</sub> O)	Type S pitot tube ( $\Delta P$ , mm H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Cp				0.842	0.842

$$Q_p(s) = Q_{ref} \sqrt{\frac{\Delta P (s)}{\Delta P (ref)}}$$

$$\left[ \bar{C}_p(A) - \bar{C}_p(B) \right] \text{ must BE } \leq 0.01$$

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

Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong  
(Mr Saksit Phaisanphut) (Mr Nattapon Jengwareewong)  
Field Scientist (4) Field Specialist (1)

Rev 281-048 (18/10/20)



### PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 12 Jul 22 Nozzle Set ID : BKK\_FS0562  
Calibration Sheet No. : C-120722-BKK\_FS0562 Vernier Caliper ID : BKK\_FS0628

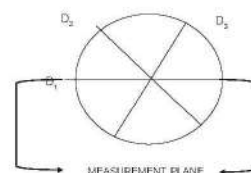
Nozzle ID #	Nozzle Diameter (mm)			Hi - Lo	(D <sub>1</sub> + D <sub>2</sub> + D <sub>3</sub> ) / 3
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	$\Delta D$	D <sub>avg</sub>
1	0.300	0.306	0.302	0.006	0.303
2	0.480	0.475	0.480	0.005	0.478
3	0.625	0.630	0.630	0.005	0.628
4	0.765	0.750	0.765	0.015	0.757
5	0.975	0.980	0.970	0.010	0.975
6	1.095	1.090	1.095	0.005	1.093
7	1.275	1.275	1.270	0.005	1.273
8	1.610	1.610	1.610	0.000	1.610

Where:

D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.005 mm.

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

D<sub>avg</sub> = (D<sub>1</sub> + D<sub>2</sub> + D<sub>3</sub>) / 3



Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong  
(Mr Saksit Phaisanphut) (Mr Nattapon Jengwareewong)  
Field Scientist (4) Field Specialist (1)

Rev No. 02-291-025 (12/01/22)



### DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date : 12 Jul 22 Barometric Pressure (mm.Hg) : 755  
Next Calibration Date : 12 Jan 23 Relative Humidity (%) : 70.0  
Temperature (°C) : 30.0  
Dry Gas Meter Data : Reference Dry Gas Meter Data  
Calibration sheet No. : C-120722-BKK\_FS0563 Serial No. : 1607009  
Dry Gas Meter No. : BKK\_FS0563 Model No. : SK25EXSR-QC6  
Console Serial No. : 1606011 Correction Factor (Y) : 1.0060  
Model No. : XC-62-CV Next Calibration Date : 7 Oct 22

Reference Dry Gas Meter Calibration				Dry Gas Meter					Dry Gas Meter Correction Factor (Y)
Vn (Liters)			Tn (°C)	Vn (Liters)			Tn (°C)	To (°C)	
Final	Initial	Total		Final	Initial	Total		Avg. Tm (°C)	
30.00	0.00	30.00	26.0	30.42	0.00	30.42	24.0	24.0	0.9855
30.00	0.00	30.00	26.0	30.45	0.00	30.45	26.0	26.0	0.9911
60.00	0.00	60.00	26.0	61.56	0.00	61.56	26.0	26.0	0.9871
60.00	0.00	60.00	26.0	61.55	0.00	61.55	26.0	26.0	0.9872
90.00	0.00	90.00	26.0	92.22	0.00	92.22	29.0	29.0	0.9916
90.00	0.00	90.00	26.0	92.23	0.00	92.23	29.0	29.0	0.9916
Avg.									0.9890

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

Calibrate by : Mr. Warawut Putpa Approved by : Nattapon Jengwareewong  
(Mr. Warawut Putpa) (Mr Nattapon Jengwareewong)  
Field Scientist (3) Field Specialist (1)

Form No. 281-022 vts (08/10/20)



### DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 12-Jul-22 Ambient Temperature (°C) : 30  
Calibration sheet No. : C-120722-BKK\_FS0563 Relative Humidity (%) : 70  
Digital Temperature ID : BKK\_FS0563 Reference Temperature ID : BKK\_FS0509  
Console Serial No. : 1606011 Serial No. : 7688004  
Model : XC-62-CV Model : FLUKE 714  
Next Calibrate : 26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	25	0	
	50	50	0	
	100	99	-1	
	150	149	-1	
	200	199	-1	
	250	248	-2	
	300	299	-1	
Probe	500	499	-1	
	1000	999	-1	
	1200	1199	-1	
	100	99	-1	
	125	124	-1	
	150	149	-1	
	100	99	-1	
	125	124	-1	
Filter	150	149	-1	
	100	99	-1	
	125	124	-1	
Exit	150	149	-1	
	0	0	0	
	10	9	-1	
Meter	20	19	-1	
	0	0	0	
	25	24	-1	
ALUX	50	49	-1	
	0	0	0	
	25	24	-1	
	50	49	-1	

Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong  
(Mr Saksit Phaisanphut) (Mr Nattapon Jengwareewong)  
Field Scientist (4) Field Specialist (1)

Rev 281-048 (12/01/22)







# ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	01 Oct 22	$Y = 1.0202x + 0.1976$	1.0000
BKK_FS0579	01 Oct 22	$Y = 1.0078x + 0.4789$	0.9998
BKK_FS0583	01 Oct 22	$Y = 1.016x + 0.3922$	1.0000
BKK_FS0584	01 Oct 22	$Y = 1.0038x + 2.2262$	0.9997
BKK_FS0585	01 Oct 22	$Y = 1.0189x - 5.6476$	0.9997
BKK_FS0586	01 Oct 22	$Y = 1.0095x - 1.1524$	0.9995
BKK_FS0587	01 Oct 22	$Y = 1.013x - 3.6619$	0.9996
BKK_FS0588	01 Oct 22	$Y = 1.0154x + 4.8357$	0.9999
BKK_FS0589	01 Oct 22	$Y = 0.9918x + 4.8069$	0.9999
BKK_FS0590	01 Oct 22	$Y = 1.0038x - 0.4857$	0.9996
BKK_FS0591	01 Oct 22	$Y = 0.9705x - 52.174$	0.9986
BKK_FS0592	01 Oct 22	$Y = 0.9646x - 37.642$	0.9985
BKK_FS0593	01 Oct 22	$Y = 0.9767x - 58.445$	0.9988
BKK_FS0594	01 Oct 22	$Y = 0.9902x - 62.87$	0.9999
BKK_FS0595	01 Oct 22	$Y = 1.0249x - 98.162$	0.9999
BKK_FS0596	01 Oct 22	$Y = 0.9843x - 28.806$	0.9991
BKK_FS0597	01 Oct 22	$Y = 0.9802x - 61.653$	0.9978
BKK_FS1004	01 Oct 22	$Y = 0.9762x + 11.724$	0.9998
BKK_FS1005	01 Oct 22	$Y = 1.0081x + 1.5143$	1.0000
BKK_FS1006	01 Oct 22	$Y = 1.098x - 2.9327$	0.9999
BKK_FS1007	01 Oct 22	$Y = 0.9917x + 1.6592$	1.0000
BKK_FS1008	01 Oct 22	$Y = 1.0132x + 0.7207$	1.0000
BKK_FS1009	01 Oct 22	$Y = 1.0132x + 1.1633$	0.9960
BKK_FS1010	01 Oct 22	$Y = 1.0033x + 0.5758$	0.9999
BKK_FS1011	01 Oct 22	$Y = 1.0234x + 0.1759$	0.9996
BKK_FS1012	01 Oct 22	$Y = 1.0106x - 2.0048$	0.9997
BKK_FS1013	01 Oct 22	$Y = 0.9677x - 35.851$	0.9997
BKK_FS1014	01 Oct 22	$Y = 1.0021x + 0.3148$	0.9998
BKK_FS1015	01 Oct 22	$Y = 0.9994x + 1.786$	1.0000
BKK_FS1016	01 Oct 22	$Y = 1.0105x - 80.256$	0.9998
BKK_FS1017	01 Oct 22	$Y = 0.9995x + 0.649$	1.0000
BKK_FS1018	01 Oct 22	$Y = 1.0011x + 1.1786$	1.0000
BKK_FS1019	01 Oct 22	$Y = 1.0023x - 68.424$	0.9996
BKK_FS1020	01 Oct 22	$Y = 1.0547x - 0.666$	0.9998
BKK_FS1021	01 Oct 22	$Y = 1.018x - 3.3286$	0.9998
BKK_FS1022	01 Oct 22	$Y = 0.9932x - 57.035$	0.9986
BKK_FS1023	01 Oct 22	$Y = 1.0094x + 0.0717$	0.9999
BKK_FS1024	01 Oct 22	$Y = 1.0042x + 0.4086$	0.9997
BKK_FS1025	01 Oct 22	$Y = 1.0132x - 88.507$	0.9996

Page 1 of 2

ALS Laboratory Group



# ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1026	01 Oct 22	$Y = 1.0018x + 1.0776$	0.9997
BKK_FS1027	01 Oct 22	$Y = 1.0053x + 0.231$	0.9995
BKK_FS1028	01 Oct 22	$Y = 0.9792x - 60.312$	0.9982
BKK_FS1029	01 Oct 22	$Y = 0.9835x + 0.8234$	1.0000
BKK_FS1030	01 Oct 22	$Y = 1.0039x + 0.515$	0.9999
BKK_FS1031	01 Oct 22	$Y = 1.008x - 79.295$	0.9998
BKK_FS1039	01 Oct 22	$Y = 0.9967x + 4.5048$	0.9999
BKK_FS1040	01 Oct 22	$Y = 0.9836x + 32.694$	0.9998
BKK_FS1041	01 Oct 22	$Y = 1.067x - 1.999$	1.0000
BKK_FS1042	01 Oct 22	$Y = 1.0019x + 2.1571$	1.0000
BKK_FS1043	01 Oct 22	$Y = 1.1569x - 96.479$	0.8412
BKK_FS1044	01 Oct 22	$Y = 1.0318x - 0.9374$	0.9999
BKK_FS1161	01 Oct 22	$Y = 1.0126x + 0.7738$	0.9999
BKK_FS1162	01 Oct 22	$Y = 0.9994x + 2.6357$	0.9995
BKK_FS1163	01 Oct 22	$Y = 0.977x - 55.03$	0.9987
BKK_FS1164	01 Oct 22	$Y = 0.9914x + 0.8427$	0.9997
BKK_FS1165	01 Oct 22	$Y = 0.9893x + 6.5919$	0.9998
BKK_FS1166	01 Oct 22	$Y = 1.0031x - 77.881$	0.9996
BKK_FS1200	01 Oct 22	$Y = 1.0313x - 0.4602$	0.9995
BKK_FS1201	01 Oct 22	$Y = 1.0045x + 0.15$	0.9996
BKK_FS1202	01 Oct 22	$Y = 0.9702x - 44.156$	0.9994
RYG_FS0197	01 Oct 22	$Y = 1.0039x - 0.179$	0.9999
RYG_FS0198	01 Oct 22	$Y = 0.9964x + 21.757$	1.0000
RYG_FS0199	01 Oct 22	$Y = 1.0577x - 1.7486$	1.0000

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jitranont)

Assistant General Manager

Page 2 of 2

ALS Laboratory Group

RYG\_EN0038

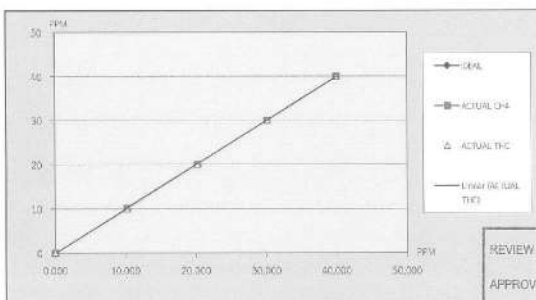


## TEST REPORT

CUSTOMER NAME	: ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน) จำกัด)
EQUIPMENT NAME	: THC Analyzer
MANUFACTURER	: HORDA
MODEL	: APHA-370
SERIAL NO.	: U430GTHB
STANDARD GAS CONCENTRATION (PPM)	: 505.1 PPM
CYLINDER NO.	: CC734373
CYLINDER PRESSURE (psig)	: 1,600 PSI
CERTIFIED DATE	: 12/05/2020
CERTIFIED BY	: AIRGAS
EXPIRED DATE	: 12/05/2025

### TEST RESULTS

POINT NO	TEST RESULTS						
	IDEAL	ACTUAL CH4	ERROR CH4	%ERROR CH4	ACTUAL THC	ERROR THC	%ERROR THC
ZERO	0.000	0.000	0.000	-	0.000	0.000	-
1	10.000	10.240	0.240	2.40	10.210	0.210	2.10
2	20.000	20.230	0.230	1.15	20.200	0.200	1.00
3	30.000	30.120	0.120	0.40	30.170	0.170	0.57
4	40.000	40.000	0.000	0.00	40.000	0.000	0.00
AVERAGE (%)				0.99	0.92		



REVIEW BY : Thanitall  
APPROVED BY : D  
NEXT CAL DATE : 14/1/2023

CALIBRATED BY : 31166 หาดใหญ่  
CHECKED BY : หาดใหญ่  
DATE : 14/1/22  
NAC  
BRARATE ASSOCIATES Co., Ltd.

สำหรับการสอบเทียบเครื่องมือ : ฝ่ายปฏิบัติการการสอบเทียบ โทร 02-866-0812 หรือ 1536, E-Mail : Engineering@brarate.com  
เลขที่ 63/16-15, 67/35-36 ซอยเทศบาลนคร 7/71 ถนนเทศบาลนคร 10 แขวงบางนา เขตบางนา กรุงเทพมหานคร 10600 โทร 02-866-0812-15 โทรสาร 02-866-1899

FO-EH-206 R01/22-10-14



## CHECK LIST

CUSTOMER NAME	: ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน) จำกัด)
EQUIPMENT NAME	: THC Analyzer
MANUFACTURER	: HORDA
MODEL	: APHA-370
SERIAL NO.	: U430GTHB

TEST VALUES			
NO.	THC Analyzer ( APHA - 370 )	UNIT	BEFORE AFTER
1	Signal ( CH4 )	mV	29.500 31.300
2	Signal ( THC )	mV	39.200 36.500
3	Detector	Temp °C, Standard Value : Ambient Temp (25°C±15°C) Pressure kPa, Standard Value : Ambient (1013±100-20-64Pa)	47.300 47.400 81.500 81.800
4	Ambient	kPa current atmospheric pressure	101.500 101.400
5	Purifier	°C, Standard Value : 300 °C to 430 °C	420.200 420.300
6	NMHC	kPa, Normal value : 8 kPa to 25 kPa	10.200 10.300
7	OC 24 V	°C, Standard Value : 230 °C to 250 °C	243.000 243.200
8	OC 5 V	V, Standard Value : 24 V ± 0.5 V	23.900 23.900
9	Bypass (Optional)	V, Standard Value : 5 V ± 0.5 V	5.000 5.000
10	Over Flow (Optional)	U/min, Normal value : 0.9 U/min ± 0.3 U/min	- -
11	CH4 Sampling Reading	U/min, Standard Value : 0.8 U/min or More	- -
12	NMHC Sampling Reading	PPM	2.900 3.580
13	THC Sampling Reading	PPM	0.720 0.830
14	Zero Gas CH4/THC	PPM	3.620 3.780
15	Span Gas	PPM	0.970/33 0.060/0.00
16	Gas H2	PPM	17.86/37.85 40.0/40.0
17	Gas H2	20 PSI	20 20

Remark : Reference : EX-EN-017-56 , Ambient HC Monitor APHA-370 Operation Manual Page #81

Remark : ( Ambient temperature = 5°C to 40°C )

อาการที่ตรวจพบ : Service Maintenance  
รายละเอียดการดำเนินการ :  
ผลการดำเนินการ :  
- เขียนใบ หรือเอกสารว่าดำเนินการตรวจพบได้ตามเกณฑ์

CALIBRATED BY : 31166 หาดใหญ่  
CHECKED BY : หาดใหญ่  
DATE : 14/1/22  
NAC  
BRARATE ASSOCIATES Co., Ltd.

