

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการตรวจ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Month)
Stack (CMM)	Oxides of Nitrogen	Analyzer - System calibration, Standard gas	-	-	-	-
Stack	Non-Methane Hydrocarbon as Propane	Dry Gas	BKH_F50825	13-Jul-23	13-Jan-24	6
Stack	Non-Methane Hydrocarbon as Propane	Dry Gas	BKH_F50834	13-Jul-23	13-Jan-24	6
Stack	Non-Methane Hydrocarbon as Propane	Pilot Tube	BKH_F50824	13-Jul-23	13-Jan-24	6
Stack	Non-Methane Hydrocarbon as Propane	Pilot Tube	BKH_F50472	13-Jul-23	13-Jan-24	6
Stack	Non-Methane Hydrocarbon as Propane	Flue gas Analyzer	RIG_F50864	20-Jan-23	20-Jan-24	12
Stack	Non-Methane Hydrocarbon as Propane	Flue gas Analyzer	RIG_F50865	23-Jan-23	23-Jan-24	12
Stack	Non-Methane Hydrocarbon as Propane	Field Rotameter	RIG_F50198	1-Jul-23	1-Oct-23	3
Stack	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RIG_EN0008	28-Jan-23	28-Jan-24	12
Stack	Non-Methane Hydrocarbon	PD Analyzer	BKH_F50758	1-Jul-23	1-Jan-24	6
Stack	Total Hydrocarbon as Propane	Dry Gas	BKH_F50825	13-Jul-23	13-Jan-24	6
Stack	Total Hydrocarbon as Propane	Dry Gas	BKH_F50834	13-Jul-23	13-Jan-24	6
Stack	Total Hydrocarbon as Propane	Pilot Tube	BKH_F50824	13-Jul-23	13-Jan-24	6
Stack	Total Hydrocarbon as Propane	Pilot Tube	BKH_F50472	13-Jul-23	13-Jan-24	6
Stack	Total Hydrocarbon as Propane	Flue gas Analyzer	RIG_F50864	20-Jan-23	20-Jan-24	12
Stack	Total Hydrocarbon as Propane	Flue gas Analyzer	RIG_F50865	23-Jan-23	23-Jan-24	12
Stack	Total Hydrocarbon as Propane	Field Rotameter	RIG_F50198	1-Jul-23	1-Oct-23	3
Stack	Total Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RIG_EN0008	28-Jan-23	28-Jan-24	12
Stack	Total Hydrocarbon as Propane	PD Analyzer	BKH_F50758	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RIG_F50281	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RIG_F50581	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RIG_F50284	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKH_F51064	1-Jul-23	1-Jan-24	6
Ambient	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RIG_EN0008	28-Jan-23	28-Jan-24	12
Ambient	1,4 Dichlorobenzene	GC-MSD	RIG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Benzene	GC-MSD	RIG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	n-Hexane	GC-MSD	RIG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Toluene	GC-MSD	RIG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Propylene	GC-MSD	RIG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Ethylene glycol	Field Rotameter	BKH_F51006	1-Jul-23	1-Oct-23	3
Ambient	Ethylene glycol	Field Rotameter	RIG_F50199	1-Jul-23	1-Oct-23	3
Ambient	Ethylene glycol	Field Rotameter	BKH_F51006	2-Oct-23	2-Jan-24	3
Ambient	Ethylene glycol	Field Rotameter	BKH_F51006	2-Oct-23	2-Jan-24	3
Ambient	Ethylene glycol	Field Rotameter	RIG_F50199	2-Oct-23	2-Jan-24	3
Ambient	Ethylene glycol	GC-FID	BKH_EN0126	21-Apr-23	21-Oct-24	18

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Month)
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50089	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50085	19-Jun-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50611	17-Nov-22	17-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50610	17-Nov-22	17-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50649	20-Jun-23	20-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKH_F50919	21-Feb-23	21-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RIG_F50230	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKH_F51374	19-Jan-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKH_F50918	21-Feb-23	21-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKH_F51371	19-Jan-23	19-Dec-24	18
Workplace	n-Octane	Field Rotameter	RIG_F50199	1-Jul-23	1-Oct-23	3
Workplace	n-Octane	Field Rotameter	BKH_F51006	2-Oct-23	2-Jan-24	3
Workplace	n-Octane	GC-FID	BKH_EN0126	21-Apr-23	21-Oct-24	18
Noise	Leq 24 hrs	Sound Calibrator	RIG_F50496	17-Jan-23	17-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RIG_F50413	12-Oct-22	12-Oct-23	12
Noise	Leq 24 hrs	Sound Level Meter	RIG_F50492	13-Jan-23	13-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RIG_F50493	13-Jan-23	13-Jan-24	12
Noise	Leq 5 min	Sound Calibrator	RIG_F50496	17-Jan-23	17-Jan-24	12
Noise	Leq 5 min	Sound Level Meter	RIG_F50492	13-Jan-23	13-Jan-24	12
Noise	Leq 5 min	Sound Level Meter	RIG_F50493	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RIG_F50496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RIG_F50390	18-Oct-22	18-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RIG_F50432	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RIG_F50213	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_F50520	1-Nov-23	1-Nov-24	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_F50516	1-Nov-23	1-Nov-24	12
Noise	Octave Band	Sound Calibrator	RIG_F50496	17-Jan-23	17-Jan-24	12
Noise	Octave Band	Sound Level Meter	RIG_F50390	18-Oct-22	18-Oct-23	12
Noise	Octave Band	Sound Level Meter	RIG_F50432	25-Jan-23	25-Jan-24	12
Noise	Octave Band	Sound Calibrator	RIG_F50213	26-Jan-23	26-Jan-24	12
Noise	Octave Band	Sound Level Meter	NKH_F50520	1-Nov-23	1-Nov-24	12
Noise	Octave Band	Sound Level Meter	NKH_F50516	1-Nov-23	1-Nov-24	12
Rayong Lab	Temperature	pH meter	RIG_F50299	24-May-23	24-May-24	12
Rayong Lab	Temperature	pH meter	RIG_F50574	3-Apr-23	3-Apr-24	12
Rayong Lab	pH at 25 °C	pH meter	RIG_EN0183	27-Feb-23	27-Feb-24	12
Rayong Lab	BOD	DO meter with Sensor	RIG_EN0032	28-Jul-23	28-Jan-25	18
Rayong Lab	BOD	Incubator	RIG_EN0154	29-May-23	29-May-24	18
Rayong Lab	COD	Spectrophotometer	RIG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RIG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RIG_EN0010	20-Oct-22	20-Apr-24	18

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Month)
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RIG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RIG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RIG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RIG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RIG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RIG_EN0188	15-Mar-23	15-Mar-24	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RIG_EN0132	22-Dec-22	22-Dec-23	12

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Lot No. 2321055-1

ANALYZER CALIBRATION DATA

Client : Siam Polyethylene Co., Ltd. Location : Furnace 1
Date : 20 Sep 23 Test Operator : Sakit P.

O₂ ANALYZER
Model : TELEDYNE API 200EH Serial No. : 774
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.01	0.12
Low-Level Gas	7.93	7.97	7.94	0.12
Span Gas	16.00	16.04	16.01	0.12

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.01	0.02
Low-Level Gas	82.38	82.44	82.40	0.02
Span Gas	164.40	164.45	164.41	0.02

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 451
Span (ppm) : 500

	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	0.00
Low-Level Gas	79.48	79.45	79.47	0.00
Span Gas	407.40	407.37	407.38	0.00

Calibrated by

Sakit P.

(Mr. Sakit Phaisangheut)
Environmental Field Scientist (4)

FORM NO. F-06-02 REVISION NO. 2 ISSUE DATE 3/6/19

ALS Laboratory Group



Lot No. 2321055-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: Siam Polyethylene Co., Ltd. Location: Furnace 1
Date: 20 Sep 23 Test Operator: Sakait P.O₂ ANALYZER Model: TELEDYNE API 100EH
Cylinder Conc. (%): 16.00 Span (%): 25

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.04	0.04	0.00	0.01	0.12	0.12
Upstream Gas	16.04	16.04	0.00	16.01	0.12	0.12

NO₂ ANALYZER Model: TELEDYNE API 200EH
Cylinder Conc. (ppm): 164.40 Span (ppm): 200

	NO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.05	0.05	0.00	0.01	0.02	0.02
Upstream Gas	164.45	164.45	0.00	164.41	0.02	0.02

CO ANALYZER Model: TELEDYNE API 300EM
Cylinder Conc. (ppm): 407.40 Span (ppm): 500

	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	0.00	-0.01	0.00	0.00
Upstream Gas	407.37	407.37	0.00	407.39	0.00	0.00

Calibrated by

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO. F 06-062 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

Client: Siam Polyethylene Co., Ltd. Run #: 1
Date: 20 Sep 23 Location: Furnace 1
Start Time: 11:20 Test Operator: Sakait P.
SO₂ Analyzer Model: TELEDYNE API 100EH Finish Time: 11:40
NO₂/O₂ Analyzer Model: TELEDYNE API 200EH Serial No.: 437
CO/CO₂ Analyzer Model: TELEDYNE API 300EM Serial No.: 774
Serial No.: 451

Time (min)	O ₂ (%)	CO ₂ (%)	NOx (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:20	5.23	9.88	15.11	-	0.20	
11:21	5.36	9.58	14.87	-	0.20	
11:22	5.21	9.70	14.98	-	0.15	
11:23	5.07	9.63	15.12	-	0.25	
11:24	5.21	9.74	15.00	-	0.24	
11:25	5.35	9.85	15.08	-	0.39	
11:26	5.43	9.58	14.97	-	0.34	
11:27	5.28	9.70	14.89	-	0.39	
11:28	5.20	9.75	14.02	-	0.41	
11:29	5.11	9.80	14.39	-	0.43	
11:30	5.23	9.88	14.81	-	0.29	
11:31	4.88	9.54	14.88	-	0.39	
11:32	5.00	9.84	14.37	-	0.57	
11:33	4.93	9.80	14.53	-	0.41	
11:34	4.58	10.04	14.39	-	0.29	
11:35	4.65	10.03	14.38	-	0.43	
11:36	4.77	9.97	14.48	-	0.24	
11:37	4.89	9.83	14.72	-	0.47	
11:38	4.98	9.88	14.48	-	0.38	
11:39	5.38	9.56	14.17	-	0.53	
11:40	4.80	9.95	14.81	-	0.33	
Average	5.07	9.80	14.65	-	0.34	

FORM NO. F 06-062 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

Client: Siam Polyethylene Co., Ltd. Run #: 2
Date: 20 Sep 23 Location: Furnace 1
Start Time: 11:41 Test Operator: Sakait P.
SO₂ Analyzer Model: TELEDYNE API 100EH Finish Time: 12:01
NO₂/O₂ Analyzer Model: TELEDYNE API 200EH Serial No.: 437
CO/CO₂ Analyzer Model: TELEDYNE API 300EM Serial No.: 774
Serial No.: 451

Time (min)	O ₂ (%)	CO ₂ (%)	NOx (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:41	4.67	10.02	14.35	-	0.57	
11:42	4.68	9.91	13.83	-	0.71	
11:43	4.68	10.07	14.27	-	0.47	
11:44	4.68	9.92	14.05	-	0.58	
11:45	5.21	9.70	14.28	-	0.47	
11:46	4.95	9.91	14.87	-	0.58	
11:47	5.15	9.79	14.47	-	0.58	
11:48	5.08	9.78	14.95	-	0.52	
11:49	5.28	9.64	14.89	-	0.47	
11:50	5.12	9.77	14.88	-	0.51	
11:51	5.13	9.78	14.98	-	0.42	
11:52	5.29	9.64	14.88	-	0.48	
11:53	5.29	9.68	14.80	-	0.65	
11:54	5.05	9.82	14.98	-	0.37	
11:55	5.43	9.55	14.53	-	0.32	
11:56	5.27	9.69	14.98	-	0.65	
11:57	5.22	9.74	15.09	-	0.48	
11:58	5.47	9.55	14.81	-	0.48	
11:59	5.47	9.57	14.93	-	0.42	
12:00	5.39	9.82	15.09	-	0.48	
12:01	5.41	9.63	15.09	-	0.51	
Average	5.18	9.75	14.68	-	0.50	

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO. F 06-062 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

Client: Siam Polyethylene Co., Ltd. Run #: 3
Date: 20 Sep 23 Location: Furnace 1
Start Time: 12:02 Test Operator: Sakait P.
SO₂ Analyzer Model: TELEDYNE API 100EH Finish Time: 12:22
NO₂/O₂ Analyzer Model: TELEDYNE API 200EH Serial No.: 437
CO/CO₂ Analyzer Model: TELEDYNE API 300EM Serial No.: 774
Serial No.: 451

Time (min)	O ₂ (%)	CO ₂ (%)	NOx (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:02	5.45	9.50	15.03	-	0.61	
12:03	5.38	9.83	14.96	-	0.37	
12:04	5.45	9.50	14.27	-	0.42	
12:05	5.17	9.72	14.62	-	0.55	
12:06	5.07	9.79	14.59	-	0.58	
12:07	5.48	9.51	13.84	-	0.81	
12:08	5.15	9.75	14.23	-	0.42	
12:09	4.94	9.91	14.43	-	0.60	
12:10	5.34	9.62	13.83	-	0.55	
12:11	5.28	9.70	14.34	-	0.51	
12:12	5.21	9.74	14.44	-	0.80	
12:13	5.33	9.88	14.42	-	0.51	
12:14	5.31	9.70	14.74	-	0.51	
12:15	5.39	9.83	14.51	-	0.48	
12:16	5.56	9.39	13.93	-	0.61	
12:17	5.18	9.75	14.22	-	0.42	
12:18	4.85	9.90	13.97	-	0.60	
12:19	5.14	9.74	14.11	-	0.51	
12:20	5.20	9.72	14.42	-	0.51	
12:21	5.45	9.57	14.50	-	0.58	
12:22	5.44	9.58	14.64	-	0.51	
Average	5.26	9.68	14.38	-	0.52	

(Mr. Sakait Phaisanphit)

Environmental Field Scientist (4)

FORM NO. F 06-062 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



Lot No. 2321055-1

ANALYZER CALIBRATION DATA

Client : Siam Polyethylene Co., Ltd. Location : Furnace 1
Date : 20 Sep 23 Test Operator : Sakit P.O₂ ANALYZER
Model : TELEDYNE API T803 Serial No. : 81
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.04	0.01	0.12
Low-Level Gas	7.93	7.97	7.94	0.12
Span Gas	16.00	16.04	16.01	0.12

NO_x ANALYZER
Model : HORIBA PG-350 Serial No. : TDBARGKP
Span (ppm) : 200

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.01	0.02
Low-Level Gas	82.39	82.44	82.40	0.02
Span Gas	164.40	164.45	164.41	0.02

CO ANALYZER
Model : HORIBA PG-350 Serial No. : TDBARGKP
Span (ppm) : 500

	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	0.00
Low-Level Gas	79.48	79.45	79.47	0.00
Span Gas	407.40	407.37	407.39	0.00

Calibrated by

(Mr. Sakit Phaisanphat)

Environmental Field Scientist (4)

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

ALS Laboratory Group



Lot No. 2321055-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Siam Polyethylene Co., Ltd. Location : Furnace 1
Date : 20 Sep 23 Test Operator : Sakit P.O₂ ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O ₂ Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.04	0.04	0.00	0.01	0.12	0.12
Upstate Gas	16.04	16.04	0.00	16.01	0.12	0.12

NO_x ANALYZER
Cylinder Conc. (ppm) : 164.40 Span (ppm) : 200

	NO _x Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.05	0.05	0.00	0.01	0.02	0.02
Upstate Gas	164.45	164.45	0.00	164.41	0.02	0.02

CO ANALYZER
Cylinder Conc. (ppm) : 407.40 Span (ppm) : 500

	CO Analyzer Calibration Response	Initial Values System Calibration Response	System Cal Bias (% of Span)	Final Values System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	-0.03	-0.03	0.00	-0.01	0.00	0.00
Upstate Gas	407.37	407.37	0.00	407.39	0.00	0.00

Calibrated by

(Mr. Sakit Phaisanphat)