สำหรับการสอบเทียบเครื่องมือ : ฝ่ายปฏิบัติการการสอบเทียบ โทร 02-866-0812 หรือ 1536, E-Mail : Engineering@brarate.com  
เลขที่ 63/16-15, 67/35-36 ซอยเทศบาลนคร 7/71 ถนนเทศบาลนคร 10 แขวงบางนา เขตบางนา กรุงเทพมหานคร 10600 โทร 02-866-0812-15 โทรสาร 02-866-1899

FO-EN-207 R01/01-08-13

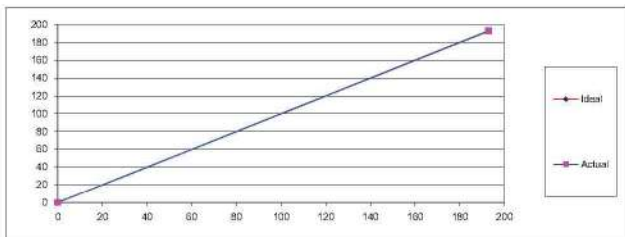


### CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment ID	BKK_FS0758
Equipment Name	FID Analyzer	Manufacturer	Baseline Mocon
Model	9000H	Serial No.	0315EF0047
Std. Gas Conc. (ppm)	193	Cylinder No.	D619622
Certified Date	17-Sep-14	Expired Date	17-Sep-22

### CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.04	0.04	0.04
SPAN	193.00	192.75	-0.25	-0.13
AVERAGE (%)				-0.04



Calibrated By

*(Signature)*

( Mr. Apleit Sing-ha )  
Field Environmental Scientist (4)

Approved By

*(Signature)*

( Mr. Sarayuth Jittrantont )  
Assistant General Manager

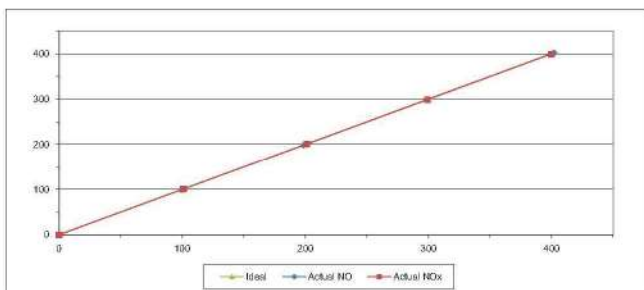
ALS Laboratory Group



### MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	H73KYD1M	Equipment ID	BKK_FS0797
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	99.70	-0.30	-0.30	101.00	1.00	1.00
2	200.00	198.80	-1.40	-0.70	201.30	1.30	0.65
3	300.00	299.00	-1.00	-0.33	299.20	-0.80	-0.27
4	400.00	402.10	2.10	0.53	399.50	-0.50	-0.13
AVERAGE (%)				-0.14			0.27



Calibrated By

*(Signature)*

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

Approved By

*(Signature)*

( Mr. Sarayuth Jittrantont )  
Assistant General Manager

ALS Laboratory Group

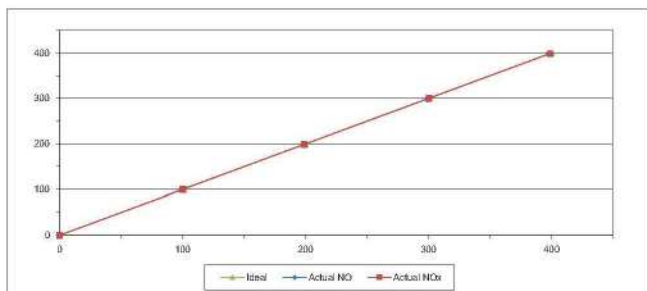
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



### MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AV89544	Equipment ID	RYG_FS0272
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	0.05	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

*(Signature)*

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

Approved By

*(Signature)*

( Mr. Sarayuth Jittrantont )  
Assistant General Manager

ALS Laboratory Group

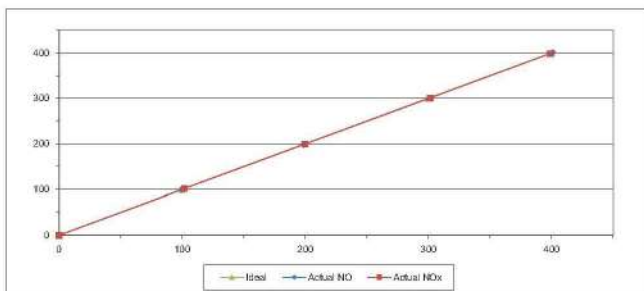
FORM NO.: F 06-058 REVISION NO.: - ISSUE DATE: 02/04/12



### MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	NV0ER3YH	Equipment ID	RYG_FS0459
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	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.80	1.80	1.80
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.50	1.50	0.50
4	400.00	401.30	1.30	0.33	398.90	-1.10	-0.28
AVERAGE (%)				-0.08			0.39



Calibrated By

*(Signature)*

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

Approved By

*(Signature)*

( Mr. Sarayuth Jittrantont )  
Assistant General Manager

ALS Laboratory Group

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

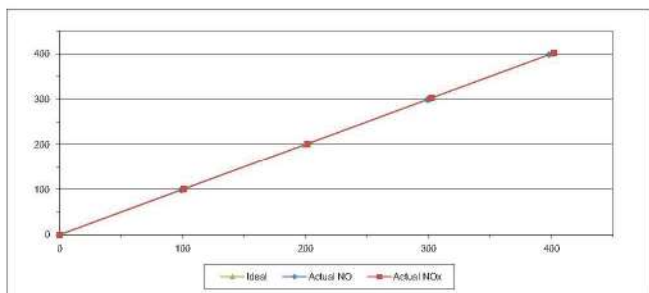




# MULTIPOINT CALIBRATION REPORT

Calibration Date: 1-Jul-22  
Manufacturer: HORIBA  
Serial No.: R06K0177  
Calibrator Manufacturer: Teledyne API  
Std. Gas Concentration (PPM): 55.88  
Cylinder Pressure (psi): 1800  
Certified Date: 9-Feb-22  
Equipment Name: NOx Analyzer  
Model: APNA-370  
Equipment ID: RYG\_FS0463  
Model: 700  
Cylinder No.: GN0027222  
Certified By: Airgas Inc.  
Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	101.10	1.10	1.10
2	200.00	201.80	1.80	0.90	201.50	1.50	0.75
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.10	-1.90	-0.47	401.90	1.90	0.47
AVERAGE (%)				-0.18			0.66



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

Approved By  
(Mr. Sarayuth Jitranont)  
Assistant General Manager

ALS Laboratory Group  
FORM NO.: F-05-055 REVISION NO.: ISSUE DATE: 02/04/12

# Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: RYG\_EN0136  
Organization Name: ALS Laboratory Group (Thailand) Co Ltd.  
Organization Location: Tambol Pluak Daeng, Amphoe Pluak Daeng, Rayong, 21140, Thailand

Date: February 2, 2021 11:38:25 AM  
EQP Name: Agilent/Recommended, Agilent/Recommended  
EQP Revision: GC.02.50, GCMS.02.50  
Overall Qualification Status: Pass

REVIEW BY: [Signature]  
APPROVED BY: [Signature]  
NEXT CAL DATE: 02/09/2022

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

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

Setpoint Status: Pass  
Zone: Oven  
Temperature: 230.0, 231.3 °C  
Accuracy: -1.3 °C  
Agilent Recommended: >= -1.0 °C, <= 1.0 °C  
% setpoint in K: (-5.0 °C, 5.0 °C)

Data for this setpoint was entered manually.

Reason: No Data Logging Software

Setpoint Status: Pass  
Zone: Oven  
Temperature: 100.0, 99.8 °C  
Accuracy: -0.2 °C  
Agilent Recommended: >= -1.0 °C, <= 1.0 °C  
% setpoint in K: (-3.7 °C, 3.7 °C)

Data for this setpoint was entered manually.

Reason: No Data Logging Software

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: 7890  
Setpoint Status: Pass  
Temperature: 100.0, 99.8 °C  
Stability: 0.0 °C  
Agilent Recommended: <= 0.5 °C

Data for this setpoint was entered manually.

Reason: No Data Logging Software

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

## 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: 1 mV  
Agilent Recommended: >= -100 and <= 100 mV  
RFPA Voltage: 475 mV

## 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

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

## Signal to Noise EI

## Tested Combination1

Name:	5977B
Source:	EI - Extractor
Filament:	1
Setpoint Status:	Pass
Signal to Noise:	7105
Agilent Recommended:	>= 1200
Source:	EI - Extractor
Filament:	2
Setpoint Status:	Pass
Signal to Noise:	3440
Agilent Recommended:	>= 1200

This test's 0 comment(s) and 1 deviation(s) are available in the Attachments section.

**Overall Signal to Noise EI Test Status**

Pass

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

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## Instrument Details

## Purpose

This section describes the as found system configuration.

## Details

System	
System ID	RYG_EN0136
Manufacturer	Agilent Technologies
Name	7890
Tested Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN16463238
Firmware Revision	8.02.04.3
Component ID/Asset No.	081117000236
Oven Type	Standard

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

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## 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

Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

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## Electronic Signature

## Purpose

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

## Details

Full Name of Signer:	Eaknarin Puangsopa
Logged On User Name:	eaknarin_puangsoa@agilent.com
Signature Creation Date:	February 2, 2021
Reason for Signature:	Executed protocol and published this original version of document

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Date: February 2, 2021 11:38:25 AM  
System ID: RYG\_EN0136

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User Name: saknath\_puangscope  
Host Name: ASRYGW7032  
System ID: RYG\_EN0136  
Print Date: February 2, 2021 11:38:27 AM

## ALS\_US101M068 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 1, 2021 12:00:51 PM	Audit	SessionCreated	Session	None
February 1, 2021 12:00:51 PM	Start	Configuration	Session	None
February 1, 2021 12:00:51 PM	Audit	Entitlement	Licensing	User is FullyEngineered and does not require an unlock code
February 1, 2021 12:06:57 PM	Audit	EngLeadon	Session	EQP details for primary technique (GC) - File path: [ProtocolRoot\GC\Config\knot02.00\GC_02.00.msp] EQP File Name: [GC_02.00.msp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique (GC/MS) - File path: [ProtocolRoot\GC/MS\Config\knot02.00\GC_02.00.msp], EQP File Name: [GC/MS_02.00.msp], EQP Name: [AgilentRecommended]
February 1, 2021 12:08:02 PM	End	Configuration	Session	None
February 1, 2021 12:08:06 PM	Start	Qualification	Session	CO
February 1, 2021 12:08:07 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7880 - Qualitative Test - No setpoints associated	None

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User Name: saknath\_puangscope  
Host Name: ASRYGW7032  
System ID: RYG\_EN0136  
Print Date: February 2, 2021 11:38:27 AM

## ALS\_US101M068 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 1, 2021 12:10:04 PM	End	Execution	System Inspection and Basic Safety and Operation - 7880 - Qualitative Test - No setpoints associated	Run Count: 1
February 1, 2021 12:10:07 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
February 1, 2021 12:19:08 PM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
February 1, 2021 12:19:42 PM	Start	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
February 1, 2021 12:28:41 PM	Start	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
February 1, 2021 12:28:44 PM	Start	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
February 1, 2021 12:28:52 PM	Audit	Data	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
February 1, 2021 12:29:36 PM	End	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
February 1, 2021 12:28:41 PM	Start	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 162.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None

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Date: February 2, 2021 11:38:26 AM  
System ID: RYG\_EN0136

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Date: February 2, 2021 11:38:26 AM  
System ID: RYG\_EN0136

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User Name: saknath\_puangscope  
Host Name: ASRYGW7032  
System ID: RYG\_EN0136  
Print Date: February 2, 2021 11:38:27 AM

## ALS\_US101M068 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 1, 2021 12:37:42 PM	Audit	Data	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 160.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
February 1, 2021 12:37:45 PM	End	Execution	GC Oven Temperature Accuracy - 7880 - Temperature - Oven - S: 160.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
February 1, 2021 12:37:58 PM	Start	Execution	GC Oven Temperature Stability - 7880 - Temperature - Oven - S: 100.0°C - L: <= 0.0°C	None
February 1, 2021 1:00:14 PM	Audit	Data	GC Oven Temperature Stability - 7880 - Temperature - Oven - S: 100.0°C - L: <= 0.0°C	Manual Data Entry
February 1, 2021 1:00:34 PM	End	Execution	GC Oven Temperature Stability - 7880 - Temperature - Oven - S: 100.0°C - L: <= 0.0°C	Run Count: 1
February 1, 2021 1:01:19 PM	Audit	AccClosed	Session	None
February 2, 2021 9:04:47 AM	Audit	AccReloaded	Session	None
February 2, 2021 9:04:48 AM	Audit	SessionReloaded	Session	None
February 2, 2021 9:04:51 AM	Start	Qualification	Session	CO
February 2, 2021 9:05:09 AM	Start	Execution	Log Amp - 5977B GC - Source: None EI - Extractor	None
February 2, 2021 9:15:19 AM	End	Execution	Log Amp - 5977B GC - Source: None EI - Extractor	Run Count: 1
February 2, 2021 9:45:21 AM	Start	Execution	RPPA - 5977B GC - Source: EI None - Extractor	None

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User Name: saknath\_puangscope  
Host Name: ASRYGW7032  
System ID: RYG\_EN0136  
Print Date: February 2, 2021 11:38:27 AM

## ALS\_US101M068 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 2, 2021 9:33:29 AM	End	Execution	RPPA - 5977B GC - Source: EI - Extractor	Run Count: 1
February 2, 2021 9:33:30 AM	Start	Execution	Tune EI - 5977B GC - Source: None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
February 2, 2021 9:35:22 AM	End	Qualification	Session	CO
February 2, 2021 9:35:22 AM	Start	Reporting	Session	None
February 2, 2021 9:35:31 AM	End	Reporting	Session	None
February 2, 2021 9:35:31 AM	Start	Qualification	Session	CO
February 2, 2021 9:35:31 AM	Start	Execution	Tune EI - 5977B GC - Source: None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
February 2, 2021 9:43:55 AM	End	Execution	Tune EI - 5977B GC - Source: None EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count: 1
February 2, 2021 9:43:57 AM	Start	Execution	Tune EI - 5977B GC - Source: None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
February 2, 2021 9:54:15 AM	End	Qualification	Session	CO
February 2, 2021 9:54:15 AM	Start	Reporting	Session	None
February 2, 2021 10:04:03 AM	End	Reporting	Session	None

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Date: February 2, 2021 11:38:26 AM  
System ID: RYG\_EN0136

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Date: February 2, 2021 11:38:26 AM  
System ID: RYG\_EN0136

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User Name: eckmrtm\_pcamgpept  
 Hostname: ASRYGW7022  
 System ID: RYG\_EN0136  
 Print Date: February 2, 2021 11:30:27 AM

ALS\_US1701M008 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 2, 2021 10:04:03 AM	Start	Qualification	Session	QC
February 2, 2021 10:04:03 AM	Start	Execution	Tune EI - 5977B SQ - Source: - None EI - Extractor Flamm 2 (Qualitative - No setpoints associated)	
February 2, 2021 10:04:14 AM	End	Execution	Tune EI - 5977B SQ - Source: - Run Count 1 EI - Extractor Flamm 2 (Qualitative - No setpoints associated)	
February 2, 2021 10:04:14 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Flamm 1 - LHM 1200	None
February 2, 2021 10:10:00 AM	End	Qualification	Session	QC
February 2, 2021 10:10:00 AM	Start	Reporting	Session	None
February 2, 2021 10:27:59 AM	End	Reporting	Session	None
February 2, 2021 10:27:59 AM	Start	Qualification	Session	QC
February 2, 2021 10:27:59 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Flamm 1 - LHM 1200	None
February 2, 2021 10:43:04 AM	End	Qualification	Session	QC
February 2, 2021 10:43:04 AM	Start	Reporting	Session	None

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Date: February 2, 2021 11:38:25 AM  
 System ID: RYG\_EN0136

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## 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.Phuakdaeng, 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: *[Signature]*  
 APPROVED BY: *[Signature]*  
 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

Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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### 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

Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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### 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: -1 mV  
 RFPA Voltage: 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

Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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Tested Combination1 Front SSL / External SQ

Name: S977B

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

Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

System	
System ID	RYG_EN0136
Manufacturer	Agilent Technologies
Name	7690
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	7690
Model Number	G3442B
Serial Number	CN16483238
Firmware Revision	B.02.04.3
Component ID/Asset No.	061117000236
Oven Type	Standard

Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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Inlet 1	
Manufacturer	Agilent Technologies
Name	7690
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	S977B
Serial Number	US1701M009
Firmware Revision	S977 6.00.34
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
Component ID/Asset No.	061117000236
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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## Electronic Signature

### Purpose

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

### Details

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

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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User Name: ashwin_junganna		System ID: RYQ_EN0135	
Hostname: ASB19G07R02		Print Date: July 7, 2022 11:37:56 AM	
ALS_RYQ_EN0135 Transaction log :			
Time	Transaction State	Activity/ Performed	Optional Information
July 6, 2022 11:15:54 PM	Audit	Sensor/Creation	None
July 6, 2022 11:15:54 PM	Start	Configuration	None
July 6, 2022 11:15:54 PM	Audit	Enrollment	License
July 6, 2022 11:17:19 PM	Audit	Exp/Loaded	Session
<p>BCP details for primary technology [00] :</p> <p>File path: [Protect]Media\Gsc\Config\Inst\02_52\Gc_02_52.exp</p> <p>BCP File Name: [G:\G252.exp] BCP Format: [Agilent] (Not recommended)</p> <p>BCP details for implemented technology [00] [00] :</p> <p>File path: [Protect]Media\Gsc\Config\Inst\02_52\Gc_02_52.exp</p> <p>BCP File Name: [G:\Gc_02_52.exp] BCP Name: [Agilent] (Recommended)</p>			
July 5, 2022 11:37:25 PM	End	Configuration	Session
July 8, 2022 11:37:26 PM	Start	Qualification	Session
July 9, 2022 11:37:26 PM	Start	Execution	COS Logon Verification - GC : None - Qualitative test
July 9, 2022 11:39:43 PM	End	Execution	COS Logon Verification - GC : Run Count : 1 - Qualitative test
July 6, 2022 11:19:43 PM	Start	Extension	System Inspection and Basic Safety and Operation - 7850 - Qualitative Test - No separate assessment

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 1:19:59 PM	End	Execution	System Inspection and Basic Safety and Operation - 7850 - Qualitative Test - No separate assessment	Run Count: 1
July 6, 2022 1:20:16 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet -S: 25.0 °C - L: -4.2 psi	None
July 6, 2022 1:21:43 PM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet -S: 25.0 °C - L: -4.2 psi	Run Count: 1
July 6, 2022 1:21:45 PM	Start	Execution	GC Oven Temperature Accuracy - 7620 - Temperature - Over: -S: 320.0 °C - L: -1.0 AND -4.0 % signal in K	None
July 6, 2022 1:25:12 PM	Abort	Data	GC Oven Temperature Accuracy - 7620 - Temperature - Over: -S: 330.0 °C - L: -1.0 AND -4.0 % signal in K	Manual Data Entry
July 6, 2022 1:29:15 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Over: -S: 230.0 °C - L: -1.0 AND -1.0 % signal in K	Run Count: 1
July 6, 2022 1:29:17 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Over: -S: 160.0 °C - L: -1.0 AND -1.0 % signal in K	None
July 6, 2022 1:29:32 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Over: -S: 160.0 °C - L: -1.0 AND -1.0 % signal in K	None
July 6, 2022 1:33:42 PM	Abort	Data	GC Oven Temperature Accuracy - 7890 - Temperature - Over: -S: 160.0 °C - L: -1.0 AND -1.0 % signal in K	Manual Data Entry

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_END136

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User Name: colson\_juan@psa

Hostname: ASRYGV77602

System No: RYG\_106136

Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_106136 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 5, 2022 1:33:43 PM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven = 5.100.0°C - LI = -0.1 AND ± 0.3 % supplier >K	Run Count: 1
July 5, 2022 1:33:45 PM	Start	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven = 100.0°C - LI = 0.0	None
July 5, 2022 1:53:05 PM	Audit	Data	GC Oven Temperature Stability - 7800 - Temperature : Oven = 100.0°C - LI = 0.0	Manual Data Entry
July 5, 2022 1:53:07 PM	End	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven = 100.0°C - LI = 0.0	Run Count: 1
July 5, 2022 1:53:11 PM	Start	Execution	Log Amp - 5977B GC - Source: None	BI - Schneider
July 5, 2022 1:57:19 PM	End	Execution	Log Amp - 5977B GC - Source: None	Run Count: 1
July 5, 2022 1:57:24 PM	Start	Execution	RPTA - 5977B GC - Source: EI	None
July 5, 2022 1:58:24 PM	End	Execution	RPTA - 5977B GC - Source: EI	Run Count: 1
July 5, 2022 2:00:20 PM	Start	Execution	Tune BI - 5977B GC - Source: None	BI - Extractor
July 5, 2022 2:04:49 PM	End	Qualification	Execution	OQ
July 5, 2022 2:34:49 PM	Start	Reporting	Session	None
July 5, 2022 2:41:30 PM	End	Reporting	Session	None
July 5, 2022 2:41:36 PM	Start	Configuration	Session	None
July 5, 2022 2:42:40 PM	End	Configuration	Session	None

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_ENC136

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User Name: sakshiraj\_punege

System Id: RYO\_EN0136

Hostname: AS RYOW0902

Print Date: July 7, 2022 11:27:55 AM

ALS\_RYO\_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 2:41:10 PM	Start	Execution	<div>Tune ID - 59770 SC - Source - None</div> <div>SI - Extractor Flament 1</div> <div>(Qualitative - No subscripts associated)</div>	None
July 6, 2022 2:41:56 PM	End	Execution	<div>Tune ID - 59770 SC - Source - Run Count : 1</div> <div>SI - Extractor Flament 1</div> <div>(Qualitative - No subscripts associated)</div>	None
July 6, 2022 2:41:55 PM	Start	Execution	<div>Tune ID - 59775 SC - Source - None</div> <div>SI - Extractor Flament 2</div> <div>(Qualitative - No subscripts associated)</div>	None
July 6, 2022 2:42:48 PM	End	Qualification	Session	OQ
July 6, 2022 2:42:43 PM	Start	Reporting	Session	None
July 6, 2022 2:50:52 PM	End	Reporting	Session	None
July 6, 2022 2:50:33 PM	Start	Qualification	Session	OQ
July 6, 2022 2:50:12 PM	Start	Execution	<div>Tune ID - 59776 SC - Source - None</div> <div>SI - Extractor Flament 2</div> <div>(Qualitative - No subscripts associated)</div>	None
July 6, 2022 2:51:12 PM	End	Qualification	Session	OQ
July 6, 2022 2:51:19 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 2:55:26 PM	Start	Execution	<div>Tune ID - 59775 SC - Source - None</div> <div>SI - Extractor Flament 2</div> <div>(Qualitative - No subscripts associated)</div>	None

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_END138

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User Name: admin@\_pumpgroup  
 Hostname: ASRYGW7002  
 System ID: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:58 AM

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 2:50:40 PM	End	Execution	Turn Off - 99778 SQ - Source: EI - Extractor Filament 2 (Qualitative - No reports associated)	Run Count: 1
July 5, 2022 2:50:45 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	None
July 5, 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 3:28:04 PM	Start	Qualification	Session	OQ
July 6, 2022 3:28:04 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	None
July 6, 2022 4:05:40 PM	Audit	Accessed	Session	None
July 7, 2022 9:13:47 AM	Audit	Accessed	Session	None
July 7, 2022 9:13:49 AM	Audit	Session Released	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 9:28:06 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Data File Path: D:\Q222222\QFN_SN_F01.D

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Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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User Name: admin@\_pumpgroup  
 Hostname: ASRYGW7002  
 System ID: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:58 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 10:01:48 AM	Audit	Test Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Deviation flag for Run Count: 1
July 7, 2022 10:01:48 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	None
July 7, 2022 10:02:00 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Data File Path: D:\Q222222\QFN_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 10:07:33 AM	Audit	Test Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Deviation flag for Run Count: 2
July 7, 2022 10:07:33 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 File Path: D:\Q222222\QFN_SN_F01.D

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Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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User Name: admin@\_pumpgroup  
 Hostname: ASRYGW7002  
 System ID: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:58 AM

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:08:18 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 10:10:26 AM	Audit	Test Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Deviation flag for Run Count: 3
July 7, 2022 10:10:26 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	None
July 7, 2022 10:10:26 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Data File Path: D:\Q222222\QFN_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	Test Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Deviation flag 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 File Path: D:\Q222222\QFN_SN_F01.D

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Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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User Name: admin@\_pumpgroup  
 Hostname: ASRYGW7002  
 System ID: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:58 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	Test Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Deviation flag 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 10:17:55 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L = 1200	Data File Path: D:\Q222222\QFN_SN_F01.D
July 7, 2022 10:17:54 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 10:18:49 AM	End	Qualification	Session	OQ
July 7, 2022 10:18:49 AM	Start	Reporting	Session	None
July 7, 2022 10:21:10 AM	End	Reporting	Session	None
July 7, 2022 10:21:19 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 10:59:45 AM	End	Qualification	Session	OQ
July 7, 2022 10:59:45 AM	Start	Reporting	Session	None
July 7, 2022 10:57:38 AM	End	Reporting	Session	None

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Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

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User Name: calx@calx\_puomaps  
Host Name: ASRYGW7002

System ID: RYG\_EN0136  
Print Date: July 7, 2022 11:27:36 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	OO
July 7, 2022 10:57:39 AM	Start	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	None
July 7, 2022 11:09:50 AM	Audit	Data	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Data File Path : D:\Q02022\QFM_SN_F021.D
July 7, 2022 11:11:47 AM	Start	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	None
July 7, 2022 11:13:43 AM	End	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Run Count : 1
July 7, 2022 11:14:29 AM	Audit	Test/Unlocked	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Deviation filed for Run Count : 1
July 7, 2022 11:14:29 AM	Start	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	None
July 7, 2022 11:14:47 AM	Audit	Data	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Data File Path : D:\Q02022\QFM_SN_F021.D
July 7, 2022 11:16:34 AM	End	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Run Count : 2

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Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

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User Name: calx@calx\_puomaps  
Host Name: ASRYGW7002

System ID: RYG\_EN0136  
Print Date: July 7, 2022 11:27:36 AM

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 11:18:58 AM	Audit	Test/Unlocked	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Deviation filed for Run Count : 2
July 7, 2022 11:19:56 AM	Start	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	None
July 7, 2022 11:20:13 AM	Audit	Data	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Data File Path : D:\Q02022\QFM_SN_F021.D
July 7, 2022 11:21:07 AM	End	Execution	Signal to Noise E1 - Liquid Injection, Front SBL, SQ - Source: E1 - Extractor using Filament 2 - L1 => 1200	Run Count : 3
July 7, 2022 11:22:49 AM	End	Qualification	Session	OO
July 7, 2022 11:22:49 AM	Start	Reporting	Session	None
July 7, 2022 11:26:48 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 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	01 Jul 22	Y = 1.0202x + 0.1976	1.0000
BKK_FS0579	01 Jul 22	Y = 1.0078x + 0.4789	0.9998
BKK_FS0583	01 Jul 22	Y = 1.016x + 0.3922	1.0000
BKK_FS0584	01 Jul 22	Y = 1.0036x + 2.2262	0.9997
BKK_FS0585	01 Jul 22	Y = 1.0189x - 5.6476	0.9997
BKK_FS0586	01 Jul 22	Y = 1.0095x - 1.1524	0.9995
BKK_FS0587	01 Jul 22	Y = 1.013x - 3.6619	0.9996
BKK_FS0588	01 Jul 22	Y = 1.0154x + 4.8357	0.9999
BKK_FS0589	01 Jul 22	Y = 0.9918x + 4.8069	0.9999
BKK_FS0590	01 Jul 22	Y = 1.0038x - 0.4857	0.9996
BKK_FS0591	01 Jul 22	Y = 0.9705x - 52.174	0.9986
BKK_FS0592	01 Jul 22	Y = 0.9646x - 37.642	0.9985
BKK_FS0593	01 Jul 22	Y = 0.9767x - 58.445	0.9988
BKK_FS0594	01 Jul 22	Y = 0.9902x - 62.87	0.9999
BKK_FS0595	01 Jul 22	Y = 1.0249x - 98.162	0.9999
BKK_FS0596	01 Jul 22	Y = 0.9843x - 26.806	0.9991
BKK_FS0597	01 Jul 22	Y = 0.9802x - 61.653	0.9978
BKK_FS1004	01 Jul 22	Y = 0.9696x + 17.69	0.9990
BKK_FS1005	01 Jul 22	Y = 1.0092x + 2.4571	0.9999
BKK_FS1006	01 Jul 22	Y = 1.168x - 5.566	0.9997
BKK_FS1007	01 Jul 22	Y = 0.9917x + 1.6592	1.0000
BKK_FS1008	01 Jul 22	Y = 1.0132x + 0.7207	1.0000
BKK_FS1009	01 Jul 22	Y = 1.0132x + 1.1633	0.9990
BKK_FS1010	01 Jul 22	Y = 1.0033x + 0.5758	0.9999
BKK_FS1011	01 Jul 22	Y = 1.0234x + 0.1759	0.9996
BKK_FS1012	01 Jul 22	Y = 1.0106x - 2.0048	0.9997
BKK_FS1013	01 Jul 22	Y = 0.9677x - 35.851	0.9997
BKK_FS1014	01 Jul 22	Y = 1.0021x + 0.3148	0.9998
BKK_FS1015	01 Jul 22	Y = 0.9994x + 1.786	1.0000
BKK_FS1016	01 Jul 22	Y = 1.0105x - 80.256	0.9998
BKK_FS1017	01 Jul 22	Y = 0.9995x + 0.649	1.0000
BKK_FS1018	01 Jul 22	Y = 1.0011x + 1.1786	1.0000
BKK_FS1019	01 Jul 22	Y = 1.0023x - 68.424	0.9996
BKK_FS1020	01 Jul 22	Y = 1.0547x - 0.666	0.9998
BKK_FS1021	01 Jul 22	Y = 1.018x - 3.3286	0.9998
BKK_FS1022	01 Jul 22	Y = 0.9932x - 57.035	0.9986
BKK_FS1023	01 Jul 22	Y = 1.0094x + 0.0717	0.9999
BKK_FS1024	01 Jul 22	Y = 1.0042x + 0.4086	0.9997
BKK_FS1025	01 Jul 22	Y = 1.0132x - 88.507	0.9996



## ROTA METER CALIBRATION RESULT JULY 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1026	01 Jul 22	Y = 1.0018x + 1.0776	0.9997
BKK_FS1027	01 Jul 22	Y = 1.0053x + 0.231	0.9995
BKK_FS1028	01 Jul 22	Y = 0.9792x - 60.312	0.9982
BKK_FS1029	01 Jul 22	Y = 0.9835x + 0.8234	1.0000
BKK_FS1030	01 Jul 22	Y = 1.0039x + 0.515	0.9999
BKK_FS1031	01 Jul 22	Y = 1.009x - 79.295	0.9998
BKK_FS1039	01 Jul 22	Y = 0.9879x + 7.3524	0.9996
BKK_FS1040	01 Jul 22	Y = 0.9704x + 88.336	0.9987
BKK_FS1041	01 Jul 22	Y = 1.0645x - 1.7878	0.9999
BKK_FS1042	01 Jul 22	Y = 0.9983x + 3.6262	0.9998
BKK_FS1043	01 Jul 22	Y = 1.0069x - 6.9619	1.0000
BKK_FS1044	01 Jul 22	Y = 1.0355x - 0.6214	0.9997
BKK_FS1161	01 Jul 22	Y = 1.0126x + 0.7738	0.9999
BKK_FS1162	01 Jul 22	Y = 0.9994x + 2.6357	0.9995
BKK_FS1163	01 Jul 22	Y = 0.977x - 55.03	0.9987
BKK_FS1164	01 Jul 22	Y = 0.9914x + 0.8427	0.9997
BKK_FS1165	01 Jul 22	Y = 0.9893x + 6.5919	0.9998
BKK_FS1166	01 Jul 22	Y = 1.0031x - 77.881	0.9996
BKK_FS1200	01 Jul 22	Y = 1.0313x - 0.4602	0.9995
BKK_FS1201	01 Jul 22	Y = 1.0045x + 0.15	0.9996
BKK_FS1202	01 Jul 22	Y = 0.9702x - 44.156	0.9984
RYG_FS0197	01 Jul 22	Y = 1.0039x - 0.179	0.9999
RYG_FS0198	01 Jul 22	Y = 0.9971x + 16.648	0.9999
RYG_FS0199	01 Jul 22	Y = 1.0832x - 2.6367	1.0000