Environmental Field Scientist (4)

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

ALS Laboratory Group



CEMS Data

Client Name : Siam Polyethylene Co., Ltd. Date : 20 Sep 23
Plant Name : SPS Location : Furnace 1

Run No. 1 Time Base: 21 min										Run No. 2 Time Base: 21 min									
Date	Time	SO ₂	NO _x	CO	CO ₂	CO ₂	CO ₂	CO ₂	CO ₂	Date	Time	SO ₂	NO _x	CO	CO ₂	CO ₂	CO ₂	CO ₂	CO ₂
20 Sep 23	11:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	11:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	11:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	11:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	11:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	11:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	11:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	11:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	12:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	12:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	12:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	12:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	12:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	12:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	12:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	12:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	13:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	13:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	13:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	13:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	13:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	13:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	14:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	14:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	14:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	14:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	14:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	14:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	14:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	14:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	15:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	15:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	15:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	15:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	15:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	15:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	15:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	15:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	16:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	16:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	16:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	16:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	16:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	16:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	16:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	16:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	17:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	17:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	17:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	17:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	17:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	17:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	18:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	18:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	18:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	18:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	18:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	18:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	18:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	18:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	19:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	19:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	19:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	19:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	19:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	19:37	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	19:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	19:53	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	20:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	20:09	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	20:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	20:25	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	20:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	20:41	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	20:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	20:57	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	21:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	21:13	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	21:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	21:29	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	21:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	21:45	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	22:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	22:01	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	22:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	22:17	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	22:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	22:33	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	22:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	22:49	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	23:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	23:05	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88
20 Sep 23	23:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88	20 Sep 23	23:21	10.80	4.88	3.36	10.80	4.88	3.36	10.80	4.88



Date 20 Sep 2
Location Europe

Teste Base : 21 ms

Date 20 Sep 2
Location Europe

Run No. 5		Time Base: 21 min						Start No. 6		Time Base: 21 min					
Date	Time	RCD	WV	DO	DO	DO	WV	Date	Time	RCD	WV	DO	DO	DO	WV
			ft/c	ft/c	ft/c	ft/c	ft/c				ft/c	ft/c	ft/c	ft/c	ft/c
20 Sep 23	12:44	-	18.80	0.51	5.15	8.90		20 Sep 23	13:05	-	13.52	0.50	4.67	10.17	
20 Sep 23	12:45	-	18.02	0.49	4.84	9.79		20 Sep 23	13:06	-	13.52	0.50	4.89	10.17	
20 Sep 23	12:46	-	18.02	0.49	4.84	9.79		20 Sep 23	13:07	-	13.52	0.50	4.80	10.17	
20 Sep 23	12:47	-	18.10	0.41	5.22	8.80		20 Sep 23	13:08	-	13.04	0.41	4.98	10.17	
20 Sep 23	12:48	-	18.11	0.41	5.26	9.61		20 Sep 23	13:09	-	13.52	0.41	5.16	10.17	
20 Sep 23	12:49	-	18.56	0.47	5.13	9.74		20 Sep 23	13:10	-	13.58	0.56	4.47	10.18	
20 Sep 23	12:50	-	18.70	0.47	5.00	8.88		20 Sep 23	13:11	-	13.56	0.48	4.75	10.18	
20 Sep 23	12:51	-	18.97	0.51	5.13	9.79		20 Sep 23	13:12	-	14.08	0.48	4.75	10.18	
20 Sep 23	12:52	-	18.51	0.56	5.41	9.79		20 Sep 23	13:13	-	13.52	0.58	4.60	9.97	
20 Sep 23	12:53	-	18.80	0.51	5.17	9.78		20 Sep 23	13:14	-	13.74	0.50	4.36	9.98	
20 Sep 23	12:54	-	18.46	0.51	5.16	9.78		20 Sep 23	13:15	-	13.42	0.58	4.58	9.98	
20 Sep 23	12:55	-	18.36	0.48	5.17	9.77		20 Sep 23	13:16	-	13.08	0.48	5.15	9.78	
20 Sep 23	12:56	-	18.30	0.50	4.71	10.04		20 Sep 23	13:17	-	13.08	0.50	5.15	9.78	
20 Sep 23	12:57	-	18.31	0.51	4.71	10.04		20 Sep 23	13:18	-	13.08	0.50	5.15	9.78	
20 Sep 23	12:58	-	18.30	0.41	4.48	10.11		20 Sep 23	13:19	-	13.78	0.48	5.44	1.02	
20 Sep 23	12:59	-	18.15	0.51	4.56	10.01		20 Sep 23	13:20	-	13.42	0.50	5.37	1.02	
20 Sep 23	13:00	-	18.30	0.41	4.56	10.01		20 Sep 23	13:21	-	13.74	0.50	5.37	1.02	
20 Sep 23	13:01	-	18.20	0.48	4.67	10.15		20 Sep 23	13:22	-	13.72	0.44	5.40	1.05	
20 Sep 23	13:02	-	18.15	0.48	4.96	10.15		20 Sep 23	13:23	-	13.42	0.49	5.40	1.05	
20 Sep 23	13:03	-	18.30	0.50	4.58	10.15		20 Sep 23	13:24	-	14.07	0.44	5.25	1.05	
20 Sep 23	13:04	-	17.98	0.50	4.73	10.20		20 Sep 23	13:25	-	13.78	0.48	5.46	1.01	
Mean			18.06	0.46	5.01	9.75		Mean			14.07	0.58	5.48	10.18	
			SD	0.05	0.08	0.08					SD	0.08	0.08	0.08	



Date 20 Sep
Location El Estero

no base : 27

Date 20 Sep
Location El Estero

Start Day: 11		Time Base: 21 min					Run No: 12					Time Base: 21 min				
Date	Time	DO2	WQ	Q1	Q2	Q3	Date	Time	DO2	WQ	Q1	Q2	Q3			
		gpm		gpm	gpm	gpm			gpm		gpm	gpm	gpm			
20 Sep 2012	14:00		13.91	0.36	4.06	1.71	20 Sep 2012	15:01		14.41	0.82	5.10	0.62			
20 Sep 2012	14:01		14.10	0.20	4.80	0.97	20 Sep 2012	15:02		14.05	2.72	4.40	0.62			
20 Sep 2012	14:02		14.52	0.42	4.80	0.97	20 Sep 2012	15:03		14.05	2.72	4.40	0.62			
20 Sep 2012	14:03		14.28	0.23	4.05	0.77	20 Sep 2012	15:04		14.26	0.73	5.10	0.83			
20 Sep 2012	14:04		14.14	0.40	4.80	0.97	20 Sep 2012	15:05		14.05	2.72	4.40	0.62			
20 Sep 2012	14:05		13.89	0.30	4.05	0.80	20 Sep 2012	15:06		14.41	0.58	6.06	0.71			
20 Sep 2012	14:06		13.98	0.02	4.41	0.10	20 Sep 2012	15:07		14.90	0.49	5.93	0.78			
20 Sep 2012	14:07		13.97	0.43	4.42	0.42	20 Sep 2012	15:08		14.90	0.49	5.93	0.78			
20 Sep 2012	14:08		13.97	0.36	4.75	0.90	20 Sep 2012	15:09		14.87	0.58	5.10	0.60			
20 Sep 2012	14:09		13.89	0.36	4.36	0.10	20 Sep 2012	15:10		14.91	0.78	5.10	0.83			
20 Sep 2012	14:10		13.97	0.36	4.36	0.10	20 Sep 2012	15:11		14.91	0.78	5.10	0.83			
20 Sep 2012	15:01		13.74	0.07	4.71	0.34	20 Sep 2012	15:12		14.75	0.97	5.11	0.85			
20 Sep 2012	15:02		14.12	0.43	4.80	0.68	20 Sep 2012	15:13		14.11	0.78	4.80	0.88			
20 Sep 2012	15:03		13.99	0.72	4.06	0.10	20 Sep 2012	15:14		14.11	0.78	4.80	0.88			
20 Sep 2012	15:04		14.08	0.77	4.07	0.91	20 Sep 2012	15:15		14.07	0.97	5.26	0.87			
20 Sep 2012	15:05		13.97	0.71	4.31	0.15	20 Sep 2012	15:16		14.01	0.78	4.47	0.86			
20 Sep 2012	15:06		13.96	0.72	4.36	0.77	20 Sep 2012	15:17		14.06	0.82	5.10	0.86			
20 Sep 2012	15:07		14.19	0.72	4.36	0.10	20 Sep 2012	15:18		14.01	0.59	4.83	0.91			
20 Sep 2012	15:08		13.98	0.82	4.75	0.10	20 Sep 2012	15:19		14.02	0.97	5.10	0.86			
20 Sep 2012	15:09		14.39	0.86	5.01	0.85	20 Sep 2012	15:20		14.22	0.89	4.82	0.86			
20 Sep 2012	15:10		14.98	0.93	4.80	0.73	20 Sep 2012	15:21		14.39	0.45	4.87	0.73			
20 Sep 2012	15:11		14.98	0.82	5.10	0.10	20 Sep 2012	15:22		14.11	0.97	5.26	0.86			
20 Sep 2012	15:12		14.98	0.82	5.10	0.10	20 Sep 2012	15:23		14.11	0.97	5.26	0.86			
20 Sep 2012	15:13		14.98	0.82	5.10	0.10	20 Sep 2012	15:24		14.11	0.97	5.26	0.86			
20 Sep 2012	15:14		14.98	0.82	5.10	0.10	20 Sep 2012	15:25		14.11	0.97	5.26	0.86			
20 Sep 2012	15:15		14.98	0.82	5.10	0.10	20 Sep 2012	15:26		14.11	0.97	5.26	0.86			
20 Sep 2012	15:16		14.98	0.82	5.10	0.10	20 Sep 2012	15:27		14.11	0.97	5.26	0.86			
20 Sep 2012	15:17		14.98	0.82	5.10	0.10	20 Sep 2012	15:28		14.11	0.97	5.26	0.86			
20 Sep 2012	15:18		14.98	0.82	5.10	0.10	20 Sep 2012	15:29		14.11	0.97	5.26	0.86			
20 Sep 2012	15:19		14.98	0.82	5.10	0.10	20 Sep 2012	15:30		14.11	0.97	5.26	0.86			
20 Sep 2012	15:20		14.98	0.82	5.10	0.10	20 Sep 2012	15:31		14.11	0.97	5.26	0.86			
20 Sep 2012	15:21		14.98	0.82	5.10	0.10	20 Sep 2012	15:32		14.11	0.97	5.26	0.86			
20 Sep 2012	15:22		14.98	0.82	5.10	0.10	20 Sep 2012	15:33		14.11	0.97	5.26	0.86			
20 Sep 2012	15:23		14.98	0.82	5.10	0.10	20 Sep 2012	15:34		14.11	0.97	5.26	0.86			
20 Sep 2012	15:24		14.98	0.82	5.10	0.10	20 Sep 2012	15:35		14.11	0.97	5.26	0.86			
20 Sep 2012	15:25		14.98	0.82	5.10	0.10	20 Sep 2012	15:36		14.11	0.97	5.26	0.86			
20 Sep 2012	15:26		14.98	0.82	5.10	0.10	20 Sep 2012	15:37		14.11	0.97	5.26	0.86			
20 Sep 2012	15:27		14.98	0.82	5.10	0.10	20 Sep 2012	15:38		14.11	0.97	5.26	0.86			
20 Sep 2012	15:28		14.98	0.82	5.10	0.10	20 Sep 2012	15:39		14.11	0.97	5.26	0.86			
20 Sep 2012	15:29		14.98	0.82	5.10	0.10	20 Sep 2012	15:40		14.11	0.97	5.26	0.86			
20 Sep 2012	15:30		14.98	0.82	5.10	0.10	20 Sep 2012	15:41		14.11	0.97	5.26	0.86			
20 Sep 2012	15:31		14.98	0.82	5.10	0.10	20 Sep 2012	15:42		14.11	0.97	5.26	0.86			
20 Sep 2012	15:32		14.98	0.82	5.10	0.10	20 Sep 2012	15:43		14.11	0.97	5.26	0.86			
20 Sep 2012	15:33		14.98	0.82	5.10	0.10	20 Sep 2012	15:44		14.11	0.97	5.26	0.86			
20 Sep 2012	15:34		14.98	0.82	5.10	0.10	20 Sep 2012	15:45		14.11	0.97	5.26	0.86			
20 Sep 2012	15:35		14.98	0.82	5.10	0.10	20 Sep 2012	15:46		14.11	0.97	5.26	0.86			
20 Sep 2012	15:36		14.98	0.82	5.10	0.10	20 Sep 2012	15:47		14.11	0.97	5.26	0.86			
20 Sep 2012	15:37		14.98	0.82	5.10	0.10	20 Sep 2012	15:48		14.11	0.97	5.26	0.86			
20 Sep 2012	15:38		14.98	0.82	5.10	0.10	20 Sep 2012	15:49		14.11	0.97	5.26	0.86			
20 Sep 2012	15:39		14.98	0.82	5.10	0.10	20 Sep 2012	15:50		14.11	0.97	5.26	0.86			
20 Sep 2012	15:40		14.98	0.82	5.10	0.10	20 Sep 2012	15:51		14.11	0.97	5.26	0.86			
20 Sep 2012	15:41		14.98	0.82	5.10	0.10	20 Sep 2012	15:52		14.11	0.97	5.26	0.86			
20 Sep 2012	15:42		14.98	0.82	5.10	0.10	20 Sep 2012	15:53		14.11	0.97	5.26	0.86			
20 Sep 2012	15:43		14.98	0.82	5.10	0.10	20 Sep 2012	15:54		14.11	0.97	5.26	0.86			
20 Sep 2012	15:44		14.98	0.82	5.10	0.10	20 Sep 2012	15:55		14.11	0.97	5.26	0.86			
20 Sep 2012	15:45		14.98	0.82	5.10	0.10	20 Sep 2012	15:56		14.11	0.97	5.26	0.86			
20 Sep 2012	15:46		14.98	0.82	5.10	0.10	20 Sep 2012	15:57		14.11	0.97	5.26	0.86			
20 Sep 2012	15:47		14.98	0.82	5.10	0.10	20 Sep 2012	15:58		14.11	0.97	5.26	0.86			
20 Sep 2012	15:48		14.98	0.82	5.10	0.10	20 Sep 2012	15:59		14.11	0.97	5.26	0.86			
20 Sep 2012	15:49		14.98	0.82	5.10	0.10	20 Sep 2012	16:00		14.11	0.97	5.26	0.86			
20 Sep 2012	15:50		14.98	0.82	5.10	0.10	20 Sep 2012	16:01		14.11	0.97	5.26	0.86			
20 Sep 2012	15:51		14.98	0.82	5.10	0.10	20 Sep 2012	16:02		14.11	0.97	5.26	0.86			
20 Sep 2012	15:52		14.98	0.82	5.10	0.10	20 Sep 2012	16:03		14.11	0.97	5.26	0.86			
20 Sep 2012	15:53		14.98	0.82	5.10	0.10	20 Sep 2012	16:04		14.11	0.97	5.26	0.86			
20 Sep 2012	15:54		14.98	0.82	5.10	0.10	20 Sep 2012	16:05		14.11	0.97	5.26	0.86			
20 Sep 2012	15:55		14.98	0.82	5.10	0.10	20 Sep 2012	16:06		14.11	0.97	5.26	0.86			
20 Sep 2012	15:56		14.98	0.82	5.10	0.10	20 Sep 2012	16:07		14.11	0.97	5.26	0.86			
20 Sep 2012	15:57		14.98	0.82	5.10	0.10	20 Sep 2012	16:08		14.11	0.97	5.26	0.86			
20 Sep 2012	15:58		14.98	0.82	5.10	0.10	20 Sep 2012	16:09		14.11	0.97	5.26	0.86			
20 Sep 2012	15:59		14.98	0.82	5.10	0.10	20 Sep 2012	16:10		14.11	0.97	5.26	0.86			
20 Sep 2012	16:00		14.98	0.82	5.10	0.10	20 Sep 2012	16:11		14.11	0.97	5.26	0.86			



O₂ ANALYZER
Model : TELEDYNE API 200EH Serial No. : 774
Span (%) : 25

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

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 451
Span (ppm) : 500

Calibrated by

Saksit P.