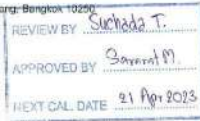
Review By:   
(Mr. Wichan Choonharat)  
Enviro Field Services Manager

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

## Certificate of System Qualification

GC-OQ

System ID: GC-6  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Phattanasri 40, Phattanasri Rd., Suan Luang, Bangkok 10250  
Date: October 21, 2021 10:05:40 AM  
EQP Name: Agilent Recommended  
EQP Revision: GC 02.50  
Overall Qualification Status: Pass



## System Inspection and Basic Safety and Operation

Name: 7890  
Setpoint Status: Pass

## Overall System Inspection and Basic Safety and Operation Test Status

Pass

## Inlet Pressure Decay

Name: 7890  
Front: SSL  
Setpoint Status: Pass  
Pressure: 25.0 psi  
Pressure Change: 0.0 psi / 5 minutes  
Agilent Recommended:  $\geq -2.0$  and  $\leq 0.5$

## Overall Inlet Pressure Decay Test Status

Pass

## Inlet Pressure Accuracy

Name: 7890  
Front: SSL

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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Setpoint Status: Pass  
Setpoint: 25.0 psi  
Actual: 24.9 psi  
Accuracy: 0.1 psi  
Agilent Recommended:  $\leq 1.2$

## 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:  $\geq -2.0$  and  $\leq 0.5$

## Overall Inlet Pressure Decay Test Status

Pass

## Inlet Pressure Accuracy

Name: 7890  
Back: SSL  
Setpoint Status: Pass  
Setpoint: 25.0 psi  
Actual: 24.9 psi  
Accuracy: 0.1 psi  
Agilent Recommended:  $\leq 1.2$

## Overall Inlet Pressure Accuracy Test Status

Pass

## Detector Flow Accuracy

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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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:  $\leq 10.0$  % 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: 394.0 mL/min  
Accuracy: 6.0 mL/min  
Agilent Recommended:  $\leq 10.0$  % 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: 24.2 mL/min  
Accuracy: 0.8 mL/min  
Agilent Recommended:  $\leq 10.0$  % 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

Date: October 21, 2021 10:05:40 AM  
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Setpoint Status: Pass  
Flow Type: Fuel  
Setpoint: 30.0 mL/min  
Measured Flow: 29.1 mL/min  
Accuracy: 0.9 mL/min  
Agilent Recommended:  $\leq 10.0$  % 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: 397.3 mL/min  
Accuracy: 2.7 mL/min  
Agilent Recommended:  $\leq 10.0$  % 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: 24.4 mL/min  
Accuracy: 0.6 mL/min  
Agilent Recommended:  $\leq 10.0$  % 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

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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## Setpoint Status:

Pass

Zone:

Oven

Temperature:

230.0 231.5 °C

Accuracy:

1.5 °C

Agilent Recommended:

&gt;= -1.0 % setpoint in K

(-5.0 °C)

&lt;= 1.0 % setpoint in K

(5.0 °C)

## Setpoint Status:

Pass

Zone:

Oven

Temperature:

100.0 100.5 °C

Accuracy:

0.5 °C

Agilent Recommended:

&gt;= -1.0 % setpoint in K

(-3.7 °C)

&lt;= 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:

100.0 100.4667 °C

Stability:

0.1 °C

Agilent Recommended:

&lt;= 0.5

## Overall GC Oven Temperature Stability Test Status

Pass

## Scouting Run

Tested Combination1

Front

SSL

/ Front

FID

Name:

7603A

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

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## 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:

12.7 pA

ASTM Noise

pA

0.06

&lt;= 0.10

Drift

pA/Hr

0.10

&lt;= 2.50

Agilent Recommended:

Status:

Pass

Pass

## Overall Noise and Drift Test Status

Pass

## Injection Precision

Tested Combination1

Front

SSL

/ Front

FID

Name:

7603A

## Setpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Area RSD:

0.42 %

Retention Time RSD:

0.16 %

Agilent Recommended:

&lt;= 3.00

&lt;= 1.00

## Overall Injection Precision Test Status

Pass

## Signal to Noise

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

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Tested Combination1

Front

SSL

/ Front

FID

Name:

7890

## Setpoint Status:

Pass

Signal to Noise:

1174861

Agilent Recommended:

&gt;= 300000

## Overall Signal to Noise Test Status

Pass

## Scouting Run

Tested Combination2

Back

SSL

/ Back

FID

Name:

7603A

## 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:

10.4 pA

ASTM Noise

pA

0.06

&lt;= 0.10

Drift

pA/Hr

0.00

&lt;= 2.50

Agilent Recommended:

Status:

Pass

Pass

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

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## Overall Noise and Drift Test Status

Pass

## Injection Precision

Tested Combination2

Back

SSL

/ Back

FID

Name:

7603A

## Setpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Area RSD:

1.16 %

Retention Time RSD:

0.12 %

Agilent Recommended:

&lt;= 3.00

&lt;= 1.00

## Overall Injection Precision Test Status

Pass

## Signal to Noise

Tested Combination2

Back

SSL

/ Back

FID

Name:

7890

## Setpoint Status:

Pass

Signal to Noise:

805466

Agilent Recommended:

&gt;= 300000

## Overall Signal to Noise Test Status

Pass

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

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## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### System

System ID	GC-6
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	CN15360030
Firmware Revision	A.11.D1
Vali Heater	Not installed

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System ID: GC-6

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#### 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	Front
Syringe Volume (µL)	10

#### Sampler 3

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16290128
Firmware Revision	A.10.08
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
Component ID/Asset No.	GC-6
Oven Type	Standard

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#### 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

Date: October 21, 2021 10:05:40 AM  
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## Electronic Signature

### Purpose

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

### Details

Full Name of Signer:	Suriya Thongkaew
Logged On User Name:	suriya.thongkaew@hnl.agilent.com
Signature Creation Date:	October 21, 2021
Reason for Signature:	Executed protocol and published this original version of document

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

GC GC ALS CN1148196 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 12:18:53 PM	Audit	Session Created	Session	None
October 20, 2021 12:18:53 PM	Start	Configuration	Session	None
October 20, 2021 12:18:53 PM	Audit	Entitlement	Licensing	User is not paying and does not register an unlock code
October 20, 2021 12:14:57 PM	Audit	EqLoaded	Session	EQP details for primary technique (Eq) : File path: [Protocol/Products/Configuration/ASBKKW7015/1148196/1148196.rpt] EQP File Name: [GC (2.0) eq], EQP Name: [Agilent Recommended]
October 20, 2021 12:25:02 PM	End	Configuration	Session	None
October 20, 2021 12:25:09 PM	Start	Configuration	Session	GC
October 20, 2021 12:25:09 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890C - Qualitative Test - No setpoints associated	None
October 20, 2021 12:30:25 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890C - Qualitative Test - No setpoints associated	Run Count : 1
October 20, 2021 12:36:29 PM	Start	Execution	Wet Pressure Decay - Front SS - Pressure Controlled Inlet - S: 25.0 psi-L: >= 2.0 psi and <= 0.0 psi	None

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

GC GC ALS CN1148196 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:02:18 PM	End	Execution	Wet Pressure Decay - Front SS - Pressure Controlled Inlet - S: 25.0 psi-L: >= 2.0 psi and <= 0.0 psi	Run Count : 1
October 20, 2021 1:02:18 PM	Start	Execution	Wet Pressure Accuracy - Front SS - Pressure Controlled Inlet - S: 25.0 psi-L: <= 1.2 psi	None
October 20, 2021 1:02:26 PM	End	Execution	Wet Pressure Accuracy - Front SS - Pressure Controlled Inlet - S: 25.0 psi-L: <= 1.2 psi	Run Count : 1
October 20, 2021 1:02:28 PM	Start	Execution	Wet Pressure Decay - Back SS - Pressure Controlled Inlet - S: 25.0 psi-L: >= 2.0 psi and <= 0.0 psi	None
October 20, 2021 1:04:21 PM	End	Execution	Wet Pressure Decay - Back SS - Pressure Controlled Inlet - S: 25.0 psi-L: >= 2.0 psi and <= 0.0 psi	Run Count : 1
October 20, 2021 1:07:53 PM	Start	Execution	Wet Pressure Accuracy - Back SS - Pressure Controlled Inlet - S: 25.0 psi-L: <= 1.2 psi	None
October 20, 2021 1:08:11 PM	End	Execution	Wet Pressure Accuracy - Back SS - Pressure Controlled Inlet - S: 25.0 psi-L: <= 1.2 psi	Run Count : 1
October 20, 2021 1:08:16 PM	Start	Execution	Detector Flow Accuracy - Front PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:22:23 PM	Audit	Data	Detector Flow Accuracy - Front PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:22:26 PM	End	Execution	Detector Flow Accuracy - Front PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

GC GC ALS CN1148196 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:29:29 PM	Start	Execution	Detector Flow Accuracy - Front PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:29:27 PM	Audit	Data	Detector Flow Accuracy - Front PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:29:29 PM	End	Execution	Detector Flow Accuracy - Front PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:29:31 PM	Start	Execution	Detector Flow Accuracy - Front PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:27:40 PM	Audit	Data	Detector Flow Accuracy - Front PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:27:42 PM	End	Execution	Detector Flow Accuracy - Front PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:27:45 PM	Start	Execution	Detector Flow Accuracy - Back PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:32:10 PM	Audit	Data	Detector Flow Accuracy - Back PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:32:12 PM	End	Execution	Detector Flow Accuracy - Back PID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:32:14 PM	Start	Execution	Detector Flow Accuracy - Back PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:34:13 PM	Audit	Data	Detector Flow Accuracy - Back PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

GC GC ALS CN1148196 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:34:16 PM	End	Execution	Detector Flow Accuracy - Back PID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:34:46 PM	Start	Execution	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:36:30 PM	Audit	Data	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:36:36 PM	End	Execution	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:36:58 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 220.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	None
October 20, 2021 2:04:31 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 220.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 20, 2021 2:04:32 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 220.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Run Count : 1
October 20, 2021 2:04:34 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	None
October 20, 2021 2:10:47 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suraj.thangkane  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:35:46 AM

## GC GC ALS CN1461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 2:10:40 PM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature Over - S: 100.0°C - L: -4.0 AND -4.0 % setpoint in K	Run Count: 1
October 20, 2021 2:10:31 PM	Start	Execution	GC Oven Temperature Stability - 7800 - Temperature Over - S: 100.0°C - L: -4.0	None
October 20, 2021 2:31:39 PM	Audit	Data	GC Oven Temperature Stability - 7800 - Temperature Over - S: 100.0°C - L: -4.0	Manual Data Entry
October 20, 2021 2:31:41 PM	End	Execution	GC Oven Temperature Stability - 7800 - Temperature Over - S: 100.0°C - L: -4.0	Run Count: 1
October 20, 2021 2:31:44 PM	Start	Execution	GC Scouting Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	None
October 20, 2021 2:43:06 PM	Audit	AsstClosed	Session	None
October 21, 2021 9:16:58 AM	Audit	AsstClosed	Session	None
October 21, 2021 9:19:02 AM	Audit	SessionReloaded	Session	None
October 21, 2021 9:19:08 AM	Start	Qualification	Session	QC
October 21, 2021 9:19:09 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:19:41 AM	Audit	AsstClosed	Session	None

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suraj.thangkane  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC GC ALS CN1461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:20:08 AM	Audit	AsstClosed	Session	None
October 21, 2021 9:20:03 AM	Audit	SessionReloaded	Session	None
October 21, 2021 9:20:13 AM	Start	Qualification	Session	QC
October 21, 2021 9:20:13 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:20:45 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-45-45\SCOUT_F001.D\FID1A.ch
October 21, 2021 9:30:05 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Run Count: 1
October 21, 2021 9:30:08 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 6.10 pA - L (Drift) <= 2.80 pAhour	None
October 21, 2021 9:30:41 AM	Audit	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 6.10 pA - L (Drift) <= 2.80 pAhour	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-45-45\SCOUT_F001.D\FID1A.ch
October 21, 2021 9:31:10 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 6.10 pA - L (Drift) <= 2.80 pAhour	Run Count: 1

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suraj.thangkane  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC GC ALS CN1461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:31:42 AM	Start	Execution	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
October 21, 2021 9:32:36 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F002.D\FID1A.ch
October 21, 2021 9:32:50 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F003.D\FID1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F004.D\FID1A.ch
October 21, 2021 9:32:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F005.D\FID1A.ch
October 21, 2021 9:32:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F006.D\FID1A.ch
October 21, 2021 9:32:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F007.D\FID1A.ch
October 21, 2021 9:32:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F008.D\FID1A.ch
October 21, 2021 9:32:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\INPREC_F009.D\FID1A.ch

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suraj.thangkane  
Host Name: ASBKKW7015  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC GC ALS CN1461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:33:07 AM	End	Execution	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:33:23 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSI, Front FID - Detector FID - L >= 30000	None
October 21, 2021 9:34:01 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSI, Front FID - Detector FID - L >= 30000	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 15-51-16\SIGTOI_F001.D\FID1A.ch
October 21, 2021 9:34:13 AM	End	Execution	Signal to Noise - Injection Tower, Front SSI, Front FID - Detector FID - L >= 30000	Run Count: 1
October 21, 2021 9:34:19 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:35:04 AM	Audit	Data	GC Scouting Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	Data File Path: C:\Chem32\DATA\AQGPV20 21\AQGPV2021_F 2021-10-20 17-15-45\SCOUT_B001.D\FID2A.ch
October 21, 2021 9:35:27 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	Run Count: 1
October 21, 2021 9:35:30 AM	Start	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 3.10 pA - L (Drift) <= 2.80 pAhour	None

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: surys.thongkiew  
Hostname: AS860W7015  
Print Date: October 21, 2021 13:05:48 AM  
System ID: GC-4

GC GC ALS CH1481866 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:09 AM	Auto	Data	Nose and DRI - Back FID - Detector FID - L (Nose) -> 0.10 pA - L (DRI) -> 2.50 pA (Nose)	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:18 AM	End	Execution	Nose and DRI - Back FID - Detector FID - L (Nose) -> 0.10 pA - L (DRI) -> 2.50 pA (Nose)	Run Count: 1
October 21, 2021 9:36:20 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	None
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:58 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: surys.thongkiew  
Hostname: AS860W7015  
Print Date: October 21, 2021 13:05:48 AM  
System ID: GC-4

GC GC ALS CH1481866 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:56 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) -> 3.00% - L (Ret. Time) -> 1.00%	Run Count: 1
October 21, 2021 9:36:11 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L -> 360000	None
October 21, 2021 9:36:28 AM	Auto	Data	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L -> 360000	Data File Path: C:\Chem32\DATA\AQSPV20\210QPV2021_B 2021-10-20\17-13-45\ALSPREC_B005.D\FID20.ch
October 21, 2021 9:36:39 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L -> 360000	Run Count: 1
October 21, 2021 9:36:43 AM	End	Qualification	Section	GC
October 21, 2021 9:36:43 AM	Start	Recording	Section	None
October 21, 2021 10:04:15 AM	Auto	Recording	Section	Report Generated Certificate

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,  
Walthapra, Bangkokyai, Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com

## CERTIFICATE OF CALIBRATION

Certificate No: WS-13072021  
Page 1 of 2 pages

Measurement Item: C.G.P. anemometer with data logger.

Manufacturer: Data logger: Novolyns  
C.G.P. anemometer: Novolyns

Model/Type: Data logger: WS-205LE  
C.G.P. anemometer: WS-02P

Serial Number: Data logger: AS375  
C.G.P. anemometer: -

IC No: Data logger: H90\_F90413  
C.G.P. anemometer: -

Customer: JLB Laboratory group (Thailand) Co., Ltd.  
104 Walthapra, 40, Petchkasem Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260 Thailand

Test Conditions: Wind tunnel cross test section area: 900 m<sup>2</sup>  
Asymmetric: Fan test area: 100 m<sup>2</sup>  
Diameter of mounting stud: 115 mm  
Roofing ratio of test object: 0.11 [1]

Test Conditions: Air temperature: 24.8 ±0.3 °C  
Air pressure: 1007.4 ±0.4 hPa  
Relative air humidity: 82.4 ±3.0 %RH

Calibration Procedure: Calibration was carried out base on:  
ISO 91400-12-1 SGL: 2005-Flow Performance Measurements of Electricity Producing Wind Turbines  
MBSNET Anemometer Calibration Procedure - Version 2: 2009

Traceability: The calibration documents the traceability to national standard, which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology (Thailand) (NIM).

Measurement Date issued Date: 1 Jul 2021  
1 Jul 2021

Calibrated by:  
☒ Mr. Somwit Thongkiew  
☐ Miss Oranai Whangwila



Approved Signature:   
Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,  
Walthapra, Bangkokyai, Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com

Continuation of Certificate of Calibration Number

Certificate No: WS-13072021  
Page 2 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment  
Calibration is in the range of 1 - 10 m/s at a calibration interval of 1 m/s

The results of calibration and associated measurement uncertainties are recorded in the table below:

V <sub>ref</sub> Reading m/s	V <sub>ref</sub> Reading m/s	Error [m/s]	Uncertainty [m/s]
2.067	2.05	<0.1	2.4
4.138	4.1	0.0	1.2
6.23	6.1	0.1	0.97
7.99	8.0	0.0	0.84
10.30	10.1	0.1	0.90
12.30	12.2	0.2	0.79
15.99	16.0	0.0	0.47
15.98	16.0	0.0	0.25
15.70	15.8	0.0	0.28
15.99	16.1	0.1	0.48
11.01	11.1	0.1	0.67
9.01	9.0	0.0	0.67
5.99	6.0	0.1	0.61
0.177	0.1	<0.1	0.97
29.72	30.0	0.3	1.5
1.044	0.9	<0.1	0.3

ISO 91400-12-1

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

Appendix 3: Instruments

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Number	Range
1	Wind static	TESTO AG	36352145	July 16, 2020	WS-083520	5 - 20 m/s
2	Pressure Differential Pressure Vane	Agilent	C742500	July 16, 2020	WS-083520	0 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8440-2	July 20, 2020	WS-083554-20	0 - 5 m/s
4	Temperature	Agilent	1051-B-P	March 30, 2021	DL-027-44	-30 - 70 °C
5	Relative humidity	Agilent	0511-B-P	March 30, 2021	PH-0262021	0 - 100 %RH
6	Atmospheric pressure	Agilent	0511-B-P	March 30, 2021	PH-0182021	250 - 1100 hPa
7	Wind tunnel	OSGIV	UP3100	-	-	0 - 50 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No: WC-13072021  
Page 1 of 2 pages

**Measurement Item** : Wind direction sensor with data logger  
**Manufacturer** : Data logger: Novolyne,  
Wind direction sensor: Novolyne.  
**Model/Type** : Data logger: 200-WS-25-B,  
Wind direction sensor: WS-02P.  
**Serial Number** : Data logger: A5375,  
Wind direction sensor :  
**ID No** : Data logger: FYQ\_P80413,  
Wind direction sensor :  
**Customer** : A.S.laboratory group (Thailand) Co.,Ltd.  
104 Phatthanasak 40, Phatthanasak Rd,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260  
Thailand.

**Environmental Conditions**  
The measurement was carried out in an ambient temperature of (23±2)°C, and relative humidity of (40±10)%.  
**Measurement Method**  
The wind direction sensor calibration according to comparison method with reference angle measurement, electronic theodolite and the laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

**Note**: The UUC was warmed up for 1 hour prior to the calibration being performed.  
**Traceability**  
The measurement results are traceable to the international system of units (SI) through Certificate No: G5663-07-UUC45, Certificate No: KW663/00-4.  
**Measurement Date** : Jul 29, 2021.  
**Issue Date** : Jul 29, 2021.

**Performed by**  
☒ Mr. Sorasit Thachad  
☐ Miss Orathai Wongsilay  
**Approved Signatory**  
Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager



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

Continuation of Certificate of Calibration Number

Certificate No: WD-13072021  
Page 2 of 2 pages

**Result of calibration**: ☐ without adjustment ☒ with adjustment.  
Calibration in the range of 0 – 360 ° at a calibration interval of 45°.  
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	181	1	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	181	1	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WS-01108021  
Page 1 of 2 pages

**Measurement Item** : Cup anemometer with data logger  
**Manufacturer** : Data logger: Novolyne,  
Cup anemometer: Novolyne.  
**Model/Type** : Data logger: 200-WS-04DL,  
Cup anemometer: WS-02P.  
**Serial Number** : Data logger: A1985,  
Cup anemometer :  
**ID No** : Data logger: FYQ\_P80395,  
Cup anemometer :  
**Customer** : A.S.laboratory group (Thailand) co., Ltd.  
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260  
Thailand.

**Test Conditions**  
Wind speed, cross test section: min 900 m/s  
Anemometer frontal area 100 cm²  
Diameter of mounting pipe 4 mm  
Backsight ratio of test object 0.111 :1  
**Test Conditions**  
Air temperature 24.0 ±0.5 °C  
Air pressure 1005.1 ±0.4 hPa  
Relative air humidity 55.1 ±3.5 %RH

**Calibration Procedure**  
Calibration was carried out base on ISO 61420-12-1 Ed.1: 2005 Power Performance Measurements of Electricity Producing Wind Turbines, MBSNET Anemometer Calibration Procedure - Version 2, 2005.

**Traceability**  
This calibration documents the traceability to national standard, which realize the unit of measurement according to the international system of units (SI) through National Institute of Metrology (NIMT).

**Measurement Date** : Oct 05, 2021.  
**Issue Date** : Oct 11, 2021.

**Calibrated by**  
☒ Mr. Sorasit Thachad  
☐ Miss Orathai Wongsilay  
**Approved Signatory**  
Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager



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

Continuation of Certificate of Calibration Number

Certificate No: WS-01108021  
Page 2 of 2 Pages

**Result of calibration**: ☒ without adjustment ☐ with adjustment.  
Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.  
The results of calibration and associated measurement uncertainties are reported in the table below:

V <sub>ref</sub> Reading m/s	V <sub>UUC</sub> Reading m/s	Error (m/s)	Uncertainty (m/s)
2.048	1.6	-0.1	2.7
4.103	4.0	-0.1	1.3
6.21	6.0	0.3	1.1
8.21	8.0	0.3	0.9
9.99	10.0	0.3	1.0
11.06	12.1	9.1	0.6
13.98	14.1	3.1	0.8
16.02	16.2	3.2	0.40
18.03	18.2	0.2	0.78
19.99	18.1	-1.9	0.61
11.06	11.0	0.0	1.1
9.00	9.0	0.0	0.78
7.02	7.0	0.0	0.84
5.147	5.0	-0.1	0.98
2.974	2.9	-0.1	1.7
1.013	0.9	-0.1	4.5

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

### Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Wind speed	TESTO AG	03505140	Aug 07, 2021	MR-0354-01	0 – 25 m/s
2	Pressure Differential Pressure Meter	Zorgas	DPV25C3	Aug 07, 2021	MR-0354-01	0 – 25 m/s
3	Air velocity standard (cup wind)	ISI INC	9400-1E	Aug 08, 2021	MR-0350-01	0 – 8 m/s
4	Temperature	Zorgas	036-100	March 22, 2021	CL-007-04	-30 – 70 °C
5	Relative humidity	Zorgas	03P-100P	March 22, 2021	GR-030203-01	0 – 100 %RH
6	Anemometer pressure	Zorgas	03P-111	March 22, 2021	GR-030203-01	000 – 100 mPa
7	Wind tunnel	285CM	UP3300			0 – 30 m/s

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





## CERTIFICATE OF CALIBRATION

Certificate No: WD-01102021  
Page 1 of 2 pages

**Measurement Item** : Wind direction sensor with data logger  
**Manufacturer** : Data logger: Novolyse  
Wind direction sensor: Novolyse  
**Model/Type** : Data logger: W0-W8-202L  
Wind direction sensor: W0-W8-202L  
**Serial Number** : Data logger: K4988  
Wind direction sensor: -  
**ID No** : Data logger: RYS\_F60086  
Wind direction sensor: -  
**Customer** : A/R laboratory group (Thailand) Co., Ltd.  
104 Phatthanasiri 40, Phatthanasiri Rd, Khwaeng Suan Luang, Phat Suan Luang, Bangkok 10250 Thailand.  
**Environmental Conditions**  
The measurement was carried out in an ambient temperature of (23±3) °C and relative humidity of (45±10) %.  
**Measurement Method**  
The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and the laser is used for site control. The measurement were taken at 45° intervals in clockwise and counter-clockwise directions.  
**Note**: The UUC was carried up for 1 hour prior to the calibration being performed.  
**Traceability**  
The measurement results are traceable to the International system of units (SI) through Certificate No: CC553-07-0045, Certificate No: KWS-64/C025.  
**Measurement Date** : Oct 08, 2021  
**Issued Date** : Oct 11, 2021.



Mr. Parinya Booncharoon  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-01102021  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.  
Calibration is in the range of 0 - 360 ° at a calibration interval of 45°.  
The results of calibration and associated measurement uncertainties are reported in table below.

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

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

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



Mr. Parinya Booncharoon  
Technical Support  
and Calibration Manager

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## CERTIFICATE OF CALIBRATION

Certificate No: WS-05012022  
Page 1 of 2 pages

**Measurement Item** : Cup anemometer with data logger  
**Manufacturer** : Data logger: Novolyse  
Cup anemometer: Novolyse  
**Model/Type** : Data logger: W0-W8-202L  
Cup anemometer: W0-W8-202L  
**Serial Number** : Data logger: A5190  
Cup anemometer: -  
**ID No** : Data logger: RYS\_F60320  
Cup anemometer: -  
**Customer** : A/R laboratory group (Thailand) Co., Ltd.  
104 Phatthanasiri 40, Phatthanasiri Rd, Khwaeng Suan Luang, Phat Suan Luang, Bangkok 10250 Thailand.  
**Test Conditions**  
Wind tunnel, cross test section size: 900 cm<sup>2</sup>  
Anemometer frame, size: 100 cm<sup>2</sup>  
Diameter of mounting pipe: 11 mm  
Blockage ratio of test object: 0.11  
**Test Conditions**  
Air temperature: 23.5 ±0.5 °C  
Air pressure: 1014.5 ±0.4 hPa  
Relative air humidity: 55.4 ±0.5 %RH  
**Calibration Procedure**  
Calibration was carried out here on:  
ISO 91423-12-1 60.1 2015-Flow Performance Measurements of Velocity-Producing Wind Tunnels  
ISO/IEC 17025:2017 Calibration Procedure - Version 2 (2019)  
**Traceability**  
This calibration documents the traceable to national standard, which realize the unit of measurement according to the International system of units (SI) through National Institute of Metrology (NIM) and (NIM).  
**Measurement Date** : JAN 28, 2022  
**Issued Date** : JAN 31, 2022.



Mr. Parinya Booncharoon  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-05012022  
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.  
Calibration is in the range of 0 - 15 m/s at a calibration interval of 1 m/s.  
The results of calibration and associated measurement uncertainties are reported in the table below.

Yes Reading m/s	Yes Reading m/s	Error m/s	Uncertainty (k)
2.075	2.3	-0.1	2.4
4.101	4.1	0.0	1.2
5.99	6.0	0.0	0.95
8.71	8.9	0.0	0.83
10.01	10.1	0.1	0.79
12.21	12.1	-0.1	0.87
13.29	13.1	-0.1	0.70
15.09	15.4	0.4	0.43
16.08	16.2	0.2	0.76
18.01	18.0	0.0	0.63
19.02	19.0	0.0	0.76
20.03	20.0	0.0	0.81
22.02	22.0	0.0	0.82
24.03	24.1	0.1	0.65
25.94	25.9	0.0	1.6
1.038	2.0	0.1	4.5

UUC\*: Unit Under Calibration

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

Appendix 1: Instruments

NO	Serial	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Plat static	TECOT INC.	00302140	Aug 07, 2021	MW-C034-01	0 - 30 m/s
2	Pressure Differential Pressure Meter	Zepco	DPV5000	Aug 07, 2021	MW-C034-01	0 - 30 m/s
3	Air velocity transducer (cal wind)	TS INC.	8455-12	Aug 06, 2021	MW-C035-01	0 - 5 m/s
4	Temperature	2048	1881 TH	March 30, 2021	CL-027-04	-20 - 70°C
5	Relative humidity	2048	2071 TH	March 30, 2021	PH-0333021	0 - 100 %RH
6	Analogic pressure	Zepco	001107	March 30, 2021	EP-0333021	500 - 1100 m/s
7	Wind tunnel	CSG20	W3300	-	-	0 - 50 m/s

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



Mr. Parinya Booncharoon  
Calibration Department Manager

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## CERTIFICATE OF CALIBRATION

Certificate No. WP-06012022  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger: Novallna,  
Wind direction sensor: Novallna.

Model/Type : Data logger: 200-W9-20LB  
Wind direction sensor: WS-02P

Serial Number : Data logger: AS192  
Wind direction sensor: -

ID No : Data logger: RYU\_F80320  
Wind direction sensor: -

Customer : AIS Laboratory group (Thailand) Co.,Ltd.  
104 Phothanawan 40, Phothanawan Rd./Kwong Siam Luang, Khut Siam Luang, Bangkok 10250  
(Thailand)

### Environmental Condition

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

### Measurement Method:

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

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

### Traceability:

The measurement results are traceable to the International system of units (SI) through Certificate No. Q21030514, Certificate for: W554/0325.

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

### Performed by

☒ Mr. Soravit Thachetel  
☐ Miss Chaiwit Whattavajay



Approved Signature

Mr. Parinya Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No. WD-05012022  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty (°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	43	-2	3.0
3		90	90	90	0	3.0
4		135	135	135	0	3.0
5		180	180	181	1	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	43	-2	3.0
11		90	90	90	0	3.0
12		135	135	135	0	3.0
13		180	180	181	1	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No. W5-01072021  
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger

Manufacturer : Data logger: Novallna,  
Cup anemometer: Novallna.

Model/Type : Data logger: 110-W9-16K  
Cup anemometer: WS-02P

Serial Number : Data logger: 1159,  
Cup anemometer: -

ID No : Data logger: RYU\_F80081,  
Cup anemometer: -

Customer : AIS Laboratory group (Thailand) co., Ltd.  
104 Phothanawan 40, Phothanawan Rd./Kwong Siam Luang, Khut Siam Luang, Bangkok 10250  
(Thailand)

Test Conditions : Wind tunnel cross test section area : 900 cm<sup>2</sup>  
Anemometer frontal area : 100 cm<sup>2</sup>  
Diameter of mounting pipe : 100 mm  
Blockage ratio of test setup : 0.111 %

Test Conditions : Air temperature : 23.9 ±0.8 °C  
Air pressure : 1013.8 ±0.4 hPa  
Relative air humidity : 62.8 ±0.5 %RH

Calibration Procedure : Calibration was carried out using:  
ISO 61400-12-1 (2014): 2035-Power Performance Measurements of Electricity Producing Wind Turbines  
JIRANATE Anemometer Calibration Procedure – Version 2 (2020)

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

Measurement Date : JUL 05, 2021  
Issued Date : JUL 08, 2021.

Calibrated by  
☒ Mr. Soravit Thachetel  
☐ Miss Chaiwit Whattavajay



Approved Signature

Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No. W5-01072021  
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.

Calibration is in the range of 2 – 16 m/s at a calibration interval of 1 m/s.