Environmental Field Scientist (4)

FORM NO. F 06-062 REVISION NO. 2 ISSUE DATE 3/05/19

ALS Laboratory Group



O₂ ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

NO _x ANALYZER	
Cylinder Conc. (ppm)	: 164.40
Span (ppm) : 200	

CO ANALYZER
Cylinder Conc. (ppm) : 407.40 Span (ppm) : 500

Calibrated by

Saksit P
(Mr.Saksit Phalsanphitsul)

Environmental Field Scientist (4)

FORM NO - E DE 883 REVISION NO - 3 ISSUE DATE: 2009

ALS Laboratory Group



EMISSION TEST RESULT

Client		Siam Polyethylene Co., Ltd.	Run #	1
Date		20 Sep 23	Location	Furnace 2
Start Time		15:35	Test Operator	Sekait P.
SO ₂ Analyzer Model		TELEDYNE API 100EH	Finish Time	15:55
NO _x /O ₂ Analyzer Model		TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model		TELEDYNE API 300EM	Serial No.	774
			Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:35	8.51	8.89	19.94	-	27.54	
15:36	8.54	8.83	19.81	-	24.69	
15:37	8.49	8.85	19.80	-	19.73	
15:38	8.50	8.83	19.91	-	24.50	
15:39	8.58	8.81	19.92	-	24.88	
15:40	8.51	8.85	19.98	-	21.97	
15:41	8.58	8.84	19.00	-	27.51	
15:42	8.60	8.82	19.95	-	27.21	
15:43	8.55	8.82	19.99	-	27.87	
15:44	8.59	8.84	19.01	-	28.63	
15:45	8.55	8.85	19.00	-	32.38	
15:46	8.47	8.89	19.98	-	24.19	
15:47	8.58	8.86	19.04	-	27.28	
15:48	8.63	8.82	19.09	-	30.02	
15:49	8.54	8.82	19.00	-	24.54	
15:50	8.49	8.87	19.32	-	25.05	
15:51	8.58	8.87	19.24	-	28.84	
15:52	8.55	8.83	19.19	-	23.51	
15:53	8.52	8.84	19.30	-	22.39	
15:54	8.53	8.85	19.22	-	27.27	
15:55	8.52	8.84	19.08	-	24.68	
Average	8.55	8.84	19.03	-	25.69	

Sekait P.

(Mr. Sekait Phaisanphat)

Environmental Field Scientist (4)

FORM NO. : F 06-02 REVISION NO. : 2 ISSUE DATE: 306/19

ALS Laboratory Group



EMISSION TEST RESULT

Client		Siam Polyethylene Co., Ltd.	Run #	2
Date		20 Sep 23	Location	Furnace 2
Start Time		16:56	Test Operator	Sekait P.
SO ₂ Analyzer Model		TELEDYNE API 100EH	Finish Time	16:16
NO _x /O ₂ Analyzer Model		TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model		TELEDYNE API 300EM	Serial No.	774
			Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
15:56	8.45	8.88	19.01	-	20.39	
15:57	8.58	8.84	19.14	-	28.51	
15:58	8.83	8.78	19.04	-	25.73	
15:59	8.82	8.76	19.03	-	22.38	
16:00	8.64	8.78	19.18	-	28.38	
16:01	8.59	8.81	19.18	-	24.72	
16:02	8.53	8.82	19.17	-	23.07	
16:03	8.62	8.83	19.09	-	27.27	
16:04	8.68	8.78	19.05	-	27.48	
16:05	8.58	8.80	19.98	-	22.24	
16:06	8.81	8.81	19.19	-	28.23	
16:07	8.69	8.79	19.11	-	28.35	
16:08	8.67	8.80	19.09	-	23.41	
16:09	8.81	8.83	19.30	-	27.78	
16:10	8.68	8.79	19.37	-	27.29	
16:11	8.65	8.74	19.38	-	24.73	
16:12	8.57	8.81	19.23	-	21.57	
16:13	8.63	8.81	19.51	-	27.35	
16:14	8.68	8.80	19.47	-	25.67	
16:15	8.58	8.84	19.38	-	21.40	
16:16	8.53	8.83	19.44	-	23.81	
Average	8.61	8.80	19.21	-	24.65	

Sekait P.

(Mr. Sekait Phaisanphat)

Environmental Field Scientist (4)

FORM NO. : F 06-02 REVISION NO. : 2 ISSUE DATE: 306/19

ALS Laboratory Group



EMISSION TEST RESULT

Client		Siam Polyethylene Co., Ltd.	Run #	3
Date		20 Sep 23	Location	Furnace 2
Start Time		16:17	Test Operator	Sekait P.
SO ₂ Analyzer Model		TELEDYNE API 100EH	Finish Time	16:37
NO _x /O ₂ Analyzer Model		TELEDYNE API 200EH	Serial No.	437
CO/CO ₂ Analyzer Model		TELEDYNE API 300EM	Serial No.	774
			Serial No.	451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
16:17	8.67	8.77	19.32	-	31.61	
16:18	8.71	8.75	19.22	-	28.88	
16:19	8.81	8.81	19.28	-	21.09	
16:20	8.61	8.82	19.34	-	23.01	
16:21	8.79	8.78	19.38	-	33.00	
16:22	8.74	8.74	19.30	-	31.01	
16:23	8.62	8.81	19.23	-	21.47	
16:24	8.55	8.87	19.28	-	21.95	
16:25	8.65	8.82	19.26	-	30.26	
16:26	8.70	8.76	19.16	-	28.14	
16:27	8.67	8.75	19.14	-	22.74	
16:28	8.69	8.77	19.03	-	26.87	
16:29	8.73	8.75	19.12	-	27.98	
16:30	8.65	8.78	19.19	-	21.94	
16:31	8.61	8.81	19.19	-	24.34	
16:32	8.68	8.78	19.22	-	28.82	
16:33	8.65	8.77	19.18	-	22.95	
16:34	8.57	8.81	19.34	-	20.14	
16:35	8.64	8.81	19.13	-	27.28	
16:36	8.68	8.80	19.23	-	27.45	
16:37	8.57	8.81	19.28	-	21.42	
Average	8.66	8.78	19.23	-	25.71	

Sekait P.

(Mr. Sekait Phaisanphat)

Environmental Field Scientist (4)

FORM NO. : F 06-02 REVISION NO. : 2 ISSUE DATE: 306/19

ALS Laboratory Group



ANALYZER CALIBRATION DATA

Lot No. 2321055-1

Client	Siam Polyethylene Co., Ltd.	Location	Furnace 2
Date	20 Sep 23	Test Operator	Sekait P.
O ₂ ANALYZER			
Model	TELEDYNE API 200EH	Serial No.	774
Span (%)	25		

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	-0.03	-0.01	0.08
Low-Level Gas	7.93	7.90	7.92	0.08
Span Gas	16.00	15.97	15.99	0.08

NO _x ANALYZER			
Model	TELEDYNE API 200EH	Serial No.	774
Span (ppm)	200		

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.05	0.01	0.02
Low-Level Gas	82.39	82.44	82.40	0.02
Span Gas	164.40	164.45	164.41	0.02

CO ANALYZER			
Model	TELEDYNE API 300EM	Serial No.	451
Span (ppm)	500		

	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	0.00
Low-Level Gas	79.48	79.45	79.47	0.00
Span Gas	407.40	407.37	407.38	0.00

Calibrated by

Sekait P.

(Mr. Sekait Phaisanphat)

Environmental Field Scientist (4)

FORM NO. : F 06-104 REVISION NO. : 1 ISSUE DATE: 306/19

ALS Laboratory Group



Client	Siam Polyethylene Co., Ltd.	Location	Furnace 2
Date	20 Sep. 23	Test Operator	Bakht B.

Client	Siam Polyethylene Co., Ltd.	Location	Furnace 2
Date	20 Sep. 23	Test Operator	Bakht B.

O₂ ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cell Bias (% of Span)	System Calibration Response	System Cell Bias (% of Span)	
Zero Gas	-0.03	-0.03	0.00	-0.01	0.08	0.08
15.9% O ₂ Gas	15.97	15.97	0.00	15.88	0.08	0.08

NO_x ANALYZER
Cylinder Conc. (ppm) : 164.40 Span (ppm) : 200

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Orft (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.05	0.05	0.00	0.01	0.02	0.02
Nonzero Gas	164.4%	164.4%	0.03	164.1%	0.02	0.02

CO ANALYZER
Cylinder Conc. (ppm) : 407.40 Span (ppm) : 500

	CO Analyzer Calibration Response	Initial Value		Final Value		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	0.00	-0.01	0.00	0.00
Span Gas	407.37	407.37	0.00	407.39	0.00	0.00

Calibrated by

Spoket P

FORM NO.: F DS-104 REVISION NO.: 1 ISSUE DATE: 30/8/19



Client Name	Slaz Polyethylene Co., Ltd.	Date	20 Sep 23
Plant Name	SRP	Location	Bussare 2

No. 7 Time Base: 21 mm Run No. 8 Time Base:

Run No. 7 Time Base: 21 mm Run No. 8 Time Base:

Run No. 7		Time Base : 21 min						Run No. 8		Time Base : 21 min					
Date	Time	R02	M04	G05	G02	G02		Date	Time	R02	M04	G05	G02	G02	
		Value	Value	Value	Value	Value	Value			Value	Value	Value	Value	Value	Value
20 Sep 23	13:55	-	16.89	37.05	6.94	-	-	20 Sep 23	14:17	-	16.75	26.08	6.96	-	-
20 Sep 23	13:57	36.83	5.94	-	-	14.78	-	20 Sep 23	14:19	17.41	6.74	-	-	-	-
20 Sep 23	13:59	-	16.77	41.35	6.70	-	-	20 Sep 23	14:21	-	19.80	25.88	6.75	-	-
20 Sep 23	13:59	-	16.80	43.06	6.69	-	-	20 Sep 23	14:23	-	19.81	33.35	6.69	-	-
20 Sep 23	14:00	14.00	17.10	6.69	-	14.21	-	20 Sep 23	14:25	18.82	6.68	-	-	-	-
20 Sep 23	14:01	-	16.91	46.46	6.68	-	-	20 Sep 23	14:27	-	19.54	40.29	6.68	-	-
20 Sep 23	14:02	-	17.02	48.17	6.12	-	-	20 Sep 23	14:29	-	19.26	45.85	7.07	-	-
20 Sep 23	14:03	14.03	14.03	7.74	-	14.03	-	20 Sep 23	14:31	19.26	7.37	-	-	-	-
20 Sep 23	14:04	-	17.29	51.57	6.62	-	-	20 Sep 23	14:32	-	18.76	49.35	7.40	-	-
20 Sep 23	14:04	-	17.34	53.29	6.67	-	-	20 Sep 23	14:33	-	18.49	47.37	7.24	-	-
20 Sep 23	14:05	17.45	36.96	6.62	-	14.05	-	20 Sep 23	14:34	18.26	6.41	-	-	-	-
20 Sep 23	14:07	-	17.39	36.84	6.66	-	-	20 Sep 23	14:35	-	18.14	36.69	7.14	-	-
20 Sep 23	14:08	-	17.67	31.52	6.66	-	-	20 Sep 23	14:36	-	18.86	110.59	6.66	-	-
20 Sep 23	14:09	-	17.79	36.82	6.66	-	-	20 Sep 23	14:37	-	19.43	5.90	-	-	-
20 Sep 23	14:10	-	17.88	30.39	6.62	-	-	20 Sep 23	14:38	-	20.79	30.19	6.62	-	-
20 Sep 23	14:11	-	18.01	29.71	6.14	-	-	20 Sep 23	14:39	-	20.96	32.35	7.41	-	-
20 Sep 23	14:12	-	18.10	29.10	6.66	-	-	20 Sep 23	14:40	-	20.43	5.90	-	-	-
20 Sep 23	14:13	-	18.27	28.90	6.66	-	-	20 Sep 23	14:41	-	19.19	36.72	6.74	-	-
20 Sep 23	14:14	-	18.40	27.85	6.04	-	-	20 Sep 23	14:42	-	18.75	36.90	6.79	-	-
20 Sep 23	14:15	-	18.59	27.42	6.66	-	-	20 Sep 23	14:43	-	18.68	6.68	-	-	-
20 Sep 23	14:16	-	18.80	30.69	6.31	-	-	20 Sep 23	14:47	-	17.09	43.57	6.60	-	-
Mar	-	18.05	53.28	6.96	-	-	-	Mar	-	20.39	110.59	6.90	-	-	-

Avg	-	19.12	36.33	6.75	-	Avg	-	19.12	47.65	7.21	-
Run No. 9	Time Base: 21 mm					Run No. 10	Time Base: 21 mm				

Date	Time	BOE	HO	GO	OE	VOE	Date	Time	BOE	HO	GO	OE	VOE
		per	per	per	per	per			per	per	per	per	per
20 Sep 29	14:08	-	17:07	45:45	0:00	-	20 Sep 29	14:09	-	17:30	41:53	0:30	-
20 Sep 29	14:10	-	17:02	47:00	0:04	-	20 Sep 29	14:12	-	17:28	42:42	0:47	-
20 Sep 29	14:13	-	17:03	46:33	0:09	-	20 Sep 29	14:14	-	17:32	43:42	0:52	-
20 Sep 29	14:17	-	17:52	52:36	0:51	-	20 Sep 29	15:02	-	17:38	42:22	0:04	-
20 Sep 29	14:20	-	17:09	39:39	0:00	-	20 Sep 29	15:03	-	17:36	41:11	0:00	-
20 Sep 29	14:23	-	17:02	40:50	0:10	-	20 Sep 29	15:04	-	17:41	41:14	0:00	-
20 Sep 29	14:24	-	17:09	40:44	0:05	-	20 Sep 29	15:05	-	17:43	40:51	0:10	-
20 Sep 29	14:40	-	17:52	42:37	0:46	-	20 Sep 29	15:08	-	17:42	40:30	0:00	-
20 Sep 29	14:47	-	17:42	41:29	0:58	-	20 Sep 29	15:10	-	17:42	40:02	0:00	-
20 Sep 29	14:47	-	17:42	44:33	0:00	-	20 Sep 29	15:09	-	17:45	37:58	0:00	-
20 Sep 29	14:48	-	17:30	43:16	0:17	-	20 Sep 29	15:10	-	17:41	35:04	0:10	-
20 Sep 29	14:49	-	17:36	43:24	0:07	-	20 Sep 29	15:10	-	17:37	34:30	0:40	-
20 Sep 29	14:50	-	17:36	43:10	0:00	-	20 Sep 29	15:11	-	17:39	34:00	0:00	-
20 Sep 29	14:51	-	17:30	42:10	0:14	-	20 Sep 29	15:12	-	17:38	33:03	0:00	-
20 Sep 29	14:52	-	17:29	41:01	0:14	-	20 Sep 29	15:13	-	17:24	32:15	0:00	-
20 Sep 29	14:53	-	17:28	41:07	0:17	-	20 Sep 29	15:14	-	17:27	31:40	0:00	-
20 Sep 29	14:54	-	17:23	40:52	0:16	-	20 Sep 29	15:15	-	17:18	30:39	0:00	-
20 Sep 29	14:55	-	17:18	39:00	0:42	-	20 Sep 29	15:16	-	17:11	30:21	0:04	-
20 Sep 29	14:56	-	17:16	38:44	0:14	-	20 Sep 29	15:17	-	17:09	29:49	0:10	-
20 Sep 29	14:57	-	17:12	30:19	0:42	-	20 Sep 29	15:18	-	17:10	30:16	0:00	-
20 Sep 29	14:58	-	17:16	35:03	0:01	-	20 Sep 29	15:19	-	17:10	30:38	0:01	-
Mon		-	17:07	42:37	7:30	-	Mon		-	17:42	41:40	0:48	-

Run No: 11	Time Base: 21 min	Run No: 12	Time Base: 21 min
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Date	Time	B02	NOB	GO	O2	GO2	Date	Time	B02	NOB	GO	O2	GO2
						MOCK							MOCK
20 Sep 29	13:20		17:20	39:00	6:30		20 Sep 29	15:47		17:04	39:04	6:30	
20 Sep 29	13:21		17:20	35:54	6:01		20 Sep 29	15:48		17:04	37:07	6:01	
20 Sep 29	13:22		17:20	35:27	5:59		20 Sep 29	15:49		17:04	35:50	5:59	
20 Sep 29	13:23		17:20	31:40	6:00		20 Sep 29	15:48		17:05	37:03	6:01	
20 Sep 29	13:24		17:30	36:03	6:14		20 Sep 29	15:49		17:06	37:08	6:10	
20 Sep 29	13:25		17:40	36:26	6:00		20 Sep 29	15:48		17:06	37:09	6:00	
20 Sep 29	13:26		17:40	36:09	5:58		20 Sep 29	15:47		17:07	37:02	5:58	
20 Sep 29	13:27		17:43	29:11	6:14		20 Sep 29	15:49		17:08	37:55	6:10	
20 Sep 29	13:28		17:46	29:54	6:00		20 Sep 29	15:49		17:08	37:48	6:10	
20 Sep 29	13:29		17:54	32:21	6:00		20 Sep 29	15:47		17:09	37:44	6:00	
20 Sep 29	13:30		17:55	27:40	6:04		20 Sep 29	15:51		16:05	36:59	6:12	
20 Sep 29	13:31		17:56	29:43	6:10		20 Sep 29	15:52		16:05	36:54	6:10	
20 Sep 29	13:32		17:56	35:52	6:00		20 Sep 29	15:53		16:07	37:23	6:10	
20 Sep 29	13:33		17:54	36:00	6:00		20 Sep 29	15:54		16:02	36:04	6:10	
20 Sep 29	13:34		17:54	31:03	6:00		20 Sep 29	15:55		16:03	36:05	6:00	
20 Sep 29	13:35		17:56	35:18	6:11		20 Sep 29	15:56		16:03	36:09	6:10	
20 Sep 29	13:36		17:50	39:07	6:09		20 Sep 29	15:57		16:04	36:04	6:00	
20 Sep 29	13:37		17:52	39:06	6:02		20 Sep 29	15:58		16:03	36:03	6:00	
20 Sep 29	13:38		17:52	39:04	6:11		20 Sep 29	15:59		16:04	36:18	6:04	
20 Sep 29	13:39		17:59	33:19	6:08		20 Sep 29	16:00		16:05	36:02	6:10	
20 Sep 29	13:40		17:59	38:11	6:08		20 Sep 29	16:01		16:05	36:15	6:10	
Mon			17:59	38:11	6:08		Mon			16:07	36:04	6:10	

reg	-	0.00	0.00	0.00	0.00	0.00	reg	0	0.00	0.00	0.00	0.00
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Client Name Siam Polyethylene Co., Ltd. Date 20 Sep 23
Plant Name SRP Location Samut Prakan 2

FISH (mm)		PC	LOCATION	PATHWAY
No. 1		Time Base 21 ml	Run No. 2	Time Base

Run No. 1	Flow Rate	GPC	Location	Time Base

Run No. 1	Flow Rate	GPC	Location	Time Base

Run No. 1							Run No. 2						
Time Base: 21 min							Time Base: 21 min						
Date	Time	DOZ	DOZ	NO ₃	NO ₃	DOZ	Date	Time	DOZ	DOZ	NO ₃	NO ₃	DOZ
20 Sep 23	13:00	-	-	16.98	67.27	0.73	20 Sep 23	12:11	-	-	16.47	54.23	6.00
20 Sep 23	13:11	-	-	16.91	68.24	0.79	-	-	-	-	16.47	67.37	6.01
20 Sep 23	13:22	-	-	16.75	69.25	0.80	-	-	-	-	16.74	68.74	6.01
20 Sep 23	13:33	-	-	16.51	57.86	0.77	-	-	-	-	16.47	66.76	6.00
20 Sep 23	13:44	-	-	16.60	53.30	0.80	-	-	-	-	16.47	47.49	6.02
20 Sep 23	13:55	-	-	16.61	46.04	0.80	-	-	-	-	16.47	32.43	6.01
20 Sep 23	13:56	-	-	16.58	44.58	0.81	-	-	-	-	16.46	37.78	6.00
20 Sep 23	13:57	-	-	16.57	40.30	0.80	-	-	-	-	16.44	62.30	6.03
20 Sep 23	13:58	-	-	16.58	43.62	0.82	-	-	-	-	16.44	62.30	6.03
20 Sep 23	13:59	-	-	16.58	45.15	0.80	-	-	-	-	16.42	58.55	6.00
20 Sep 23	14:00	-	-	16.56	46.39	0.79	-	-	-	-	16.40	66.30	6.00
20 Sep 23	14:01	-	-	16.50	51.41	0.81	-	-	-	-	16.40	66.30	6.01
20 Sep 23	14:02	-	-	16.52	50.44	0.81	-	-	-	-	16.39	65.63	6.04
20 Sep 23	14:03	-	-	16.57	61.61	0.81	-	-	-	-	16.24	56.29	6.00
20 Sep 23	14:04	-	-	16.50	51.51	0.75	-	-	-	-	16.37	62.05	6.71
20 Sep 23	14:05	-	-	16.49	44.54	0.75	-	-	-	-	16.43	61.62	6.01
20 Sep 23	14:06	-	-	16.46	32.16	0.73	-	-	-	-	16.41	61.71	6.01
20 Sep 23	14:07	-	-	16.49	54.72	0.64	-	-	-	-	16.37	47.80	6.77
20 Sep 23	14:08	-	-	16.49	33.35	0.79	-	-	-	-	16.34	60.39	6.62
20 Sep 23	14:09	-	-	16.43	45.33	0.73	-	-	-	-	16.39	60.39	6.69
20 Sep 23	14:10	-	-	16.40	45.20	0.61	-	-	-	-	16.39	51.77	6.58
Mon	-	-	-	16.40	69.23	0.50	-	-	-	-	16.36	70.55	6.00

Aug	-	100	0.184	0.70	-	Aug	-	10.40	52.52	0.73	-
Run No. 3						Run No. 4					
Time Base: 21 min						Time Base: 21 min					

Date	Time	POD	MOB	GO	GO	GO2	Date	Time	POD	MOB	GO	GO	GO2
		POD	MOB	GO	GO	GO2			POD	MOB	GO	GO	GO2
20 Jan 23	12:30	16.08	15.45	8.83			20 Jan 23	12:00	16.02	15.83	9.12	6.80	
20 Jan 23	12:30	16.08	15.71	8.88			20 Jan 23	12:00	16.02	15.72	9.12	6.80	
20 Jan 23	12:30	16.08	15.84	8.75			20 Jan 23	12:00	16.02	15.72	9.12	6.80	
20 Jan 23	12:05	17.04	16.32	8.80			20 Jan 23	12:00	16.04	16.02	9.13		
20 Jan 23	12:06	16.08	16.60	8.72			20 Jan 23	12:07	16.08	16.03	9.15		
20 Jan 23	12:07	16.14	16.08	8.72			20 Jan 23	12:08	16.09	16.03	9.15		
20 Jan 23	12:08	16.08	16.19	8.80			20 Jan 23	12:08	16.04	16.05	9.17		
20 Jan 23	12:30	16.08	16.08	8.79			20 Jan 23	13:00	16.04	16.08	9.00		
20 Jan 23	12:30	16.17	16.08	8.80			20 Jan 23	13:00	16.04	16.08	9.00		
20 Jan 23	12:41	16.73	16.59	8.80			20 Jan 23	13:02	16.04	16.08	9.00		
20 Jan 23	12:42	16.67	16.53	8.78			20 Jan 23	13:06	16.04	16.01	9.02		
20 Jan 23	12:43	16.62	16.42	8.72			20 Jan 23	13:04	16.04	16.18	8.98		
20 Jan 23	12:44	16.44	16.21	8.80			20 Jan 23	13:06	16.03	16.15	9.02		
20 Jan 23	12:45	16.52	16.30	8.80			20 Jan 23	13:06	16.04	16.30	9.03		
20 Jan 23	12:46	16.47	16.33	8.81			20 Jan 23	13:07	16.04	16.26	9.03		
20 Jan 23	12:47	16.38	16.08	8.80			20 Jan 23	13:08	16.04	16.44	9.03		
20 Jan 23	12:48	16.37	16.27	8.80			20 Jan 23	13:10	16.04	16.05	9.04		
20 Jan 23	12:49	16.32	16.02	8.80			20 Jan 23	13:12	16.04	16.03	9.07		
20 Jan 23	12:50	16.11	16.08	8.80			20 Jan 23	13:15	16.04	16.20	9.05		
20 Jan 23	12:51	16.22	16.14	8.81			20 Jan 23	13:16	16.04	16.09	9.05		
20 Jan 23	12:52	16.16	16.17	8.81			20 Jan 23	13:18	16.04	16.23	9.04		
Mean		17.04	16.85	8.80			Mean		16.12	16.22	9.06		

Run No. 5	Time Base: 21 min	Run No. 6	Time Base: 21 min
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[illegible][illegible]

Client Name	Siam Polyethylene Co., Ltd.	Date	20 Sep 23
Plant Name	SPS	Location	Furnace 2

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

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

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

Run No. 1						Time Base: 21 min						Run No. 2						Time Base: 21 min					
Date	Time	RO2	WbO2	GO	GO	GO	Date	Time	RO2	WbO2	GO	GO	GO	Date	Time	RO2	WbO2	GO	GO	GO			
20 Sep 23	11:50	18.39	18.39	47.40	8.70	8.70	20 Sep 23	12:11		18.12	39.27	6.99	8.80	20 Sep 23	12:11	18.39	47.40	8.70	8.70				
20 Sep 23	11:51	18.39	18.39	47.40	8.70	8.70	20 Sep 23	12:12		18.48	39.41	6.99	8.80	20 Sep 23	12:12	18.39	47.40	8.70	8.70				
20 Sep 23	11:52		18.71	47.37	8.50	8.90	20 Sep 23	12:13		18.20	39.61	6.90	8.80	20 Sep 23	12:13	18.39	47.40	8.70	8.70				
20 Sep 23	11:53	18.59	18.84	53.00	8.00	8.75	20 Sep 23	12:14		18.19	39.37	6.55	8.80	20 Sep 23	12:14	18.39	47.40	8.70	8.70				
20 Sep 23	11:54	18.59	18.59	47.03	8.67	8.67	20 Sep 23	12:15		18.30	41.41	6.90	8.80	20 Sep 23	12:15	18.39	47.40	8.70	8.70				
20 Sep 23	11:55	18.59	18.59	34.14	8.40	8.82	20 Sep 23	12:16		18.30	45.55	6.47	8.80	20 Sep 23	12:16	18.39	47.40	8.70	8.70				
20 Sep 23	11:56	18.87	30.11	4.40	8.87		20 Sep 23	12:17		18.28	35.56	6.52	8.81	20 Sep 23	12:17	18.39	47.40	8.70	8.70				
20 Sep 23	11:57	18.88	1.87	8.40	8.40		20 Sep 23	12:18		18.30	44.50	6.41	8.80	20 Sep 23	12:18	18.39	47.40	8.70	8.70				
20 Sep 23	11:58		18.69	36.18	8.40	8.86	20 Sep 23	12:19		18.18	44.11	6.41	8.80	20 Sep 23	12:19	18.39	47.40	8.70	8.70				
20 Sep 23	11:59		18.76	31.60	8.36	8.86	20 Sep 23	12:20		18.22	34.91	6.45	8.80	20 Sep 23	12:20	18.39	47.40	8.70	8.70				
20 Sep 23	12:00		18.78	30.83	8.36	8.86	20 Sep 23	12:21		18.27	35.87	6.51	8.80	20 Sep 23	12:21	18.39	47.40	8.70	8.70				
20 Sep 23	12:01		18.81	43.70	8.47	8.84	20 Sep 23	12:22		18.17	52.88	6.58	8.78	20 Sep 23	12:22	18.39	47.40	8.70	8.70				
20 Sep 23	12:02	19.40	42.28	8.50	8.82		20 Sep 23	12:23		18.24	44.90	6.51	8.78	20 Sep 23	12:23	18.39	47.40	8.70	8.70				
20 Sep 23	12:03	18.81	32.96	8.36	8.86		20 Sep 23	12:24		18.34	46.94	6.51	8.78	20 Sep 23	12:24	18.39	47.40	8.70	8.70				
20 Sep 23	12:04	18.62	42.55	8.37	8.87		20 Sep 23	12:25		18.34	35.15	6.59	8.81	20 Sep 23	12:25	18.39	47.40	8.70	8.70				
20 Sep 23	12:05	18.47	32.88	8.40	8.87		20 Sep 23	12:26		18.36	44.31	6.51	8.81	20 Sep 23	12:26	18.39	47.40	8.70	8.70				
20 Sep 23	12:06	18.54	42.54	8.47	8.87		20 Sep 23	12:27		18.43	42.40	6.41	8.80	20 Sep 23	12:27	18.39	47.40	8.70	8.70				
20 Sep 23	12:07		18.30	37.87	8.36	8.85	20 Sep 23	12:28		18.43	52.72	6.41	8.80	20 Sep 23	12:28	18.39	47.40	8.70	8.70				
20 Sep 23	12:08	19.44	41.73	8.36	8.80		20 Sep 23	12:29		18.32	43.93	6.47	8.87	20 Sep 23	12:29	18.39	47.40	8.70	8.70				
20 Sep 23	12:09	18.30	34.23	8.40	8.86		20 Sep 23	12:30		18.35	48.48	6.57	8.80	20 Sep 23	12:30	18.39	47.40	8.70	8.70				
20 Sep 23	12:10		18.50	55.34	8.57	8.93	20 Sep 23	12:31		18.35	39.78	6.27	8.81	20 Sep 23	12:31	18.39	47.40	8.70	8.70				
Mar			18.78	54.29	8.57	8.90	Mar			18.36	63.87	6.58	8.91	Mar									

Aug	-	10.0	43.30	0.40	0.02	Aug	-	10.20	40.00	0.40	0.04
Run No. 3						Run No. 4					
Time Base: 21 min						Time Base: 21 min					