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

V <sub>uc</sub> Reading m/s	V <sub>ac</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.071	1.8	-0.3	3.7
4.089	3.8	-0.3	7.1
6.01	5.9	-0.1	1.33
8.01	7.8	-0.2	2.74
10.03	10.0	0.0	0.60
12.05	12.0	0.0	0.48
14.05	14.2	0.1	0.58
16.04	16.3	0.3	0.53
14.99	15.2	0.2	0.59
12.99	13.1	0.1	0.46
10.96	11.0	0.0	0.49
9.03	8.9	-0.1	0.55
7.01	6.9	-0.1	0.68
5.168	4.9	-0.3	1.00
3.011	2.7	-0.3	1.9

UUC\*: Unit Under Calibration

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

### Appendix 1: calibrations

NO.	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flux gate	KOITO AC	GS352145	July 14, 2020	MW-0334-20	5 – 30 m/s
2	Pressure differential pressure meter	Zorga	DM9500	July 14, 2020	MW-0334-20	5 – 30 m/s
3	Air velocity (anemometer) (cup type)	TSI INC.	8455-12	July 26, 2020	MW-0334-20	0 – 5 m/s
4	Temperature	Zorga	DSPT-1P	March 30, 2021	CL-057-54	-30 – 70°C
5	Relative humidity	Zorga	DSPT-1P	March 30, 2021	HE-0333-2021	0 – 100 %RH
6	Atmospheric pressure	Zorga	DSPT-1P	March 30, 2021	HP-01-0333-2021	900 – 1013 mPa
7	Wind turbine	DECOM	MP3300	-	-	0 – 85 1/2

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



## CERTIFICATE OF CALIBRATION

Certificate No: WJ-Q1072021  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger: Novakyne  
Wind direction sensor: Novakyne

Model/Type : Data logger: 110-W3-16N  
Wind direction sensor: W3-02S

Serial Number : Data logger: 1159  
Wind direction sensor: -

ID No : Data logger: RWQ180081  
Data logger: -

Customer : A.S laboratory group (Thailand) Co.,Ltd.  
124 Phathanakan 40, Phathanakan Rd,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250  
Thailand.

### Environmental Condition

The measurement was carried out in an ambient temperature of (23±3)°C, and relative humidity of (60±10)%.

### Measurement Method

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

Note: The U.C was warmed up for 1 hour prior to the calibration being performed

### Traceability

The measurement results are traceable to the International system of units (SI) through Certificate No: D0553-07-0045.  
Certificate No: RW563/0044.

Measurement Date : Jul 05, 2021.  
Issue Date : Jul 05, 2021.

Performed by :  
☒ Mr. Serevit Thacholad  
☐ Miss Onitai Wathavithaya



Approved Signatory:   
Mr. Parinya Boonchroch,  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WJ-Q1072021  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	359	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	133	-3	3.0
5		180	180	179	-1	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	317	2	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	176	-4	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	317	2	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WJ-Q1072021  
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger

Manufacturer : Data logger: Novakyne  
Cup anemometer: Novakyne

Model/Type : Data logger: 203-W3-260L  
Cup anemometer: W3-03F

Serial Number : Data logger: A4956  
Cup anemometer: -

ID No : Data logger: RW P50087  
Cup anemometer: -

Customer : A.S laboratory group (Thailand) co., Ltd.  
104 Phathanakan 43, Phathanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 13250  
Thailand.

Test Conditions : Wind tunnel: power test sector area : 900 m<sup>2</sup>  
Anemometer frontal area : 100 m<sup>2</sup>  
Diameter of mounting plate : - mm  
Blockage ratio of test object : 0.111 %

Test Conditions : Air temperature : 24.0 ±0.5 °C  
Air pressure : 1013.5 ±0.4 hPa  
Relative air humidity : 50.9 ±3.5 %RH

Calibration Procedure : Calibration was carried out based on  
ISO 91:40G-12-1 (D.1): 2005:Power Performance Measurements of Capacity Producing Wind  
Tunnels  
MEASNET Anemometer Calibration Procedure - Version B, 2006

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

Measurement Date : Jul 13, 2021.  
Issue Date : Jul 14, 2021.

Calibrated by :  
☒ Mr. Serevit Thacholad  
☐ Miss Onitai Wathavithaya



Approved Signatory:   
Mr. Parinya Boonchroch  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WJ-Q1072021  
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration is in the range of 1 ~ 15 m/s at a calibration interval of 1 m/s.

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

V <sub>ref</sub> Reading m/s	V <sub>test</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.082	2.0	0.1	5.4
4.150	4.1	-0.1	1.9
6.09	6.0	0.0	1.1
8.61	8.6	0.0	0.73
10.09	10.0	0.0	0.58
11.96	12.0	0.0	0.69
13.67	14.0	0.3	0.65
16.09	16.0	0.6	0.48
18.96	19.0	0.5	0.37
23.03	23.4	0.4	0.65
26.97	27.0	0.0	0.69
30.0	30.1	0.1	0.65
33.07	33.0	0.0	0.81
36.16	36.0	0.2	0.88
39.18	39.0	0.0	1.5
42.3	42.0	-0.1	4.7

UUC\*: Unit Under Calibration

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

### Appendix 1: Instrumentation

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flat plate	NOVAK INC.	66389-142	July 14, 2021	WJ-0025-20	5 ~ 30 mm
2	Pressure Differential Pressure Meter	Zepeda	3PM200C	July 14, 2021	WJ-0035-20	5 ~ 30 mm
3	Air velocity transducer (flat wall)	TSI INC.	8450-12	July 20, 2021	WJ-0035-20	0 ~ 5 m/s
4	Temperature	Zepeda	DS18B10	March 30, 2021	CL-027-21	-30 ~ 70°C
5	Relative humidity	Zepeda	DS18B10	March 30, 2021	PH-0035-2021	0 ~ 100 %RH
6	Atmospheric pressure	Zepeda	DS18B10	March 30, 2021	8450-12-0021	800 ~ 1100 hPa
7	Wind tunnel	66389-142	N/3330	-	-	0 ~ 50 m/s

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





## CERTIFICATE OF CALIBRATION

Certificate No: WD-03072021  
Page 1 of 2 pages

**Measurement Item:** Wind direction sensor with data logger.  
**Manufacturer:** Data logger: Novolytic.  
Wind direction sensor: Novolytic.  
**Model/Type:** Data logger: 200-WS-25DL.  
Wind direction sensor: WS-02P.  
**Serial Number:** Data logger: A4982.  
Wind direction sensor: ~.  
**ID No:** Data logger: RYD-FS008Z.  
Wind direction sensor: ~.  
**Customer:** ALB laboratory group (Thailand) Co.,Ltd.  
104 Phatthanasri 40, Phatthanasri Rd,Khaoeng Sam Luang, Khut Sam Luang, Bangkok 10250 Thailand.

### Environmental Condition:

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

### Measurement Method:

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

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

### Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: DC553-07-0045, Certificate No: RW553/0044.

**Measurement Date:** Jul. 14, 2021.  
**Issued Date:** Jul. 14, 2021.



Approved Signatory:

*[Signature]*  
Mr. Petcha Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-03072021  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle °	Standard Reading °	UUC* Reading °	Error °	Uncertainty ±°
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	178	-2	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	178	-2	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-12072021  
Page 1 of 2 pages

**Measurement Item:** Cup anemometer with data logger.  
**Manufacturer:** Data logger: Novolytic.  
Cup anemometer: Novolytic.  
**Model/Type:** Data logger: 200-WS-25DL.  
Cup anemometer: WS-02P.  
**Serial Number:** Data logger: A5074.  
Cup anemometer: ~.  
**ID No:** Data logger: RYD-FS041Z.  
Cup anemometer: ~.

**Customer:** ALB laboratory group (Thailand) Co., Ltd.  
104 Phatthanasri 40, Phatthanasri Rd,Khaoeng Sam Luang, Khut Sam Luang, Bangkok 10250 Thailand.

**Test Conditions:**  
Wind tunnel, cross wind section area: 900 cm<sup>2</sup>  
Anemometer frontal area: 100 cm<sup>2</sup>  
Diameter of mounting pipe: ~ mm  
Blockage ratio of test object: 3.11% [1]

**Test Conditions:**  
Air temperature: 23.9 ±0.5 °C  
Air pressure: 1007.7 ±0.4 hPa  
Relative air humidity: 57.7 ±3.5 %RH

**Calibration Procedure:** Calibration was carried out based on:  
ISO 61400-12:2011 6.3.3.3 Power Performance Measurements of Electricity Producing Wind Turbines  
MBSA001 Anemometer Calibration Procedure - Version 2, 2009.

**Traceability:** This calibration documents the traceability to national standards, which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology (NIMT).

**Measurement Date:** Jul. 29, 2021.  
**Issued Date:** Jul. 29, 2021.

**Calibrated by:**  
☒ Mr. Sorawit Thachak  
☐ Mrs. Orathai Wisetwong



Approved Signatory:

*[Signature]*  
Mr. Petcha Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-12072021  
Page 2 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.

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

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

V <sub>ref</sub> Reading m/s	V <sub>UUC</sub> Reading m/s	Error m/s	Uncertainty (k)
2.075	2.0	-0.1	2.6
4.150	4.1	-0.1	1.9
6.225	6.0	-0.2	1.58
8.300	8.1	-0.2	1.29
10.375	10.1	-0.3	1.07
12.450	12.2	-0.2	0.86
14.525	14.3	-0.2	0.81
16.600	16.4	-0.2	0.76
18.675	18.5	-0.2	0.69
20.750	20.3	-0.4	0.61
22.825	22.1	-0.7	0.58
24.900	24.0	-0.9	0.57
26.975	25.9	-1.1	0.56
29.050	27.8	-1.3	0.54

UUC\*: Unit Under Calibration.

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

### Appendix 1: Instrumentation

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flow stick	TECOT INC	DS302145	July 14, 2020	NW-0055-02	5 ~ 30 m/s
2	Pressure differential Pressure Meter	ZepLab	DM42000	July 15, 2020	NW-0055-2C	0 ~ 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	6558-15	July 20, 2020	MW-0054-00	0 ~ 5 m/s
4	Temperature	ZepLab	DSF-T1P	March 30, 2021	DL-007-04	-35 ~ 70 °C
5	Relative humidity	ZepLab	DSH-H1P	March 30, 2021	HH-003-0021	0 ~ 100 %RH
6	Absolute static pressure	ZepLab	DSH-T1P	March 30, 2021	PH-003-0021	500 ~ 1100 hPa
7	Wind tunnel	DS60M	W93300	-	-	0 ~ 30 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-12072021  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger Novinsky  
: Wind direction sensor Novinsky

Model/Type : Data logger: 20C-W8-25L3  
: Wind direction sensor: W8-22P

Serial Number : Data logger: A5374  
: Wind direction sensor: -

ID No : Data logger: FYD-780412  
: Wind direction sensor: -

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

### Environmental Condition:

The measurement was carried out in an ambient temperature of (23.3)°C, and relative humidity of (40-10)%.

### Measurement Method:

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

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

### Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: 02563-07-0045, Certificate No: KW353/CO44.

Measurement Date : Jul 29, 2021,  
Issued Date : Jul 29, 2021



Approved Signatory:

Mr. Panyia Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-12072021  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	LUD* Reading (°)	Error (°)	Uncertainty (°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	178	-2	3.0
6		225	225	226	1	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	178	-2	3.0
14		225	225	226	1	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-36012022  
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger

Manufacturer : Data logger Novinsky  
: Cup anemometer: Novinsky

Model/Type : Data logger: 20C-W8-25L3  
: Cup anemometer: W8-00P

Serial Number : Data logger: A5191  
: Cup anemometer: -

ID No : Data logger: FYD-780329  
: Cup anemometer: -

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

Test Conditions : Wind tunnel, cross test section area : 900 cm<sup>2</sup>  
: Anemometer frontal area : 100 cm<sup>2</sup>  
: Diameter of mounting pipe : 100 mm  
: Blockage ratio of test object : 0.111

Test Conditions : Air temperature : 23.5 ±0.5 °C  
: Air pressure : 1014.8 ±0.4 hPa  
: Relative air humidity : 58.5 ±3.5 %RH

Calibration Procedure : Calibration was carried out based on:  
ISO 9140-1-2-1 O-1: 2004 Power Performance Measurement of Electricity Producing Wind  
Turbines  
MSR88ST Anemometer Calibration Procedure - Version 2-2020.

Traceability : This calibration conforms to the procedure is national standard, which realizes the unit of measurement according to the international system of units (SI) through National Institute of Metrology (Thailand) NIMT.

Measurement Date : 2 JAN 28, 2022,  
Issued Date : 2 JAN 31, 2022.

Calibrated by :  
☒ Mr. Soravit Thacholad  
☐ Miss Chantel Wachwattaya



Approved Signatory:

Mr. Panyia Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-36012022  
Page 2 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.

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

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

V <sub>ref</sub> Reading m/s	V <sub>meas</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.078	2.0	-0.1	2.4
4.125	4.0	-0.1	1.5
6.00	6.0	-0.2	1.5
8.01	7.9	-0.1	1.3
10.00	9.8	-0.2	0.9
11.99	11.9	-0.1	0.6
14.00	13.6	-0.4	2.8
15.68	15.7	0.3	1.2
14.99	14.8	-0.2	1.1
13.00	12.8	-0.2	1.5
11.01	10.8	-0.2	1.2
9.00	8.7	-0.3	0.9
7.00	6.7	-0.3	0.9
5.150	5.1	-0.1	1.0
2.976	3.0	0.0	2.0
1.054	0.8	-0.3	4.5

LUD\*: Unit Under Calibration

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

### Appendix 1: Instrumentation

ID	Serial	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	PSC-440	TEOSTA INC	04362145	Aug 07, 2021	MY-0334-01	± 16 m/s
2	Pressure Differential Pressure Meter	Zigab	CPV2500	Aug 07, 2021	MY-0334-01	± 16 m/s
3	Air velocity sensor (cup wind)	TBI INC	8450-12	Aug 08, 2021	MY-0334-01	0 - 6 m/s
4	Temperature	Zigab	35A-TMP	March 30, 2021	CI-027-04	-30 - 70°C
5	Relative humidity	Zigab	35R-TMP	March 30, 2021	RI-02532021	0 - 100 %RH
6	Rheochroic pressure	Zigab	300-10P	March 30, 2021	SP-03032021	0.00 - 1100 MPa
7	Wind tunnel	SSS3M	MP3000	-	-	0 - 85 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-05012022  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

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

Serial Number : Data logger: A5191  
: Wind direction sensor: -

ID No : Data logger: RW-F80328  
: Wind direction sensor: -

Customer : A.S. laboratory group (Thailand) Co., Ltd.  
104 Phatthanaburi 40, Phatthanaburi Rd, Khwaeng Suan Luang, Rte. Suan Luang, Bangkok 10260  
Thailand.

### Environmental Condition

The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (45±10) %.

### Measurement Method

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

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

### Traceability

The measurement results are traceable to the international system of units (SI) through Certificate No: 021066014, Certificate No: RWSA40025.

Measurement Date : JAN 24, 2022,  
Issued Date : JAN 31, 2022.

Performed by  
☒ Mr. Sorvil Thachalad  
☐ Miss Chaitin Witwattayee



Approved Signatory:

*Mr. Panya Booncharoon*

Mr. Panya Booncharoon  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-05012022  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.  
Calibration in the range of 0 ~ 360 ° at a calibration interval of 45°.  
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Tuning Direction	Nominal Angle (°)	Standard Reading (°)	LAUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	1	1	3.0
2		45	46	46	0	3.0
3		90	90	91	1	3.0
4		135	135	134	-1	3.0
5		180	180	179	-1	3.0
6		225	225	226	0	3.0
7		270	270	272	2	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	0	1	1	3.0
10		45	46	46	0	3.0
11		90	90	91	1	3.0
12		135	135	134	-1	3.0
13		180	180	179	-1	3.0
14		225	225	226	0	3.0
15		270	270	272	2	3.0
16		315	315	319	4	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WS-05012022  
Page 1 of 2 pages

Measurement Item : Cup anemometer with rate logger.

Manufacturer : Data logger: Novaya.  
: Cup anemometer: Novaya.

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

Serial Number : Data logger: A5190  
: Cup anemometer: -

ID No : Data logger: RW-F80328  
: Cup anemometer: -

Customer : A.S. laboratory group (Thailand) Co., Ltd.  
104 Phatthanaburi 40, Phatthanaburi Rd, Khwaeng Suan Luang, Rte. Suan Luang, Bangkok 10260  
Thailand.

Test Conditions : Wind tunnel, cross test section size : 900 cm<sup>2</sup>  
: Anemometer frame, size : 100 cm<sup>2</sup>  
: Diameter of mounting pipe : 11 mm  
: Blockage ratio of test object : 0.11

Test Conditions : Air temperature : 23.5 ±0.5 °C  
: Air pressure : 1014.5 ±0.4 hPa  
: Relative air humidity : 53.4 ±0.5 %RH

Calibration Procedure : Calibration was carried out here on:  
ISO 91423-12-1 60.1 2035-Flow Performance Measurements of Velocity-Producing Wind Turbines  
ISO/IEC 17025:2017 Calibration Procedure – Version 2 (2020)

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

Measurement Date : JAN 28, 2022,  
Issued Date : JAN 31, 2022.