20 Sep 23										20 Sep 23									
Date	Time	BOD		COD		DO		pH		Date	Time	BOD		COD		DO		pH	
		mg/l	%	mg/l	%	mg/l	%					mg/l	%	mg/l	%	mg/l	%		
20 Sep 23	12:30	-	-	18.58	48.84	5.41	8.01	-	-	20 Sep 23	12:30	18.34	42.43	4.28	6.28	-	-	-	-
20 Sep 23	12:30	-	-	18.48	41.81	6.47	8.04	-	-	20 Sep 23	12:30	18.32	34.15	5.15	8.24	-	-	-	-
20 Sep 23	12:30	-	-	18.58	42.27	6.41	8.01	-	-	20 Sep 23	12:30	18.32	42.29	4.48	6.28	-	-	-	-
20 Sep 23	12:30	-	-	18.49	41.91	6.48	8.00	-	-	20 Sep 23	12:30	18.38	39.65	4.28	8.33	-	-	-	-
20 Sep 23	12:30	-	-	18.41	45.41	6.50	8.05	-	-	20 Sep 23	12:30	18.35	47.08	6.27	9.32	-	-	-	-
20 Sep 23	12:30	-	-	18.37	42.38	6.46	8.01	-	-	20 Sep 23	12:30	18.37	42.38	4.28	6.28	-	-	-	-
20 Sep 23	12:30	-	-	18.79	36.71	6.40	8.01	-	-	20 Sep 23	12:30	17.91	34.05	4.45	8.04	-	-	-	-
20 Sep 23	12:30	-	-	18.85	44.62	6.40	8.08	-	-	20 Sep 23	12:30	18.06	38.42	5.32	8.80	-	-	-	-
20 Sep 23	12:30	-	-	18.83	42.61	6.52	8.05	-	-	20 Sep 23	12:30	18.32	42.38	6.33	8.33	-	-	-	-
20 Sep 23	12:31	-	-	18.64	36.03	6.40	8.01	-	-	20 Sep 23	13:02	18.30	35.30	4.30	8.42	-	-	-	-
20 Sep 23	12:42	-	-	18.81	37.30	6.36	8.01	-	-	20 Sep 23	13:02	-	-	-	-	-	-	-	-
20 Sep 23	12:43	-	-	18.62	45.40	6.44	8.00	-	-	20 Sep 23	13:04	-	-	-	-	-	-	-	-
20 Sep 23	12:43	-	-	18.85	42.16	6.44	8.01	-	-	20 Sep 23	13:04	18.22	39.79	5.35	8.33	-	-	-	-
20 Sep 23	12:43	-	-	18.67	36.01	6.36	8.01	-	-	20 Sep 23	13:04	18.32	42.38	6.33	8.33	-	-	-	-
20 Sep 23	12:43	-	-	18.67	36.01	6.36	8.00	-	-	20 Sep 23	13:05	18.28	43.13	6.44	8.04	-	-	-	-
20 Sep 23	12:44	-	-	18.60	42.29	6.38	8.03	-	-	20 Sep 23	13:07	-	-	-	-	-	-	-	-
20 Sep 23	12:44	-	-	18.41	37.48	6.40	8.01	-	-	20 Sep 23	13:07	18.01	36.85	6.35	8.34	-	-	-	-
20 Sep 23	12:44	-	-	18.39	42.45	6.42	8.07	-	-	20 Sep 23	13:08	18.01	42.38	6.33	8.33	-	-	-	-
20 Sep 23	12:44	-	-	18.39	42.45	6.42	8.07	-	-	20 Sep 23	13:08	18.00	36.80	6.35	8.35	-	-	-	-
20 Sep 23	12:44	-	-	18.30	42.27	6.37	8.06	-	-	20 Sep 23	13:09	18.29	43.22	6.34	8.33	-	-	-	-
20 Sep 23	12:45	-	-	18.30	42.45	6.38	8.06	-	-	20 Sep 23	13:10	18.14	42.38	6.33	8.33	-	-	-	-
20 Sep 23	12:51	-	-	18.18	47.86	6.30	8.01	-	-	20 Sep 23	13:12	-	-	-	-	-	-	-	-
20 Sep 23	12:51	-	-	18.22	39.31	6.30	8.05	-	-	20 Sep 23	13:13	18.27	39.30	6.45	8.08	-	-	-	-
Mon	-	-	-	18.85	50.80	6.30	8.05	-	-	Mon	-	-	-	-	-	-	-	-	-

Run No. 5	Time Base: 21 min	Run No. 8	Time Base: 21 min
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Date	Time	DOZ	WdN	GO	QZ	GOZ	Date	Time	DOZ	WdN	GO	QZ	GOZ
		per											
20 Sep 23	13:14		18:23	42:40	0:42	8:59	20 Sep 23	13:35		18:42	51:08	0:50	8:06
20 Sep 23	13:15		18:23	38:14	0:28	8:59	20 Sep 23	13:36		18:54	52:02	0:50	8:06
20 Sep 23	13:16		18:23	33:59	0:15	8:59	20 Sep 23	13:37		18:51	53:00	0:50	8:06
20 Sep 23	13:17		18:21	29:40	0:06	8:59	20 Sep 23	13:38		18:40	54:50	0:57	8:10
20 Sep 23	13:18		18:11	48:37	0:08	8:51	20 Sep 23	13:39		18:42	52:61	0:50	8:07
20 Sep 23	13:19		18:16	36:54	0:23	8:59	20 Sep 23	13:40		18:47	51:56	0:54	8:06
20 Sep 23	13:20		18:10	42:59	0:28	8:59	20 Sep 23	13:41		18:58	52:58	0:47	8:06
20 Sep 23	13:21		18:12	55:22	0:36	8:54	20 Sep 23	13:42		19:10	54:48	0:44	8:02
20 Sep 23	13:22		18:11	42:09	0:36	8:52	20 Sep 23	13:43		19:01	52:49	0:47	8:06
20 Sep 23	13:23		18:10	52:27	0:38	8:52	20 Sep 23	13:44		18:57	54:47	0:47	8:06
20 Sep 23	13:24		18:29	41:59	0:28	8:59	20 Sep 23	13:45		19:40	52:36	0:51	8:06
20 Sep 23	13:25		18:20	53:00	0:40	8:52	20 Sep 23	13:46		19:36	57:10	0:44	8:07
20 Sep 23	13:26		18:22	48:46	0:38	8:52	20 Sep 23	13:47		19:40	56:56	0:47	8:06
20 Sep 23	13:27		18:30	36:21	0:28	8:59	20 Sep 23	13:48		19:48	56:54	0:47	8:01
20 Sep 23	13:28		18:36	36:10	0:27	8:59	20 Sep 23	13:49		19:24	54:19	0:45	8:00
20 Sep 23	13:29		18:37	44:05	0:37	8:59	20 Sep 23	13:50		19:42	53:48	0:45	8:00
20 Sep 23	13:30		18:29	48:43	0:40	8:58	20 Sep 23	13:51		19:12	56:09	0:50	8:01
20 Sep 23	13:31		18:23	41:11	0:36	8:54	20 Sep 23	13:52		19:02	54:40	0:53	8:03
20 Sep 23	13:32		18:34	42:01	0:38	8:54	20 Sep 23	13:53		19:02	52:20	0:53	8:03
20 Sep 23	13:33		18:12	36:46	0:20	8:59	20 Sep 23	13:54		18:48	57:10	0:20	8:00
20 Sep 23	13:34		18:29	46:37	0:37	8:53	20 Sep 23	13:55		18:36	56:11	0:21	8:00
20 Sep 23	13:35		18:36	55:22	0:42	8:53	20 Sep 23	13:56		18:48	56:51	0:51	8:03
20 Sep 23	13:36		18:36	55:22	0:42	8:53	20 Sep 23	13:57		18:29	56:51	0:51	8:03
20 Sep 23	13:37		18:36	55:22	0:42	8:53	20 Sep 23	13:58		18:29	56:51	0:51	8:03
20 Sep 23	13:38		18:36	55:22	0:42	8:53	20 Sep 23	13:59		18:29	56:51	0:51	8:03
20 Sep 23	13:39		18:36	55:22	0:42	8:53	20 Sep 23	14:00		18:29	56:51	0:51	8:03
20 Sep 23	13:40		18:36	55:22	0:42	8:53	20 Sep 23	14:01		18:29	56:51	0:51	8:03
20 Sep 23	13:41		18:36	55:22	0:42	8:53	20 Sep 23	14:02		18:29	56:51	0:51	8:03
20 Sep 23	13:42		18:36	55:22	0:42	8:53	20 Sep 23	14:03		18:29	56:51	0:51	8:03
20 Sep 23	13:43		18:36	55:22	0:42	8:53	20 Sep 23	14:04		18:29	56:51	0:51	8:03
20 Sep 23	13:44		18:36	55:22	0:42	8:53	20 Sep 23	14:05		18:29	56:51	0:51	8:03
20 Sep 23	13:45		18:36	55:22	0:42	8:53	20 Sep 23	14:06		18:29	56:51	0:51	8:03
20 Sep 23	13:46		18:36	55:22	0:42	8:53	20 Sep 23	14:07		18:29	56:51	0:51	8:03
20 Sep 23	13:47		18:36	55:22	0:42	8:53	20 Sep 23	14:08		18:29	56:51	0:51	8:03
20 Sep 23	13:48		18:36	55:22	0:42	8:53	20 Sep 23	14:09		18:29	56:51	0:51	8:03
20 Sep 23	13:49		18:36	55:22	0:42	8:53	20 Sep 23	14:10		18:29	56:51	0:51	8:03
20 Sep 23	13:50		18:36	55:22	0:42	8:53	20 Sep 23	14:11		18:29	56:51	0:51	8:03
20 Sep 23	13:51		18:36	55:22	0:42	8:53	20 Sep 23	14:12		18:29	56:51	0:51	8:03
20 Sep 23	13:52		18:36	55:22	0:42	8:53	20 Sep 23	14:13		18:29	56:51	0:51	8:03
20 Sep 23	13:53		18:36	55:22	0:42	8:53	20 Sep 23	14:14		18:29	56:51	0:51	8:03
20 Sep 23	13:54		18:36	55:22	0:42	8:53	20 Sep 23	14:15		18:29	56:51	0:51	8:03
20 Sep 23	13:55		18:36	55:22	0:42	8:53	20 Sep 23	14:16		18:29	56:51	0:51	8:03
20 Sep 23	13:56		18:36	55:22	0:42	8:53	20 Sep 23	14:17		18:29	56:51	0:51	8:03
20 Sep 23	13:57		18:36	55:22	0:42	8:53	20 Sep 23	14:18		18:29	56:51	0:51	8:03
20 Sep 23	13:58		18:36	55:22	0:42	8:53	20 Sep 23	14:19		18:29	56:51	0:51	8:03
20 Sep 23	13:59		18:36	55:22	0:42	8:53	20 Sep 23	14:20		18:29	56:51	0:51	8:03
20 Sep 23	14:00		18:36	55:22	0:42	8:53	20 Sep 23	14:21		18:29	56:51	0:51	8:03
20 Sep 23	14:01		18:36	55:22	0:42	8:53	20 Sep 23	14:22		18:29	56:51	0:51	8:03
20 Sep 23	14:02		18:36	55:22	0:42	8:53	20 Sep 23	14:23		18:29	56:51	0:51	8:03
20 Sep 23	14:03		18:36	55:22	0:42	8:53	20 Sep 23	14:24		18:29	56:51	0:51	8:03
20 Sep 23	14:04		18:36	55:22	0:42	8:53	20 Sep 23	14:25		18:29	56:51	0:51	8:03
20 Sep 23	14:05		18:36	55:22	0:42	8:53	20 Sep 23	14:26		18:29	56:51	0:51	8:03
20 Sep 23	14:06		18:36	55:22	0:42	8:53	20 Sep 23	14:27		18:29	56:51	0:51	8:03
20 Sep 23	14:07		18:36	55:22	0:42	8:53	20 Sep 23	14:28		18:29	56:51	0:51	8:03
20 Sep 23	14:08		18:36	55:22	0:42	8:53	20 Sep 23	14:29		18:29	56:51	0:51	8:03
20 Sep 23	14:09		18:36	55:22	0:42	8:53	20 Sep 23	14:30		18:29	56:51	0:51	8:03
20 Sep 23	14:10		18:36	55:22	0:42	8:53	20 Sep 23	14:31		18:29	56:51	0:51	8:03
20 Sep 23	14:11		18:36	55:22	0:42	8:53	20 Sep 23	14:32		18:29	56:51	0:51	8:03
20 Sep 23	14:12		18:36	55:22	0:42	8:53	20 Sep 23	14:33		18:29	56:51	0:51	8:03
20 Sep 23	14:13		18:36	55:22	0:42	8:53	20 Sep 23	14:34		18:29	56:51	0:51	8:03
20 Sep 23	14:14		18:36	55:22	0:42	8:53	20 Sep 23	14:35		18:29	56:51	0:51	8:03
20 Sep 23	14:15		18:36	55:22	0:42	8:53	20 Sep 23	14:36		18:29	56:51	0:51	8:03
20 Sep 23	14:16		18:36	55:22	0:42	8:53	20 Sep 23	14:37		18:29	56:51	0:51	8:03
20 Sep 23	14:17		18:36	55:22	0:42	8:53	20 Sep 23	14:38		18:29	56:51	0:51	8:03
20 Sep 23	14:18		18:36	55:22	0:42	8:53	20 Sep 23	14:39		18:29	56:51	0:51	8:03
20 Sep 23	14:19		18:36	55:22	0:42	8:53	20 Sep 23	14:40		18:29	56:51	0:51	8:03
20 Sep 23	14:20		18:36	55:22	0:42	8:53	20 Sep 23	14:41		18:29	56:51	0:51	8:03
20 Sep 23	14:21		18:36	55:22	0:42	8:53	20 Sep 23	14:42		18:29	56:51	0:51	8:03
20 Sep 23	14:22		18:36	55:22	0:42	8:53	20 Sep 23	14:43		18:29	56:51	0:51	8:03
20 Sep 23	14:23		18:36	55:22	0:42	8:53	20 Sep 23	14:44		18:29	56:51	0:51	8:03
20 Sep 23	14:24		18:36	55:22	0:42	8:53	20 Sep 23	14:45		18:29	56:51	0:51	8:03
20 Sep 23	14:25		18:36	55:22	0:42	8:53	20 Sep 23	14:46		18:29	56:51	0:51	8:03
20 Sep 23	14:26		18:36	55:22	0:42	8:53	20 Sep 23	14:47		18:29	56:51	0:51	8:03
20 Sep 23	14:27		18:36	55:22	0:42	8:53	20 Sep 23	14:48		18:29	56:51	0:51	8:03
20 Sep 23	14:28		18:36	55:22	0:42	8:53	20 Sep 23	14:49		18:29	56:51	0:51	8:03
20 Sep 23	14:29		18:36	55:22	0:42	8:53	20 Sep 23	14:50		18:29	56:51	0:51	8:03
20 Sep 23	14:30		18:36	55:22	0:42	8:53	20 Sep 23	14:51		18:29	56:51	0:51	8:03
20 Sep 23	14:31		18:36	55:22	0:42	8:53	20 Sep 23	14:52		18:29	56:51	0:51	8:03
20 Sep 23	14:32		18:36	55:22	0:42	8:53	20 Sep 23	14:53		18:29	56:51	0:51	8:03
20 Sep 23	14:33		18:36	55:22	0:42	8:53	20 Sep 23	14:54		18:29	56:51	0:51	8:03
20 Sep 23	14:34		18:36	55:22	0:42	8:53	20 Sep 23	14:55		18:29	56:51	0:51	8:03
20 Sep 23	14:35		18:36	55:22	0:42	8:53	20 Sep 23	14:56		18:29	56:51	0:51	8:03
20 Sep 23	14:36		18:36	55:22	0:42	8:53	20 Sep 23	14:57		18:29	56:51	0:51	8:03
20 Sep 23	14:37		18:36	55:22	0:42	8:53	20 Sep 23	14:58		18:29	56:51	0:51	8:03
20 Sep 23	14:38		18:36	55:22	0:42	8:53	20 Sep 23	14:59		18:29	56:51	0:51	8:03
20 Sep 23	14:39		18:36	55:22	0:42	8:53	20 Sep 23	15:00		18:29	56:51	0:51	8:03
20 Sep 23	14:40		18:36	55:22	0:42	8:53	20 Sep 23	15:01		18:29	56:51	0:51	8:03
20 Sep 23	14:41		18:36	55:22	0:42	8:53	20 Sep 23	15:02		18:29	56:51	0:51	8:03
20 Sep 23	14:42		18:36	55:22	0:42	8:53	20 Sep 23	15:03		18:29	56:51	0:51	8:03
20 Sep 23	14:43		18:36	55:22	0:42	8:53	20 Sep 23	15:04		18:29	56:51	0:51	8:03
20 Sep 23	14:44		18:36	55:22	0:42	8:53	20 Sep 23	15:05		18:29	56:51	0:51	8:03
20 Sep 23	14:45		18:36	55:22	0:42	8:53	20 Sep 23	15:06		18:29	56:51	0:51	8:03
20 Sep 23	14:46		18:36	55:22	0:42	8:53	20 Sep 23	15:07		18:29	56:51	0:51	8:03
20 Sep 23	14:47		18:36	55:22	0:42	8:53	20 Sep 23	15:08		18:29	56:51	0:51	8:03

mg	g	kg	mg	g	kg	mg	g	kg	mg	g	kg
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Reference Method Data

Client Name: State Polyethylene Co., Ltd.

Date: 20 Sep 23

Plant Name: SPS

Location: Furnace 2

Run No. 7						Run No. 8					
Time Base: 21 min						Time Base: 21 min					
Date	Time	DO2	NOx	CO	CO2	Date	Time	DO2	NOx	CO	CO2
20 Sep 23	13:55	99.91	40.98	6.42	9.90	20 Sep 23	14:17	99.94	29.97	6.97	9.90
20 Sep 23	13:57	99.97	31.98	6.43	9.97	20 Sep 23	14:18	99.94	29.98	6.71	9.92
20 Sep 23	13:58	99.98	26.98	6.47	9.98	20 Sep 23	14:19	99.95	29.99	6.90	9.93
20 Sep 23	13:59	99.99	26.99	6.50	9.99	20 Sep 23	14:20	99.96	21.94	6.99	9.96
20 Sep 23	14:00	99.99	36.99	6.50	9.99	20 Sep 23	14:21	99.97	29.99	6.99	9.98
20 Sep 23	14:01	99.99	36.99	6.50	9.99	20 Sep 23	14:22	99.98	29.99	6.74	9.99
20 Sep 23	14:02	99.99	36.99	6.50	9.99	20 Sep 23	14:23	99.99	21.97	6.71	9.94
20 Sep 23	14:03	99.99	36.99	6.50	9.99	20 Sep 23	14:24	99.99	30.97	6.91	9.92
20 Sep 23	14:04	99.99	36.99	6.50	9.99	20 Sep 23	14:25	99.99	29.99	7.00	9.94
20 Sep 23	14:05	99.99	36.99	6.50	9.99	20 Sep 23	14:26	99.99	30.94	7.10	9.91
20 Sep 23	14:06	99.99	36.99	6.50	9.99	20 Sep 23	14:27	99.99	44.41	7.00	9.99
20 Sep 23	14:07	99.99	36.99	6.50	9.99	20 Sep 23	14:28	99.99	37.07	6.92	9.97
20 Sep 23	14:08	99.99	36.99	6.50	9.99	20 Sep 23	14:29	99.99	14.06	7.00	9.99
20 Sep 23	14:09	99.99	36.99	6.50	9.99	20 Sep 23	14:30	99.99	14.06	7.00	9.99
20 Sep 23	14:10	99.99	36.99	6.50	9.99	20 Sep 23	14:31	99.99	14.06	7.00	9.99
20 Sep 23	14:11	99.99	36.99	6.50	9.99	20 Sep 23	14:32	99.99	29.99	7.00	9.99
20 Sep 23	14:12	99.99	36.99	6.50	9.99	20 Sep 23	14:33	99.99	29.99	7.00	9.99
20 Sep 23	14:13	99.99	36.99	6.50	9.99	20 Sep 23	14:34	99.99	14.06	7.00	9.99
20 Sep 23	14:14	99.99	36.99	6.50	9.99	20 Sep 23	14:35	99.99	29.99	7.00	9.99
20 Sep 23	14:15	99.99	36.99	6.50	9.99	20 Sep 23	14:36	99.99	29.99	7.00	9.99
20 Sep 23	14:16	99.99	36.99	6.50	9.99	20 Sep 23	14:37	99.99	29.99	7.00	9.99
Mar	20	99.99	40.98	6.50	9.99	Mar	20	99.99	29.99	7.00	9.99
Aug	20	99.99	36.99	6.50	9.99	Aug	20	99.99	29.99	7.00	9.99

Run No. 9						Run No. 10					
Time Base: 21 min						Time Base: 21 min					
Date	Time	DO2	NOx	CO	CO2	Date	Time	DO2	NOx	CO	CO2
		ppm	ppm	ppm	%Vol			ppm	ppm	ppm	%Vol
20 Sep 23	14:38	99.99	22.98	6.50	9.99	20 Sep 23	14:58	99.99	29.99	6.40	9.99
20 Sep 23	14:39	99.99	29.98	6.50	9.99	20 Sep 23	14:59	99.99	29.99	6.40	9.99
20 Sep 23	14:40	99.99	29.98	6.50	9.99	20 Sep 23	15:00	99.99	29.99	6.40	9.99
20 Sep 23	14:41	99.99	29.98	6.50	9.99	20 Sep 23	15:01	99.99	29.99	6.40	9.99
20 Sep 23	14:42	99.99	29.98	6.50	9.99	20 Sep 23	15:02	99.99	29.99	6.40	9.99
20 Sep 23	14:43	99.99	29.98	6.50	9.99	20 Sep 23	15:03	99.99	29.99	6.40	9.99
20 Sep 23	14:44	99.99	29.98	6.50	9.99	20 Sep 23	15:04	99.99	29.99	6.40	9.99
20 Sep 23	14:45	99.99	29.98	6.50	9.99	20 Sep 23	15:05	99.99	29.99	6.40	9.99
20 Sep 23	14:46	99.99	29.98	6.50	9.99	20 Sep 23	15:06	99.99	29.99	6.40	9.99
20 Sep 23	14:47	99.99	29.98	6.50	9.99	20 Sep 23	15:07	99.99	29.99	6.40	9.99
20 Sep 23	14:48	99.99	29.98	6.50	9.99	20 Sep 23	15:08	99.99	29.99	6.40	9.99
20 Sep 23	14:49	99.99	29.98	6.50	9.99	20 Sep 23	15:09	99.99	29.99	6.40	9.99
20 Sep 23	14:50	99.99	29.98	6.50	9.99	20 Sep 23	15:10	99.99	29.99	6.40	9.99
20 Sep 23	14:51	99.99	29.98	6.50	9.99	20 Sep 23	15:11	99.99	29.99	6.40	9.99
20 Sep 23	14:52	99.99	29.98	6.50	9.99	20 Sep 23	15:12	99.99	29.99	6.40	9.99
20 Sep 23	14:53	99.99	29.98	6.50	9.99	20 Sep 23	15:13	99.99	29.99	6.40	9.99
20 Sep 23	14:54	99.99	29.98	6.50	9.99	20 Sep 23	15:14	99.99	29.99	6.40	9.99
20 Sep 23	14:55	99.99	29.98	6.50	9.99	20 Sep 23	15:15	99.99	29.99	6.40	9.99
20 Sep 23	14:56	99.99	29.98	6.50	9.99	20 Sep 23	15:16	99.99	29.99	6.40	9.99
20 Sep 23	14:57	99.99	29.98	6.50	9.99	20 Sep 23	15:17	99.99	29.99	6.40	9.99
20 Sep 23	14:58	99.99	29.98	6.50	9.99	20 Sep 23	15:18	99.99	29.99	6.40	9.99
Mar	20	99.99	29.98	6.50	9.99	Mar	20	99.99	29.99	6.40	9.99
Aug	20	99.99	29.98	6.50	9.99	Aug	20	99.99	29.99	6.40	9.99

Run No. 11						Run No. 12					
Time Base: 21 min						Time Base: 21 min					
Date	Time	DO2	NOx	CO	CO2	Date	Time	DO2	NOx	CO	CO2
20 Sep 23	15:20	99.99	22.98	6.50	9.99	20 Sep 23	15:41	99.99	27.91	6.50	9.99
20 Sep 23	15:21	99.99	29.98	6.50	9.99	20 Sep 23	15:42	99.99	27.91	6.50	9.99
20 Sep 23	15:22	99.99	32.94	6.50	9.99	20 Sep 23	15:43	99.99	22.98	6.50	9.99
20 Sep 23	15:23	99.99	29.98	6.50	9.99	20 Sep 23	15:44	99.99	28.99	6.50	9.99
20 Sep 23	15:24	99.99	32.94	6.50	9.99	20 Sep 23	15:45	99.99	31.99	6.50	9.99
20 Sep 23	15:25	99.99	28.97	6.51	9.99	20 Sep 23	15:46	99.99	28.99	6.51	9.99
20 Sep 23	15:26	99.99	34.99	6.50	9.99	20 Sep 23	15:47	99.99	27.99	6.51	9.99
20 Sep 23	15:27	99.99	32.95	6.50	9.99	20 Sep 23	15:48	99.99	28.99	6.51	9.99
20 Sep 23	15:28	99.99	29.94	6.52	9.99	20 Sep 23	15:49	99.99	24.94	6.54	9.99
20 Sep 23	15:29	99.99	29.96	6.50	9.99	20 Sep 23	15:50	99.99	26.99	6.49	9.99
20 Sep 23	15:30	99.99	34.96	6.49	9.99	20 Sep 23	15:51	99.99	24.94	6.54	9.99
20 Sep 23	15:31	99.99	32.99	6.48	9.99	20 Sep 23	15:52	99.99	19.99	6.51	9.99
20 Sep 23	15:32	99.99	36.99	6.52	9.99	20 Sep 23	15:53	99.99	22.99	6.52	9.99
20 Sep 23	15:33	99.99	32.97	6.48	9.99	20 Sep 23	15:54	99.99	27.97	6.51	9.99
20 Sep 23	15:34	99.99	30.97	6.47	9.99	20 Sep 23	15:55	99.99	24.99	6.52	9.99
20 Sep 23	15:35	99.99	30.99	6.51	9.99	20 Sep 23	15:56	99.99	26.99	6.47	9.99
20 Sep 23	15:36	99.99	24.99	6.54	9.99	20 Sep 23	15:57	99.99	19.94	6.56	9.99
20 Sep 23	15:37	99.99	19.99	6.49	9.99	20 Sep 23	15:58	99.99	24.99	6.57	9.99
20 Sep 23	15:38	99.99	24.99	6.53	9.99	20 Sep 23	15:59	99.99	22.99	6.52	9.99
20 Sep 23	15:39	99.99	24.99	6.56	9.99	20 Sep 23	16:00	99.99	19.99	6.58	9.99
20 Sep 23	15:40	99.99	26.99	6.51	9.99	20 Sep 23	16:01	99.99	19.97	6.52	9.99
Mar	20	99.99	32.94	6.50	9.99	Mar	20	99.99	32.99	6.50	9.99
Aug	20	99.99	32.94	6.50	9.99	Aug	20	99.99	32.99	6.50	9.99

Airgas Specialty Gases
Airgas USA LLC
5445 Barton Road
Plumsteadville, PA 19399
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E04N199E3HA0002
Cylinder Number: GN0027210
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402340013-1
Cylinder Volume: 247.2 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Feb 11, 2022
Expiration Date: Feb 11, 2030

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.39 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	60.00 PPM	79.49 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022
NITRIC OXIDE	60.00 PPM	82.39 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	C0733106	80.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Oct 06, 2026
NTRM	200610-14	C0708944	83.51 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Oct 06, 2026
SMS	12420806139	CC333707	4.687 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11070419	KAL004513	99.5 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Nicolet iS60 FTIR AUP2010245 CO	FTIR		Feb 03, 2022		
Nicolet iS60 FTIR AUP2010245 NO	FTIR		Feb 10, 2022		
Nicolet iS60 FTIR AUP2010245 NO2	FTIR		Jun 27, 2022		
Nicolet iS60 FTIR AUP2010245 SO2	FTIR		Jun 20, 2022		

Triad Data Available Upon Request

Notes: Gross Weight: 48.5 Kg
Net Weight: 8.1 Kg

Airgas Specialty Gases
Airgas USA, LLC
540 Union Landing Road
Cranston, RI 02906-0001
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E3HA00026
Cylinder Number: ND62877
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 82-401257890-1
Cylinder Volume: 247.2 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Aug 07, 2018
Expiration Date: Aug 07, 2028

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	180.0 PPM	184.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
NITRIC OXIDE†	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
SULFUR DIOXIDE	180.0 PPM	184.9 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
CARBON MONOXIDE	400.0 PPM	427.4 PPM	G1	+/- 1.1% NIST Traceable	07/29/2018
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	77650241	864410759521	15.03 PPM NITRIC OXIDENITROGEN	+/- 1.6%	May 01, 2019
PM1	12345678	CC603861	20.51 PPM NITROGEN DIOXIDESULFUR	+/- 1.6%	Jun 01, 2017
GM5	7043010164	CC603861	98.96 PPM NITROGEN DIOXIDENITROGEN	+/- 2.3%	Jan 01, 2019
NTRM	11010914	KAL044782	99.96 PPM SULFUR DIOXIDENITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	10000538	CC453297	49.91 PPM CARBON MONOXIDENITROGEN	+/- 0.6%	Jan 06, 2021
The ENR, PM1 or NO2 method alone is only in reference to the GM5 used in the assay and not part of the analysis.					
ANALYTICAL EQUIPMENT					
Instrument/Make/Model		Analytical Principle		Last Multiple Calibration	
Nicolet 6700 APW41 100391 CO		FTIR		Jul 10, 2018	
Nicolet 6700 APW41 100391 NO		FTIR		Jul 12, 2018	
Nicolet 6700 APW41 100391 NO2		FTIR		Aug 03, 2018	
Nicolet 6700 APW41 100391 SO2		FTIR		Jul 07, 2018	

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	Expiry Date
Oxygen in Nitrogen	2436255G	25.08 ± 0.13 %	19-Aug-2017

Analytical Instruments used in Assay

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

Method of Analysis

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

Cylinder Number: S50730
Production Order Number: 90132928

Certification Date: 20-Jan-2016
Expiration Date: 20-Jan-2024

Page 2 of 2

บริษัท ลินด์ (ประเทศไทย) จำกัด (มหาชน)
อาคารพาณิชย์ 101/11 หมู่ 14 ตำบลบางพลีใหญ่ อำเภอบางพลี จังหวัดสมุทรปราการ 10540

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
โทรสาร: 02-579-479-93 โทรสาร: 02-579-323

Linde (Thailand) Public Company Limited
151 หมู่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323

CERTIFICATE OF ANALYSIS

Customer Details:

ALS Laboratory Group (Thailand)

Production Order Number: 90137389

Material Number: 557200-J-44

Certification Date: 24-Sep-2016

Expiry Date: 24-Sep-2024

Cylinder 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-800/8-12531 for the Assay and Certification of Gases Calibration Standards using procedure G-1. The results are reported on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number:

285716

Analyst:

THIRAT LOYRAT

Cylinder Number:

363075

Nominal Cylinder Content:

6,560 M³

Approve:

SUKANYA KAMUTHARAT

Nominal Pressure:

145.0 Bar

Valve Outlet:

CGA 599 BRASS

To Re-Order Please Quote:

557200-J-44

Comment:

- It is recommended that this product be not used below 5% of actual content 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)
อาคารพาณิชย์ 101/11 หมู่ 14 ตำบลบางพลีใหญ่ อำเภอบางพลี จังหวัดสมุทรปราการ 10540

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323

Linde (Thailand) Public Company Limited
151 หมู่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323

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	Expiry Date
Oxygen in Nitrogen	2436255G	25.08 ± 0.13 %	19-Aug-2017

Analytical Instruments used in Assay

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

Method of Analysis

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

Cylinder Number: 363075
Production Order Number: 90137389

Certification Date: 24-Sep-2016
Expiration Date: 24-Sep-2024

Page 2 of 2

บริษัท ลินด์ (ประเทศไทย) จำกัด (มหาชน)
อาคารพาณิชย์ 101/11 หมู่ 14 ตำบลบางพลีใหญ่ อำเภอบางพลี จังหวัดสมุทรปราการ 10540

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323

Linde (Thailand) Public Company Limited
151 หมู่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14, บางพลีใหญ่ 14

เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323
เบอร์โทร: 02-579-479-93 โทรสาร: 02-579-323



DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date: 13 Jul 23

Next Calibration Date: 13-Jan-24

Barometric Pressure (mm.Hg): 751

Relative Humidity (%): 62.2

Temperature (°C): 29.0

Dry Gas Meter Data:

Calibration sheet No.: C-DOMMY-BKK_FS0525

Dry Gas Meter ID: BKK_FS0525

Serial No.: 1302005

Model No.: XC-60-CV

Reference Dry Gas Meter Data:

Reference Dry Gas Meter ID: BKK_FS0529

Serial No.: 160 r009

Correction Factor (Y): 1.0000

Next Calibration Date: 9 Dec 23

Reference Dry Gas Meter Calibration				Dry Gas Meter					Dry Gas Meter Correction	
Vn (Liters)			Tn	Vm (Liters)			Ti	To	Avg. Tm	Factor (Y)
Final	Initial	Total	(°C)	Final	Initial	Total	(°C)	(°C)	(°C)	
30.00	0.00	30.00	26.0	30.40	0.00	30.40	28.0	28.0	26.0	0.9934
30.00	0.00	30.00	26.0	30.58	0.00	30.58	28.0	28.0	27.0	0.9843
60.00	0.00	60.00	26.0	61.43	0.00	61.43	28.0	28.0	27.0	0.9833
60.00	0.00	60.00	26.0	61.60	0.00	61.60	29.0	29.0	27.0	0.9773
90.00	0.00	90.00	26.0	92.47	0.00	92.47	29.0	29.0	27.0	0.9766
90.00	0.00	90.00	26.0	92.44	0.00	92.44	29.0	29.0	27.0	0.9769
									Avg.	0.9920

Y = Ratio of reading of reference dry gas meter to dry gas meter; tolerance for individual ± 0.05 from average.