Calibrated by  
☒ Mr. Sorvil Thachalad  
☐ Miss Chaitin Witwattayee



Approved Signatory:

*Mr. Panya Booncharoon*

Mr. Panya Booncharoon  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-05012022  
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.  
Calibration in the range of 0 ~ 15 m/s at a calibration interval of 1 m/s.  
The results of calibration and associated measurement uncertainties are reported in table below.

Yes Reading m/s	Y <sub>UUC</sub> Reading m/s	Error m/s	Uncertainty (k)
2.075	2.3	-0.1	2.4
4.101	4.1	0.0	1.2
5.99	6.0	0.0	0.95
8.71	8.9	0.0	0.85
10.01	10.1	0.1	0.79
12.21	12.1	-0.1	0.87
13.29	13.1	-0.1	0.70
15.09	15.4	0.4	0.45
16.0	15.8	-0.2	0.76
18.01	18.0	0.0	0.65
19.02	19.0	0.0	0.76
20.0	20.0	0.0	0.81
22.02	22.0	0.0	0.82
24.195	24.1	0.0	0.65
25.91	25.9	0.0	1.6
1.038	2.0	0.1	4.5

LAUC\*: Unit Under Calibration

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

### Appendix 1: Instrumentation

NO	Brand	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flot static	ICSD INC.	00350140	Aug 07, 2021	MW-0034-01	0 ~ 30 m/s
2	Pressure Differential Pressure Meter	Zepco	DPV5000	Aug 07, 2021	MW-0034-01	0 ~ 30 m/s
3	Air velocity transducer (cal wind)	TS INC.	9455-12	Aug 06, 2021	MW-0035-01	0 ~ 5 m/s
4	Temperature	2004E	1881 THF	March 30, 2021	CL-007-04	-20 ~ 70°C
5	Relative humidity	2004E	2001 THF	March 30, 2021	PH-003302-01	0 ~ 100 %RH
6	Analogic pressure	Zepco	991 THF	March 30, 2021	BP-003302-01	500 ~ 1100 mPa
7	Wire current	CSG20	WP300J	-	-	0 ~ 50 Hz

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





## CERTIFICATE OF CALIBRATION

Certificate No. WP-0601/2022  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger: Novolyns,  
Wind direction sensor: Novolyns.

Model/Type : Data logger: 200-W9-20LB  
Wind direction sensor: WS-02P

Serial Number : Data logger: AS192  
Wind direction sensor: -

ID No : Data logger: RYU\_F8032  
Wind direction sensor: -

Customer : AIS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd./Kwangsuan Luang, Khwaeng Suwan Luang, Bangkok 10250  
(Thailand)

### Environmental Condition

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

### Measurement Method

The wind direction sensor calibration according to comparison method with reference single measurement electronic theodolite and line laser is used for X/Y/Z control. The measurement were taken at 45° intervals in clockwise and counter-clockwise directions.

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

### Traceability

The measurement results are traceable to the International system of units (SI) through Certificate No. Q21035C14, Certificate No. WY564/0325.

Measurement Date : JAN 26, 2022  
Issue Date : JAN 31, 2022

### Performed by

☒ Mr. Somwit Thacharad  
☐ Miss Chaiwit Witwitayee



Approved Signature

Mr. Parinya Boonchansorn  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No. WD-0501/2022  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty (°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	45	-2	3.0
3		90	90	90	0	3.0
4		135	135	135	0	3.0
5		180	180	181	1	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	43	-2	3.0
11		90	90	90	0	3.0
12		135	135	135	0	3.0
13		180	180	181	1	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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



## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC22001  
Pages : 1 of 3

## Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-75  
Serial No. : 35002736  
ID No. : - R160478

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2022  
Calibration Date : 10 JANUARY 2022  
Date of Issue : 13 JANUARY 2022

Calibrated by : Nattakorn Pisurpaisan

Approved by :

T. Petchuraj  
( Thanakul Petchuraj )

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## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

### Continuation of Calibration Certificate

Cert. No. : ACC22001  
Job No. : VC65AC0040  
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-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-21	10-Feb-22

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

T. Petchuraj

Cert. No. : ACC22001  
Job No. : VC65AC0040  
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	93.99	-0.01	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 (%)
0.28	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

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



Cert. No. : ACL22028  
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,  
KHUWAENG PHATTHANAKAN, KHUET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %  
Received Date : 05 JANUARY 2022  
Calibration Date : 10-12 JANUARY 2022  
Date of Issue : 13 JANUARY 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>Thanakul P.</i>
NEXT CAL DATE	10/1/23

Calibrated by : Nathakorn Pisutpaisan

Approved by : *Thanakul P.*  
( Thanakul Petchurai )

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QF-TS12-04-04-020664

Cert. No. : ACL22028  
Job No. : VC65AC0040  
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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	I-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.9%)	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	23.5

## 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	0.1	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	0.1	0.1	±5.0

QF-TS12-04-04-020664

T. B. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	-0.1	-0.1	-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

QF-TS12-04-04-020664

T. B. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.1	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	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-04-020664

T. B. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

QF-TS12-04-04-020664

T. B. A.



## Continuation of Calibration Certificate

Cert. No. : ACL22028  
Job No. : VC65AC0040  
Pages : 8 of 8

## 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.5	89.7	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 level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

451-451/1 Sirinthorn Rd., Bangbunru, Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL21118  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01122578 / 143486 / 22620  
ID No. : RYG FS0017

Condition As Found : GOOD

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

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

Received Date : 21 SEPTEMBER 2021  
Calibration Date : 04-06 OCTOBER 2021  
Date of Issue : 11 OCTOBER 2021

REVIEW BY : *Nathakorn P.*  
APPROVED BY : *T. Petchur*  
NEXT CAL. DATE : 4/10/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
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 test results of each items were made by observation of each Instruments display and also with SLM's display.

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 3 of 8

## Summary of Measurement Result :

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

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value ( dB )
17.9

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

Frequency Weighting	Measured value ( dB )
A - weight	15.5
C - weight	20.9
Flat	26.3

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	0.1	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.5	0.6	0.6	±5.0

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.2	0.2	± 1.1
29.0	29.2	0.2	± 1.1
28.0	28.2	0.2	± 1.1
27.0	27.3	0.3	± 1.1
26.0	26.4	0.4	± 1.1
25.0	25.5	0.5	± 1.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

T. Petch



Continuation of Calibration Certificate

Cert. No. : ACL21118  
Job No. : VC64AC0070  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurui



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

Cert. No. : ACL22162  
Pages : 1 of 8

Calibration Certificate

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

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 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 JULY 2022  
Calibration Date : 11-18 JULY 2022  
Date of Issue : 19 JULY 2022

REVIEW BY	Nathakorn P.
APPROVED BY	T. Petchurui
NEXT CAL DATE	11/14/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurui  
( Thanakul Petchurui )

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
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).

QF-TS12-04-04-020664

T. Petchurui

Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

T. Petchurui



## Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
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	12.6
C - weight	18.7
Flat	24.5

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.0	-0.9	-0.9	±5.0

QF-TS12-04-04-020664

T. R. R. R.

## Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

QF-TS12-04-04-020664

T. R. R. R.

## Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

T. R. R. R.

## Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

QF-TS12-04-04-020664

T. R. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL22162  
Job No. : VC65AC0069  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value	Acceptance Limits
Positive	Negative	( dB )	( dB )
one-half cycle	one-half cycle		
89.7	89.5	-0.2	±1.5

12. High level stability

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

T. Petchurui



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

Cert. No. : ACL21117  
Pages : 1 of 8

Calibration Certificate

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

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PIATTHANAKAN 40, PIATTHANAKAN ROAD,  
KHWANG PIATTHANAKAN, 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 : 21 SEPTEMBER 2021  
Calibration Date : 04-06 OCTOBER 2021  
Date of Issue : 11 OCTOBER 2021

REVIEW BY : *Nathakorn P.*  
APPROVED BY : *T. Petchurui*  
NEXT CAL. DATE : 4/10/22

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchurui*  
( Thanakul Petchurui )

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

QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL21117  
Job No. : VC64AC0070  
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 Anchoic 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QP-TS12-04-04-020664

T. Petchurui

Continuation of Calibration Certificate

Cert. No. : ACL21117  
Job No. : VC64AC0070  
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.4	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

QP-TS12-04-04-020664

T. Petchurui



Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value ( dB )
22.9

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	19.7
Flat	25.4

3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	-0.1	-0.1	± 1.5
1000	0.0	-0.1	0.0	± 1.0
8000	0.3	0.4	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	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	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	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	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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



## Continuation of Calibration Certificate

Cert. No. : ACL21117  
Job No. : VC64AC0070  
Pages : 8 of 8

## 11. Overload Indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2435-1679 e-mail:center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22054  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00233184 / 144837 / 23232  
ID No. : RYG\_FS0025

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 : 14 JANUARY 2022  
Calibration Date : 21-24 JANUARY 2022  
Date of Issue : 25 JANUARY 2022

REVIEW BY	Nathakorn P.
APPROVED BY	[Signature]
NEXT CAL DATE	28/1/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]  
( Thanakul Petchurai )

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

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.4	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

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.2

## 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	17.0
Flat	22.8

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.9	-0.8	-0.8	±5.0

QF-TS12-04-04-020664

T. P. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

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T. P. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	131.9	-0.1	± 1.1
131.0	130.9	-0.1	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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T. P. A.

## Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	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	135.2	-0.2	±2.0

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T. P. A.



Continuation of Calibration Certificate

Cert. No. : ACL22054  
Job No. : VC65AC0043  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

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



Cert. No. : ACC22013  
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 : 22 APRIL 2022  
Calibration Date : 26 APRIL 2022  
Date of Issue : 29 APRIL 2022



Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchurui*  
( Thanakul Petchurui )

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC22013  
Job No. : VC65AC0054  
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).

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Continuation of Calibration Certificate

Cert. No. : ACC22013  
Job No. : VC65AC0054  
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.11	0.11	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.1	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
2.02	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

Cert. No. : ACL22031  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01222716 / 143832 / 22763  
**ID No.:** RYG\_FS0020

**Condition As Found :** GOOD

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

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

**Received Date :** 05 JANUARY 2022  
**Calibration Date :** 10-12 JANUARY 2022  
**Date of Issue :** 13 JANUARY 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchur )

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22031  
Job No. : VC65AC0040  
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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	FEL_BP_05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	FEL_BP_03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22031  
Job No. : VC65AC0040  
Pages : 3 of 8

### Summary of Measurement Result :

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22031  
Job No. : VC65AC0040  
Pages : 4 of 8

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	12.6
C - weight	19.2
Flat	24.6

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.7	0.7	0.7	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.1	-2.0	-2.0	±5.0

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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7. Level linearity on the reference level range

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

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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664



## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Pre-amplifier NH-24  
Serial No. : 01222723 / 143841 / 22770  
ID No. : RYG\_FS0022

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 : 14 JANUARY 2022  
Calibration Date : 21-24 JANUARY 2022  
Date of Issue : 25 JANUARY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchur )

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QF-TS12-04-04-020664

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL-BP_03/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

### 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

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### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.0
Flat	24.1

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

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

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

QF-TS12-04-04-020664



Continuation of Calibration Certificate

Cert. No. : ACL22062  
Job No. : VC65AC0043  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

QP-TS12-04-04-020664

T. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22062  
Job No. : VC65AC0043  
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QP-TS12-04-04-020664

T. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22062  
Job No. : VC65AC0043  
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

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

QP-TS12-04-04-020664

T. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL22062  
Job No. : VC65AC0043  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

T. P. P.



Cert.No.: 22CH405  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven Compact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received: Used Item  
Received Date : 16 March 2022  
Calibration Date : 17 March 2022  
Reference : 2203-0611DSC-4  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T.Moenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure :  
In-house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :   
Approved Signatory

( ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 22 March 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 Services

A 0037307



Cert.No.: 22CH405  
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	21E2682	25 Aug 2022
2) Ref. Standard Thermometer	4982054	110RC044	21H1201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	768995	01 Jan 2024
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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

### Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: C104059460	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

a 1100955



Cert.No.: 22CH405  
Page.: 3 of 3

### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 1453404	4.008	4.010	177.7	0.0046	2.00
	6.982	6.988	3.6	0.0084	2.00
	10.015	10.010	-172.9	0.0073	2.05

### Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert 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	25.002	24.9	-0.102	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1100954



## Certificate of Calibration

Certificate No.: 22E988  
Page: 1 of 2

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenCompact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received: Used Item  
Received Date : 16 March 2022  
Calibration Date : 21 March 2022  
Reference : 2203-0611DSC  
Ambient Temperature : (23 ± 2) °C  
Relative Humidity : (50 ± 10) %  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5 T.Moenam 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 instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	8440007	21E1444	07 May 2022

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)

REVIEW BY   
APPROVED BY   
NEXT CAL DATE 31/3/23

Calibrated by : Pongasorn Boonyaporn  
Issue Date : 22 March 2022

Approved Signatory :   
( ) Phatinee Prapatsai  
( ) Nuntawat Khanchai  
( ) Ponthippa Tameysakul

B 0284414





Cert. No.: 22E986  
Page: 2 of 2

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

Function:	DC voltage measurement	Range:	2000	mV
Standard Value	UUC* Reading	Error	Uncertainty	
( mV )	( mV )	( mV )	( ± 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	100.0	0.0	65	
150.0000	150.0	0.0	69	
200.0000	200.0	0.0	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.

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a 1101070



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 22TW34  
Page: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Received Date : 11 February 2022  
Test Date : 14 February 2022  
Reference : 2202-04040SC-4  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
(Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.Phuakdaeng,  
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 : Walasak Sirithon  
Approved by :   
Approved Signatory  
( ) Malee Butkrues  
(✓) Sathip Meangmai  
( ) Warakorn Lemgatrakul  
Issue Date : 18 February 2022



b 0281285



Cert.No.: 22TW34  
Page: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.02	8.02	0.0084

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

-000-

Sathip

a 1094744



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TEL. 0-2717-3000 FAX. 0-2719-9484



Cert. No.: 22LM12  
Page: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
(Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.Phuakdaeng,  
Rayong 21140, Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 11 February 2022  
Calibrated Date : 21 February 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V  
Calibrated by : Kunsit Promprat  
Approved by :   
Approved Signatory  
( ) Ponthippa Tameyakul  
(✓) Malee Butkrues  
( ) Suwit Imjai  
Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0038008





Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2202-0404DSC-5  
Procedure Used :-

Cert. No.: 22LM12  
Page: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2180080	2111273	22 Nov 2022

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 15E100464

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.00	45	20.001	19.88	-0.121	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-

Male

a 1095714



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TEL. 0-2717-5000-77 FAX. 0-2719-9884



## Certificate of Calibration

Cert. No.: 22TM317  
Page: 1 of 3

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP750

Serial No. : V818.0084

ID No. : RYG\_EN0154

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

Location :

Received Order : 22 April 2022

Calibration Date : 22 April 2022

Ambient Temperature : ( 25 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Man Pattanasongpaiboon

Approved by :

Approved Signatory

( ) Pornthipha Tameyakul  
( ) Malee Bulkrusa  
( ) Suwit Imjai

Issue Date : 3 May 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 Services.