Calibrate by:

Jiraporn

Approved by:

Nattapon Jangwong

Mr. (Jiraporn Sriwasa)
Field Scientist (2)

Mr. Nattapon Jangwong
Field Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	13 Jul 23	Ambient Temperature (°C)	29
Calibration sheet No. :	C-130723-BKK_FS0525	Relative Humidity (%) :	60
Digital Temperature ID :	BKK_FS0525	Reference Temperature ID :	BKK_FS1144
Serial No. :	1302005	Serial No. :	201090006013
Model :	XC-60-CV	Model :	Digicon-CC-VT-MS
		Next Calibrate :	14 Aug 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	152	2	±3	Pass
	200	202	2	±3	Pass
Probe	250	252	2	±3	Pass
	300	303	3	±3	Pass
	500	503	3	±3	Pass
	100	101	1	±3	Pass
	120	122	2	±3	Pass
	140	142	2	±3	Pass
Oven	100	-	-	±3	-
	120	-	-	±3	-
	140	-	-	±3	-
Filter	100	101	1	±3	Pass
	120	122	2	±3	Pass
	140	142	2	±3	Pass
Exit	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	19	-1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Jittakorn (Mr Jittakorn Srivasa) Field Scientist (2)
Approved by : Nattapon Jangwarewong (Mr Nattapon Jangwarewong) Specialist (1)

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



DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date	13 Jul 23	Barometric Pressure (mm.Hg) :	751
Next Calibration Date	13-Jan-24	Relative Humidity (%) :	60.0
		Temperature (°C) :	29.0

Dry Gas Meter Data
Calibration sheet No. : C-130/23-BKK_FS0534
Dry Gas Meter ID : BKK_FS0534
Serial No. : 1509020
Model No. : XC-60-CV

Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK_FS0529
Serial No. : 160/009
Correction Factor (Y) : 1.0000
Next Calibration Date : 9 Dec 23

Reference Dry Gas Meter Calibration				Dry Gas Meter						Dry Gas Meter Correction
Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg. Tm (°C)	Factor (Y)
Final	Initial	Total		Final	Initial	Total				
30.00	0.00	30.00	27.0	29.44	0.00	29.44	27.0	27.0	27.0	1.0190
30.00	0.00	30.00	27.0	29.48	0.00	29.48	29.0	29.0	29.0	1.0244
60.00	0.00	60.00	27.0	59.88	0.00	59.88	29.0	29.0	29.0	1.0087
60.00	0.00	60.00	27.0	59.68	0.00	59.68	29.0	29.0	29.0	1.0121
90.00	0.00	90.00	27.0	89.70	0.00	89.70	29.0	29.0	29.0	1.0100
90.00	0.00	90.00	27.0	89.77	0.00	89.77	30.0	30.0	30.0	1.0126
Avg.										1.0145

Y = Ratio of reading of reference dry gas meter to dry gas meter ; tolerance for individual ± 0.05 from average.

Calibrate by : Jittakorn Mr. (Jittakorn Srivasa) Field Scientist (2)
Approved by : Nattapon Jangwarewong Mr. (Nattapon Jangwarewong) Specialist (1)

FORM NO. : F 06-022 REVISION NO. : 1 ISSUE DATE: 30/8/22



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	13 Jul 23	Ambient Temperature (°C)	29
Calibration sheet No. :	C-130723-BKK_FS0534	Relative Humidity (%) :	60
Digital Temperature ID :	BKK_FS0534	Reference Temperature ID :	BKK_FS1144
Serial No. :	1509020	Serial No. :	201090006013
Model :	XC-60-CV	Model :	Digicon-CC-VT-MS
		Next Calibrate :	14 Aug 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	251	1	±3	Pass
	300	301	1	±3	Pass
	500	501	1	±3	Pass
	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	-	-	±3	-
	120	-	-	±3	-
	140	-	-	±3	-
Filter	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	21	1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Jittakorn (Mr Jittakorn Srivasa) Field Scientist (2)
Approved by : Nattapon Jangwarewong (Mr Nattapon Jangwarewong) Specialist (1)

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

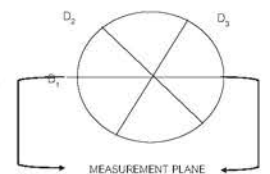


PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	13 Jul 23	Nozzle Set ID. :	BKK_FS0524
Calibration Sheet No. :	C-130723-BKK_FS0524	Vernier Caliper ID. :	BKK_FS1123

Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	(D ₁ + D ₂ + D ₃) / 3 D _{avg}
	D ₁	D ₂	D ₃		
1	0.316	0.316	0.316	0.000	0.316
2	0.472	0.474	0.475	0.003	0.474
3	0.632	0.635	0.634	0.003	0.634
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.091	1.110	1.092	0.019	1.098
7	1.256	1.262	1.262	0.006	1.260
8	1.601	1.596	1.600	0.003	1.600

Where
D₁, D₂, D₃ = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm
ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.
D_{avg} = (D₁ + D₂ + D₃) / 3



Calibrated by : Saksit Phaisanphiset (Mr Saksit Phaisanphiset) Field Scientist (4)
Approved by : Nattapon Jangwarewong (Mr Nattapon Jangwarewong) Field Specialist (1)

FORM NO. : F 06-022 REVISION NO. : 1 ISSUE DATE: 16/2/23



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0472 Calibration Date : 13 Jul 23
Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK_FS0441
Calibration Sheet No. : C-130723-BKK_FS0472 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H ₂ O)	Type s pitot tube (ΔP, mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
Cp				0.842	0.842

$$C_p(S) = C_{p_{ref}} \sqrt{\frac{\Delta P(S)}{\Delta P(S_{ref})}}$$

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

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

Calibrated by

Saksit Phaisanphut

(Mr. Saksit Phaisanphut)
Field Scientist (4)

Approved by

Nattapol Jangwawong

(Mr. Nattapol Jangwawong)
Specialist (1)

FORM NO. P-06-025 REVISION NO. 1 ISSUE DATE 24 Jan 22



Calibration Certificate

Certificate No: G 660018
Date of issue : 23-Jan-23

REVIEW BY	<u>Hinsorn P.</u>
APPROVED BY	<u>[Signature]</u>
NEXT CAL. DATE	<u>20/1/24</u>

Instrument description : Blue gas Analyzer
Instrument model : Testo 350 Now
Instrument serial no. : 62965049
ID no. or control no. : RYG_FS0564
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : ALS LABORATORY GROUP (THAILAND) CO.,LTD.
Customer address : 104 Phatthanasri 40, Phatthanasri Road, Khwaeng Phatthanasri, Khet Suan Luang, Bangkok, 10250 Thailand
Total pages of certificate : 3 Pages
Receiving no. : I-230152
Receiving date : 19 Jan 23
Parameter of calibration : Gas Calibration (Oxygen 2.498, 10.04, 21.02 %Vol, Carbon Monoxide 80.14, 309.9, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 202.2 ppm, Nitric Oxide 30.06, 150.9, 320.6 ppm, Sulphur Dioxide 50.04, 100.8, 601.1 ppm)

Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Nijamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210

Calibration procedure no. : WI-CL-28-C

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

Date of calibration : 20-Jan-23

[Signature]
Mr. Sedawat Nueothong
Calibration Technician

[Signature]
Mrs. Nongluk Wongsettee
Technical Manager

FM-CL-00-C Rev.8

Page 1 of 3

Issued Date 25/02/23

Entech Industrial Solution Co.,Ltd.

17/121 Soi Nijamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Fax ID : 0105536035591 www.entech.co.th



Calibration Certificate

Certificate No.: G 660018

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide (NO2) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO2) 80.96 ppm	2041/22	Linde	26-Jun-24
Nitrogen Dioxide (NO2) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide (NO) 30.06 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3203/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.8 °C Humidity : 58.5 %RH Pressure : 1013.5 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.4 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.45	-0.048	0.20
O2 (%Vol)	10.04	9.99	-0.15	0.40
O2 (%Vol)	21.02	21.16	0.14	0.50
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.9	313	3.1	6.0
CO (ppm)	1003	1014	11	12
NO2 (ppm)	30.34	31.2	0.86	8.0
NO2 (ppm)	80.96	82.7	1.74	8.0
NO2 (ppm)	202.2	205.6	3.4	12
NO (ppm)	30.06	32	1.90	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.8	100	-0.8	6.0
SO2 (ppm)	601.1	598	-3.1	13

FM-CL-00-C Rev.8

Page 2 of 3

Issued Date 25/02/23

Entech Industrial Solution Co.,Ltd.

17/121 Soi Nijamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Fax ID : 0105536035591 www.entech.co.th



Calibration Certificate

Certificate No.: G 660018

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.45	-0.048	0.20
O2 (%Vol)	10.04	9.99	-0.15	0.40
O2 (%Vol)	21.02	21.16	0.14	0.50
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.9	313	3.1	6.0
CO (ppm)	1003	1014	11	12
NO2 (ppm)	30.34	31.2	0.86	8.0
NO2 (ppm)	80.96	82.7	1.74	8.0
NO2 (ppm)	202.2	205.6	3.4	12
NO (ppm)	30.06	32	1.90	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.8	100	-0.8	6.0
SO2 (ppm)	601.1	598	-3.1	13

Remark : 1 cmol/mol = 1 %Vol , 1 μmol/mol = 1 ppm.

End of Report

FM-CL-00-C Rev.8

Page 3 of 3

Issued Date 25/02/23

Entech Industrial Solution Co.,Ltd.

17/121 Soi Nijamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Fax ID : 0105536035591 www.entech.co.th



Instrument description : Five gas Analyser
Instrument model : Testo 340
Instrument serial no. : 62150585
ID no. or control no. : RYG_F50465
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : ALS LABORATORY GROUP (THAILAND) CO.,LTD.
Customer address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok, 10250 Thailand
Total pages of certificate : 2 Pages
Receiving no. : L-230166
Receiving date : 20-Jan-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.01,21.02 %Vol, Carbon Monoxide 80.14,309.9,1003 ppm,
Nitric Oxide 30.06,150.9,320.6 ppm, Sulphur Dioxide 50.01,80.96,601.1 ppm)
Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23.45 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Tongsonghong, Lakki, Bangkok 10210
Calibration procedure no.: WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement
Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal not valid.
This calibration certificate documents are traceability to national standards, which realize measurement according to the
International System of Units (SI).
Date of calibration : 23-Jan-23

Mr. Satchawat Nuchathong
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager



Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nmt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nmt	16-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nmt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	23-Jun-23
Carbon monoxide (CO) 1003 ppm	2582/22	Linde	09-Aug-24
Nitric Oxide (NO) 30.06 ppm	SGS10068	Nmt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.6 °C Humidity : 57.8 %RH Pressure : 1015.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1018.2 mbar

Calibration Results (before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.46	-0.038	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.18	0.16	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO (ppm)	30.06	30	-0.06	8.0
NO (ppm)	150.9	144	-6.9	8.0
NO (ppm)	320.6	309	-11.9	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	99	-1.8	6.0
SO2 (ppm)	601.1	597	-4.1	13

Calibration Results (after adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.46	-0.038	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.18	0.16	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO (ppm)	30.06	30	-0.06	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	316	-4.6	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	99	-1.8	6.0
SO2 (ppm)	601.1	597	-4.1	13

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

End of Report



ROTA METER CALIBRATION RESULT JULY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	03 Jul 23	Y = 1.2484x - 0.6741	0.9931
BKK_FS0579	03 Jul 23	Y = 1.0997x - 0.4918	1.0000
BKK_FS0583	01 Jul 23	Y = 1.0068x + 1.6459	0.9998
BKK_FS0584	01 Jul 23	Y = 0.9804x + 9.469	0.9999
BKK_FS0585	07 Jul 23	Y = 1.0248x + 0.8333	0.9996
BKK_FS0586	01 Jul 23	Y = 0.9907x + 11.074	1.0000
BKK_FS0587	07 Jul 23	Y = 0.986x + 17.77	0.9993
BKK_FS0588	01 Jul 23	Y = 0.9751x + 9.8452	0.9999
BKK_FS0589	03 Jul 23	Y = 1.0174x + 0.0381	1.0000
BKK_FS0590	01 Jul 23	Y = 1.0127x - 3.4333	1.0000
BKK_FS0591	03 Jul 23	Y = 1.0452x - 51.824	0.9998
BKK_FS0592	07 Jul 23	Y = 1.0003x + 14.344	1.0000
BKK_FS0593	01 Jul 23	Y = 1.0386x - 41.415	0.9997
BKK_FS0594	07 Jul 23	Y = 1.0025x + 6.32	0.9999
BKK_FS0595	01 Jul 23	Y = 1.0871x - 114.97	0.9985
BKK_FS0596	03 Jul 23	Y = 1.038x - 51.974	0.9993
BKK_FS0597	01 Jul 23	Y = 1.0059x - 9.9086	1.0000
BKK_FS1004	01 Jul 23	Y = 1.0186x + 6.731	0.9998
BKK_FS1005	01 Jul 23	Y = 0.9922x + 13.993	0.9970
BKK_FS1006	01 Jul 23	Y = 1.1747x - 3.1235	0.9991
BKK_FS1007	07 Jul 23	Y = 1.0737x + 0.8677	0.9997
BKK_FS1008	07 Jul 23	Y = 1.0446x + 1.2156	0.9999
BKK_FS1009	01 Jul 23	Y = 1.1044x - 0.8245	1.0000
BKK_FS1010	03 Jul 23	Y = 1.2271x - 2.0139	1.0000
BKK_FS1011	03 Jul 23	Y = 1.2611x - 1.7003	1.0000
BKK_FS1012	03 Jul 23	Y = 0.9978x - 3.7238	0.9990
BKK_FS1013	03 Jul 23	Y = 1.0245x - 28.65	0.9999
BKK_FS1014	01 Jul 23	Y = 1.3135x - 7.0966	0.9961
BKK_FS1015	01 Jul 23	Y = 0.9802x + 3.8214	0.9999
BKK_FS1016	01 Jul 23	Y = 1.0726x - 85.581	0.9995
BKK_FS1020	01 Jul 23	Y = 1.1161x - 1.1986	1.0000
BKK_FS1021	01 Jul 23	Y = 0.9566x + 16.524	0.9987
BKK_FS1022	01 Jul 23	Y = 1.0712x - 89.51	0.9990
BKK_FS1023	01 Jul 23	Y = 1.3791x - 8.8721	0.9944
BKK_FS1024	01 Jul 23	Y = 0.9448x + 11.421	0.9993
BKK_FS1025	01 Jul 23	Y = 1.0477x - 41.116	1.0000
BKK_FS1026	01 Jul 23	Y = 1.3389x - 4.918	1.0000
BKK_FS1027	01 Jul 23	Y = 0.9852x + 1.5238	1.0000
BKK_FS1028	01 Jul 23	Y = 1.0281x - 19.897	0.9996



ROTA METER CALIBRATION RESULT JULY 2023

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

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

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

RYG_EN0038

TEST REPORT

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน))

EQUIPMENT NAME : THC Analyzer

MANUFACTURER : HORIBA MODEL : APHA-370 SERIAL NO : UA3NG4TH

STANDARD GAS CONCENTRATION (PPM) : 506.1 PPM CYLINDER NO : CC734373

CYLINDER PRESSURE (psig) : 1,600 PSI CERTIFIED DATE : 12/05/2020

CERTIFIED BY : AIRGAS EXPIRED DATE : 12/05/2028

TEST RESULTS

POINT NO	TEST RESULTS						
	IDEAL	ACTUAL CH4	ERROR CH4	ERROR O4H	ACTUAL THC	ERROR THC	%ERROR THC
ZERO	0.000	0.210	0.210	-	0.200	0.200	-
1	10.000	10.050	0.050	0.50	10.050	0.050	0.50
2	20.000	20.120	0.120	0.60	20.150	0.150	0.75
3	30.000	30.110	0.110	0.37	30.050	0.050	0.17
4	40.000	40.030	0.030	0.08	40.030	0.030	0.08
AVERAGE (%)				0.39			0.37

REVIEW BY: Tranthol
APPROVED BY: [Signature]
NEXT CAL DATE: 5/01/2024

CALIBRATED BY: [Signature] DATE: 25/1/16
CHECKED BY: [Signature] DATE: 25/1/16

ALSO ASSOCIATES CO., LTD.