REVIEW BY *N. Samart*  
APPROVED BY *D. ...*  
NEXT CAL. DATE *21/10/23*

A 0040735



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2204-0146OC-1  
Procedure Used :-

Cert. No.: 22TM317  
Page: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement. 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	MY44031789	21LM12	02 Sep 2022

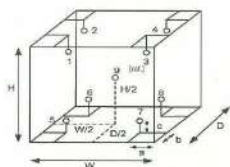
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



Probe Installation Details : Dimension of Chamber :  
a = 10 cm D = 0.60 m  
b = 10 cm W = 1.0 m  
c = 10 cm H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL Humid. ( % )	54	58
AC Supply ( Volt )	221	223

Position :	Ref. Std. ID No.:
1	9RTD-2/1
2	9RTD-2/2
3	9RTD-2/3
4	9RTD-2/4
5	9RTD-2/5
6	9RTD-2/6
7	9RTD-2/7
8	9RTD-2/8
9 (ref.)	9RTD-2/9

Male

a 1106485



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2204-0146OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM317  
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
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Measured Temperature ( °C )									
Calibration Point ( °C )	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.209	20.174	20.199	20.110	20.075	20.062	20.027	20.069	20.030

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

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

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

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

UUC\* : Unit Under Calibration

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

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

-o0o-

Male

a 1106484



## Certificate of Calibration

**Equipment:** SPECTROPHOTOMETER  
**Model:** DR8000  
**Serial No. (or ID):** 1627845 (RYG\_EN0037)  
**Manufacturer:** HACH  
**Condition:** In Condition

**Certificate No.:** C06220464  
**Issued Date:** 27 September 2022  
**Job No.:** KSPR2212224  
**Page:** 1 of 3

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

**Environment Condition:** Temperature 23.1 °C ±  
Humidity 65.4 %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 Fothong  
**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 Starna 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 Fothong)  
Person in charge

(Mr. Thalerngkiet Pongngam)  
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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CALFM-C06-13: 20 Jul 2022



Certificate No.: C06220464 Page 2 of 3

### Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.4	0.21	0.14	
536.66	536.7	-0.04	0.14	
637.98	638.3	-0.32	0.14	
748.48	748.8	-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
	0.9804	0.982	-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
	0.8847	0.885	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

บริษัท เทคโนโลยี ดีเคเอสไทย จำกัด  
DKSH Technology Limited  
2533 หมู่ 5 ตำบลบ้านนา อำเภอรามราช จังหวัดสุพรรณบุรี 18280  
2533 Sukhumvit Road, Bangnae, Phra Prachin, Bangkok 10280  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CALFM-C06-13: 20 Jul 2022



Certificate No.: C06220464 Page 3 of 3

### Calibration Results: Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7423	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 )	0.4610	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

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2533 Sukhumvit Road, Bangnae, Phra Prachin, Bangkok 10280  
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CALFM-C06-13: 20 Jul 2022

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องวัด: SPECTROPHOTOMETER			รุ่น: DR8000		หมายเลขเครื่อง: 1627845	
ตรวจสอบ (วัน)			รายการตรวจเช็ค	ตรวจสอบ (ฟังก์)		หมายเหตุ
27 Sep 2022				27 Sep 2022		
ปกติ	ไม่ปกติ			ปกติ	ไม่ปกติ	
General						
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Spectrophotometer						
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวคูณเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	856.1 น้ 856.1 nm	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
pH Meter and Conductivity Meter						
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>		
Turbidimeter						
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่น้อย 3.0)	<input type="checkbox"/>	<input type="checkbox"/>		
Automatic titrator						
<input type="checkbox"/>	<input type="checkbox"/>	18. สลัก Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>		

เพิ่มข้อมูลหมายเหตุ:

Mr. Chattuphon Fothong  
Service Engineer

บริษัท เทคโนโลยี ดีเคเอสไทย จำกัด  
DKSH Technology Limited  
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CAL-FM-R31-09: 29 Jul 2022



## Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22103

Certificate No.: PTC/07/22103 Page: 1 of 2  
Equipment: Digital Balance Condition: Normal  
Manufacturer: Sartorius Serial No: 26207038  
Model: MSE224S-100-DU ID No: RYG\_EN0002  
Type of Balance: Single Interval

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

Environment Condition: Temperature 23.9 °C ± 0.3 °C  
Humidity 58.1 %RH ± 4.4 %RH  
Air density 1.17 kg/m<sup>3</sup>

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.  
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,  
Rayong 21140, Thailand

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

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

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroj Metakul

REVIEW BY: *Thawitall*  
APPROVED BY: *D. Kerdito*  
NEXT CAL. DATE: 03/03/23



Reviewed by:  
(Mr. Kriangsak Kalasri)

Approved By: *D. Kerdito*  
(Mr. Keattisak Kerdito)  
Laboratory Manager

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other 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). The effect that the results relate only to the items calibrated.

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

PTC/07/22103

Represent to Certificate of Calibration ,PTC/07/22103

Certificate No.: PTC/07/22103

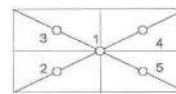
Page: 2 of 2

## Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 100 (g)				
Position (g)				
1	2	3	4	5
0.0000	0.0000	-0.0002	0.0002	0.0002
Maximum deviation: 0.0002				

Repeatability Test : Weight to be 1/2 ≤ L<sub>i</sub> ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
20	0.000042
200	0.000027

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.000086	2.16
0.01	0.01000	0.0100	0.0000	0.00010	2.06
0.1	0.10000	0.1000	0.0000	0.00010	2.05
1	1.00000	1.0000	0.0000	0.00010	2.05
2	2.00000	1.9999	0.0001	0.00010	2.06
5	5.00001	5.0000	0.0000	0.00010	2.06
10	10.00000	10.0000	0.0000	0.00010	2.06
20	20.00003	19.9999	0.0001	0.00011	2.05
50	50.00004	49.9999	0.0001	0.00012	2.00
100	100.00004	100.0001	-0.0001	0.00017	2.00
200	200.00011	200.0000	0.0001	0.00027	2.00

Note: Weight of adjust - (g)

The End of Certificate

PTC/07/22103

RYG\_EN0010



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TEL: 0-2717-0000-27 FAX: 0-2716-4444



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 Pattansongpaiboon

Approved by: *M. Pattansongpaiboon*  
Approved Signatory

( ) Ponthippa Tameyskul  
( ) Malea 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: 2210-0378OC-2

Cert. No.: 22TM1517  
Page: 2 of 3

## Procedure Used :-

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

The temperature scale used was based on ITS-90.

## Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

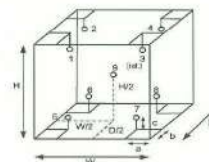
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Ref. Std. ID No.: @ Calibration Point		
Position:	( 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: Dimension of Chamber :  
a = 5.0 cm D = 0.40 m  
b = 5.0 cm W = 0.56 m  
c = 5.0 cm H = 0.48 m  
Capacity = 0.11 m<sup>3</sup>

a 1132466





Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-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 %.

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a 1132465



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 TEL: 0-2717-3000-23 FAX: 0-2719-6181



Cert. No.: 22TM1492  
 Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Menmert

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. Puaakdaeng,  
 Rayong 21140, Thailand

Location : Oven Room

Received Order : 20 October 2022

Calibration Date : 20 October 2022

Ambient Temperature : (28 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hahib

Approved by : Approved Signatory

( ) Pornthipha Tamayakul  
 (✓) Malee Butkrues  
 ( ) Suwit Imjai

Issue Date : 2 November 2022

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

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

A 0046905



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-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

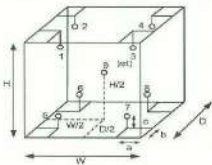
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



### Probe Installation Details :

### Dimension of Chamber :

a = 5.0 cm  
 b = 5.0 cm  
 c = 5.0 cm  
 D = 0.33 m  
 W = 0.40 m  
 H = 0.40 m  
 Capacity = 0.063 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	29
REL.Humid. ( % )	43	47
AC Supply ( Volt )	220	221

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

Melu.

a 1132473



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-1  
 Result of Calibration :- ( \* ) Without Adjustment  
 Function of UUC\* : Temperature Source  
 Fresh air setting : Close

Cert. No.: 22TM1492  
 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
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	69.985	70.079	70.177	70.664	70.039	70.688	70.149	70.326

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

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation  
 UUC\* : Unit Under Calibration

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

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

-o0o-

Melu.

a 1132472



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TEL: 0-2711-3000-21 FAX: 0-2719-9484



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  
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 Hlathib  
Approved by :   
( ) Pornthippa Taneyakul  
(✓) Malee Butkruea  
( ) 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 Services.

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

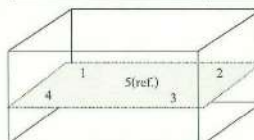
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

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)				
			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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL: 0-2711-3000-21 FAX: 0-2719-9484



Cert.No.: 22GH377  
Page: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2Go  
Serial No. : B531256371  
ID No. : RYG\_FS0420  
Condition As-Received : Used Item  
Received Date : 11 March 2022  
Calibration Date : 14 March 2022  
Reference : 2203-0495DSC-1  
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)

Calibrated by : Warakorn Lomgagrakul

Approved by :   
Approved Signatory

(✓) Malee Butkruea  
( ) Saitthip Meangmai  
( ) Warakorn Lomgagrakul

Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 22CH377  
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	21E2682	25 Aug 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials :- The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	766820	23 Sep 2023
pH 6.963	CPA chem	766822	04 Sep 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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

**Calibration Results**

Function : mV Measurement

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

Unit Under Calibration	Nominal Value		Standard Voltage Input		Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
	pH	mV	mV	pH	mV	pH		
pH Meter S/N.: B5312563/1	4.00	177.48	177	4.00	0.58	2.00	2.00	
	7.00	0.00	0	7.00	0.58	2.00	2.00	
	10.00	-177.48	-178	10.00	0.58	2.00	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 S/N.: 1311407	4.008	4.01	181	0.0079	2.00
	6.963	6.98	7	0.0093	2.00
	10.015	10.01	-171	0.0092	2.00

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

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Cert. No.: 22LM41  
Page.: 1 of 2

**Certificate of Calibration**

**Equipment :** pH Meter with Sensor

**Manufacturer :** Mettler Toledo

**Model :** Seven2Go

**Serial No. :** B531256371

**ID No. :** RYG\_FS0420

**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 :** 11 March 2022

**Calibrated Date :** 15 March 2022

**Ambient Temperature :** ( 28 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**AC Line Voltage :** ( 220 ± 22 ) V

**Calibrated by :** Maloe Bulkruea

**Approved by :**   
Approved Signatory

( ) Ponthippa Tameyakul  
(✓) Suwit Imjai

**Issue Date :** 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 22LM41  
Page.: 2 of 2

**Equipment :** pH Meter with Sensor

**Condition As-Received :** Used Item

**Reference :** Z203-0495DSC-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	1523	2168080	2111273	22 Nov 2022

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

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

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

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1311407

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.008	25.4	0.391	0.16	2.00
30.0	100	30.008	30.5	0.492	0.16	2.00
40.0	100	39.997	40.6	0.603	0.16	2.00
50.0	100	49.997	50.6	0.603	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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## SPC Calibration Center



## Certificate of Calibration

**Equipment:** Block Digestion Unit

**Model:** KT-20s

**Serial No. (or ID.):** 5720210009/5770200073

**Manufacturer:** Gerhardt

**Condition:** In Condition

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

**Environment Condition:** Temperature: 24 °C ± 0.8 °C  
Humidity: 67 %RH ± 2.2 %RH  
Voltage: 228 VAC ± 1.7 VAC

**Calibration Place:** ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
(Wet Chemistry Lab)  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand.

**Calibration By:** Mr. Worachai Hongkaew

**Calibration Date:** 17 March 2022

**The Method used:** In house method, base on by comparison with standard

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)  
Certificate No.: TC21/0075

**Certificate No.:** C29220011

**Issued Date:** 18 March 2022

**Job No.:** KSPR2203623

**Page:** 1 of 3

**Digestion Block:** 20 holes.

**REVIEW BY:** N-Samit

**APPROVED BY:** 

**NEXT CAL. DATE:** 17/3/23

(Mr. Worachai Hongkaew)  
Person in charge

**SERT**  
บริษัท เอสเอช ดีเคช จำกัด  
SPC Co., Ltd.

(Mr. Udon Srichana)  
Authorized signatory

This certificate is issued to the user 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 by stated in 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. This results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.



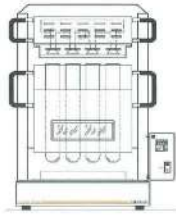
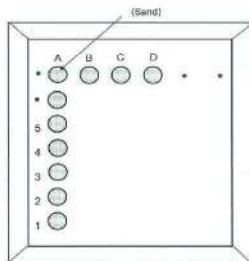


Fig. 1.: Front view



Location of standard

Fig. 2.: Digestion block

## Definitions

**Indicating Temperature:** The average reading of indicating device which forms the integral part of the Digestion block.

**Measured Temperature:** The average reading of working standard at any positions or location.

Calibration Results:  
Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC, (°C)	Uncertainty (± °C)
A1	380	380	380	378.6	-1.4	1.5
A2				382.2	2.2	1.5
A3				380.2	0.2	1.5
A4				381.5	1.5	1.5
A5				381.2	1.2	1.5
B1				378.8	-1.2	1.5
B2				381.8	1.8	1.5
B3				379.4	-0.6	1.5
B4				382.1	2.1	1.5
B5				380.9	0.9	1.5
C1				378.2	-1.8	1.5
C2				380.0	0.0	1.5
C3				377.4	-2.6	1.5
C4				381.8	1.8	1.5
C5				382.3	2.3	1.5
D1				379.7	-0.3	1.5
D2				378.3	-1.7	1.5
D3				378.8	-1.2	1.5
D4				379.0	-1.0	1.5
D5				379.4	-0.6	1.5

The End of Certificate

## ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2203623

ชนิดเครื่องมือ: Block Digestion Unit รุ่น: KT-20s  
หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<b>General</b>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ชื่อและนามสกุล: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Mr. Worachai Hongkaew  
Service Engineer




TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL: 0-2717-0000-77 FAX: 0-2719-9088



Cert.No.: 21CH1733  
Page: 1 of 3

## Certificate of Calibration

**Equipment:** pH Meter  
**Manufacturer:** Mettler Toledo  
**Model:** SevenExcellence  
**Serial No.:** B834291445  
**ID No.:** RYG\_EN0152  
**Condition As-Received:** Used Item  
**Received Date:** 22 December 2021  
**Calibration Date:** 23 December 2021  
**Reference:** 2112-0636DSC-2  
**Submitted by:** ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
 816/10 Moo 5 T. Maenam Khu. A. Phakdaeng,  
 Rayong 21140, Thailand  
**Ambient Temperature:** (25 ± 2.5) °C  
**Relative Humidity:** (50 ± 15) %  
**Calibration Procedure:** In-house method:  
 - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
 - CP-CH8 by comparison with standard thermometer  
**Calibrated by:** Warakorn Lemgragrakul  
**Approved by:**   
 Approved Signatory  
 (✓) Malee Butkrues  
 ( ) Sathip Meangmai  
 ( ) Warakorn Lemgragrakul  
**Issue Date:** 24 December 2021

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 21CH1733  
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	21E2882	25 Aug 2022
2) Ref. Standard Thermometer	4982054	110RC044	21I1201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

##### 2. Certified Reference Materials :- The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	761016	02 Aug 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

#### Calibration Results

##### Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N: B834291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

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Cert.No.: 21CH1733  
Page.: 3 of 3

#### Calibration Results

##### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode S/N: 1475518	4.008	4.011	180.6	0.0049	2.05
	6.982	6.984	5.3	0.0077	2.00
	10.015	10.014	-171.3	0.0065	2.00

#### Function : Temperature Measurement

##### (\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model :	InLab Expert Pro-ISM
- Serial No. :	1475518
- Dimension of probe:	
- Length :	120 mm.
- Diameter :	12 mm.
- Immersion Depth :	100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor k
25.0	25.002	24.9	-0.102	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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## Certificate of Calibration

Certificate No.: 21E4151  
Page : 1 of 2

Equipment : pH Meter

Manufacturer: Mettler Toledo

Model : SevenExcellence

Serial No.: B834291445

ID No.: RYG\_END152

Condition As-Received: Used Item

Received Date: 22 December 2021

Calibration Date: 28 December 2021

Reference: 2112-08380SC

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

Ambient Temperature: (  $23 \pm 2$  ) °C

615/10 Moo 5 T.Moenam Khu, A.Pluakdeeng, Rayong  
21140, Thailand

Relative Humidity: (  $50 \pm 10$  ) %

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 Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	0440007	21E1444	07 May 2022

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 : Wuthareepong Wongchulkrane

Issue Date : 07 January 2022

Approved Signatory :

[✓] Pheeline Prasertpaipal  
[ ] Nuntawat Khamchai  
[ ] Ponthipha Tameysakul

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Cert. No.: 21E4151  
Page.: 2 of 2

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

Function: DC voltage measurement

Range: 2000

mV

Standard Value

UUC\* Reading

Error

Uncertainty

( mV )

( mV )

( mV )

(  $\pm$   $\mu$ V )

-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

100.0

0.0

65

150.0000

150.0

0.0

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.

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