ข้อมูลการสอบเทียบฉบับนี้ใช้ได้เฉพาะกับเครื่องมือที่ระบุไว้เท่านั้น ไม่สามารถนำไปใช้กับเครื่องมืออื่นได้
วันที่ 63/14-15.67/35-36 เลขสอบเทียบ 7.7/1 เลขวันที่สอบ 25/01/2016 โทรศัพท์ 02-868-0812 โทรสาร 02-868-1889

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

CHECK LIST

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน))

EQUIPMENT NAME : THC Analyzer

MANUFACTURER : HORIBA MODEL : APHA-370 SERIAL NO : UA3NG4TH

TEST VALUES

NO.	THC Analyzer (APHA - 370)	UNIT	BEFORE	AFTER
1	Signal (CH4)	mV	4.300	42.403
2	Signal (THC)	mV	3.200	69.403
3	Detector	Temp °C , Standard Value : Ambient temp ± 5°C to 15°C	46.700	50.000
4	Ambient	Pressure kPa , Standard Value : (Ambient/101.3x100-20)±5kPa	70.000	70.103
5	Flow Rate	kPa current atmospheric pressure	101.000	101.100
6	NMHC	°C , Standard Value : 390 °C to 430 °C	420.400	421.200
7	DC 24 V	V , Standard Value : 24 V ± 0.5 V	23.900	23.900
8	DC 5 V	V , Standard Value : 5 V ± 0.5 V	5.000	5.000
9	Bypass (Optional)	L/min, Normal value : 0.9 L/min ± 0.3 L/min	-	-
10	Over Flow (Optional)	L/min, Standard Value : 0.8 L/min or More	-	-
11	CH4 Sampling Reading	PPM	3.530	2.330
12	NMHC Sampling Reading	PPM	4.280	1.150
13	THC Sampling Reading	PPM	8.810	3.480
14	Zero Gas CH4/THC	PPM	0.21/0.20	0.00/0.00
15	Span Gas	PPM	54.87/55.78	40.03/40.03
16	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)

รายการตรวจสอบ
Service Maintenance
รายละเอียดการดำเนินการ
การ Calibration Zero/Span, Multi point
ผลการดำเนินการ
เซ็นเซอร์ เครื่องมือการดำเนินการตรวจสอบมีค่าภายในเกณฑ์

CALIBRATED BY: [Signature] DATE: 25/1/16
CHECKED BY: [Signature] DATE: 25/1/16

ALSO ASSOCIATES CO., LTD.

ข้อมูลการสอบเทียบฉบับนี้ใช้ได้เฉพาะกับเครื่องมือที่ระบุไว้เท่านั้น ไม่สามารถนำไปใช้กับเครื่องมืออื่นได้
วันที่ 63/14-15.67/35-36 เลขสอบเทียบ 7.7/1 เลขวันที่สอบ 25/01/2016 โทรศัพท์ 02-868-0812 โทรสาร 02-868-1889

FO-EN-207 R00/01-08-13

CALIBRATION REPORT

Calibration Date : 1-Jul-23 Equipment ID : BKK_FS0758

Equipment Name : FID Analyzer Manufacturer : Baseline Moon

Model : 9000H Serial No. : 0315EF0047

Std. Gas Conc. (ppm) : 152 Cylinder No. : D878173

Certified Date : 27-Jun-18 Expired Date : 27-Jun-26

CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.02	0.02	0.02
SPAN	152.00	151.85	-0.15	-0.10
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-23 Equipment Name : NOx Analyzer

Manufacturer : HORIBA Model : APNA-370

Serial No. : SEEAWS3E Equipment ID : RYG_FS0261

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

CALIBRATION RESULTS

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	100.40	0.40	0.40
2	200.00	197.80	-2.20	-1.10	201.50	1.50	0.75
3	300.00	298.10	-1.90	-0.63	302.20	2.20	0.73
4	400.00	398.50	-1.50	-0.38	401.40	1.40	0.35
AVERAGE (%)				-0.68			0.47

Calibrated By: [Signature] (Mr. Jirawat Sakam) Field Environmental Scientist (3)

Approved By: [Signature] (Mr. Sarayuth Jittrantont) Assistant General Manager

ALS Laboratory Group

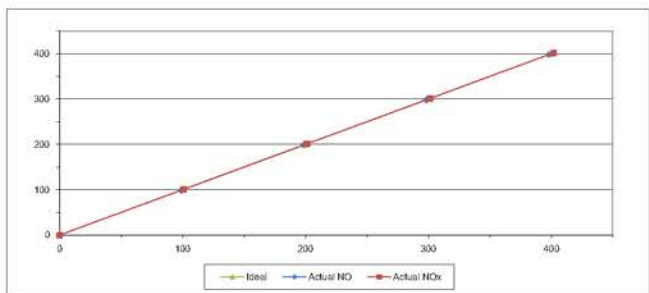
FORM NO.: F-06-068 REVISION NO.: ISSUE DATE: 03/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
Manufacturer HORIBA Model APNA-370
Serial No. U8ADEACK Equipment ID RYG_FS0551
Calibrator Manufacturer Teledyne API Model 700
Serial No. 947
Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
Certified Date 9-Feb-22 Expired Date 9-Feb-30

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



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

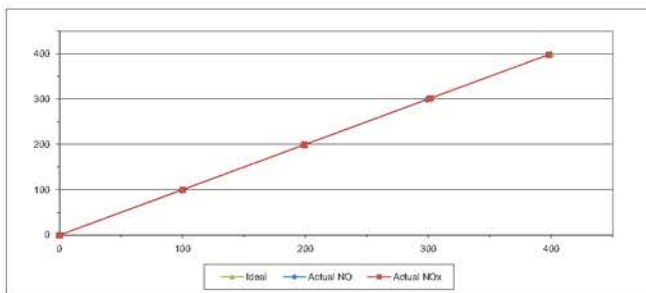
ALS Laboratory Group
FORM NO.: F 06-06 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
Manufacturer HORIBA Model APNA-370
Serial No. 8G314J3K Equipment ID RYG_FS0264
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	99.20	-0.80	-0.80	100.10	0.10	0.10
2	200.00	198.40	-1.60	-0.80	199.10	-0.90	-0.45
3	300.00	298.60	-1.40	-0.47	301.50	1.50	0.50
4	400.00	398.10	-1.90	-0.47	398.00	-2.00	-0.50
AVERAGE (%)				-0.50			-0.05



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

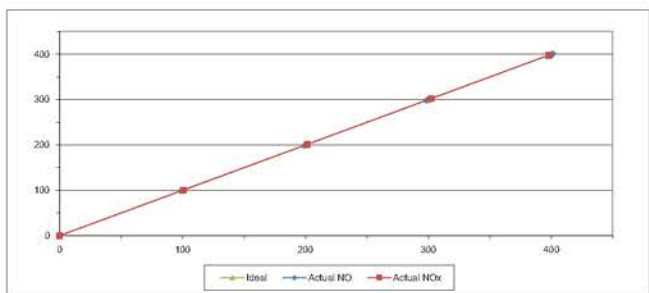
ALS Laboratory Group
FORM NO.: F 06-06 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
Manufacturer HORIBA Model APNA-370
Serial No. 148EH0E0 Equipment ID BKK_FS1064
Calibrator Manufacturer Teledyne API Model 700
Serial No. 947
Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.70	0.70	0.70
2	200.00	199.40	-0.60	-0.30	201.50	1.50	0.75
3	300.00	298.60	-1.40	-0.47	302.30	2.30	0.77
4	400.00	401.40	1.40	0.35	398.00	-2.00	-0.50
AVERAGE (%)				-0.26			0.38



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

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

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Agilent CrossLab Compliance Services

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.Puakdeang, Rayong, 21140, Thailand
Date: July 7, 2022 11:27:53 AM
EQP Name: Agilent Recommended, Agilent Recommended
EQP Revision: GC.02.52, GCMS.02.52
Overall Qualification Status: Pass

REVIEW BY *N. Bannai*
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: 25.0 psi

Actual: 25.1 psi

Accuracy: 0.1 psi

Agilent Recommended: 1.2 psi

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

Page 1 / 17

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status:

Pass

Zone:

Oven

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

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

Temperature:

Setpoint/Average
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

Page 2 / 17

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: 5977B

Source: EI • Extractor Filament: 1

Setpoint Status:

Pass

Signal to Noise:

7485

Agilent Recommended:

>= 1200

Source: EI • Extractor Filament: 2

Setpoint Status:

Pass

Signal to Noise:

2097

Agilent Recommended:

>= 1200

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

Overall Signal to Noise EI Test Status

Pass

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	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN16463236
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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Date: July 7, 2022 11:27:53 AM
System ID: RYG-EN0136

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_puangsope@aglient.com
Signature Creation Date:	July 7, 2022
Reason for Signature:	Executed protocol and published this original version of document

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

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System ID: RYG_EN0136

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

User Name: eaknarin_puangsepa
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 5, 2022 1:33:43 PM	End	Execution	GC Oven Temperature Accuracy - 7600 - Temperature : Oven - S: 130.0°C - L: >= -4.0 /AQD <= 1.2 % suspect is OK	Run Count: 1
July 5, 2022 1:33:45 PM	Start	Execution	GC Oven Temperature Stability - 7600 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	None
July 5, 2022 1:53:05 PM	Audit	Data	GC Oven Temperature Stability - 7600 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	Manual Data Entry
July 6, 2022 1:53:07 PM	End	Execution	GC Oven Temperature Stability - 7600 - Temperature : Oven - S: 100.0°C - L: <= 0.0°C	Run Count: 1
July 6, 2022 1:53:11 PM	Start	Execution	Log Amp - 5977B SQ - Source: None	None
July 6, 2022 1:57:10 PM	End	Execution	Log Amp - 5977B SQ - Source: None	None
July 6, 2022 1:57:24 PM	Start	Execution	RP/PA - 5977B SQ - Source: None	None
July 6, 2022 2:09:24 PM	End	Execution	RP/PA - 5977B SQ - Source: None	None
July 6, 2022 2:09:28 PM	Start	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:24:45 PM	End	Qualification	Session	None
July 6, 2022 2:24:45 PM	Start	Reporting	Session	None
July 6, 2022 2:41:39 PM	End	Reporting	Session	None
July 6, 2022 2:41:50 PM	Start	Configuration	Session	None
July 6, 2022 2:41:40 PM	End	Configuration	Session	None

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

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User Name: eaknarin_puangsepa
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 2:41:40 PM	Start	Qualification	Session	None
July 6, 2022 2:41:40 PM	Start	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:41:50 PM	End	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:41:56 PM	Start	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:42:48 PM	End	Qualification	Session	None
July 6, 2022 2:42:48 PM	Start	Reporting	Session	None
July 6, 2022 2:50:32 PM	End	Reporting	Session	None
July 6, 2022 2:50:52 PM	Start	Qualification	Session	None
July 6, 2022 2:50:52 PM	Start	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:51:12 PM	End	Qualification	Session	None
July 6, 2022 2:51:12 PM	Start	Reporting	Session	None
July 6, 2022 2:55:29 PM	End	Reporting	Session	None
July 6, 2022 2:55:29 PM	Start	Qualification	Session	None
July 6, 2022 2:55:29 PM	Start	Execution	Turns EI - 5977B SQ - Source: None	None

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

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User Name: eaknarin_puangsepa
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 2:55:04 PM	End	Execution	Turns EI - 5977B SQ - Source: None	None
July 6, 2022 2:55:04 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 6, 2022 3:21:32 PM	End	Qualification	Session	None
July 6, 2022 3:21:32 PM	Start	Reporting	Session	None
July 6, 2022 3:28:04 PM	End	Reporting	Session	None
July 6, 2022 3:28:04 PM	Start	Qualification	Session	None
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	AccClosed	Session	None
July 7, 2022 9:12:47 AM	Audit	AccRestarted	Session	None
July 7, 2022 9:12:48 AM	Audit	SessionResumed	Session	None
July 7, 2022 9:13:54 AM	Start	Qualification	Session	None
July 7, 2022 9:13:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 9:58:06 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Data File Path: D:\C02022\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: eaknarin_puangsepa
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 9:58:53 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count: 1
July 7, 2022 10:01:46 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation Used for Run Count
July 7, 2022 10:01:46 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:02:00 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Data File Path: D:\C02022\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 10:07:30 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation Used for Run Count
July 7, 2022 10:07:35 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:\C02022\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_ruanggaspa System ID: RYG_EN0136
Host Name: ASRYGW7002 Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:08:18 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Run Count: 2
July 7, 2022 10:10:28 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Deviation filed for Run Count: 13
July 7, 2022 10:10:28 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	None
July 7, 2022 10:10:36 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Data File Path: D:\Q000022\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 - L1 = 1200	Run Count: 4
July 7, 2022 10:14:54 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Deviation filed for Run Count: 4
July 7, 2022 10:14:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 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 - L1 = 1200	Data File Path: D:\Q000022\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_ruanggaspa System ID: RYG_EN0136
Host Name: ASRYGW7002 Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:10:27 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Run Count: 6
July 7, 2022 10:16:48 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Deviation filed for Run Count: 6
July 7, 2022 10:18:48 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	None
July 7, 2022 10:17:05 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 1200	Data File Path: D:\Q000022\QFN_SN_F01.D
July 7, 2022 10:17:14 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 = 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 10:21:10 AM	Start	Qualification	Session	OQ
July 7, 2022 10:21:17 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	None
July 7, 2022 10:36:41 AM	End	Qualification	Session	OQ
July 7, 2022 10:35:13 AM	Start	Reporting	Session	None
July 7, 2022 10:37:38 AM	End	Reporting	Session	None

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Date: July 7, 2022 11:27:53 AM
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User Name: admin_ruanggaspa System ID: RYG_EN0136
Host Name: ASRYGW7002 Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:57:38 AM	Start	Qualification	Session	OQ
July 7, 2022 10:57:38 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	None
July 7, 2022 11:06:50 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Data File Path: D:\Q000022\QFN_SN_F02.D
July 7, 2022 11:11:47 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	None
July 7, 2022 11:13:13 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Run Count: 1
July 7, 2022 11:14:29 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Deviation filed for Run Count: 11
July 7, 2022 11:14:29 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	None
July 7, 2022 11:14:47 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Data File Path: D:\Q000022\QFN_SN_F02.D
July 7, 2022 11:16:34 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - 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: admin_ruanggaspa System ID: RYG_EN0136
Host Name: ASRYGW7002 Print Date: July 7, 2022 11:27:56 AM

ALS_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 11:19:58 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Deviation filed for Run Count: 12
July 7, 2022 11:19:58 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	None
July 7, 2022 11:20:13 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Data File Path: D:\Q000022\QFN_SN_F02.D
July 7, 2022 11:21:52 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 = 1200	Run Count: 3
July 7, 2022 11:22:49 AM	End	Qualification	Session	OQ
July 7, 2022 11:22:49 AM	Start	Reporting	Session	None
July 7, 2022 11:28:48 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 OCTOBER 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	02 Oct 23	$Y = 1.2862x - 1.2952$	0.9963
BKK_FS0579	02 Oct 23	$Y = 1.2546x + 0.0065$	0.9946
BKK_FS0583	03 Oct 23	$Y = 1.0773x + 2.4138$	0.9989
BKK_FS0584	02 Oct 23	$Y = 0.9787x + 12.569$	0.9999
BKK_FS0585	18 Oct 23	$Y = 1.0322x + 3.7767$	0.9998
BKK_FS0586	02 Oct 23	$Y = 0.9777x + 15.405$	0.9997
BKK_FS0587	18 Oct 23	$Y = 1.0175x + 14.717$	0.9997
BKK_FS0589	03 Oct 23	$Y = 1.0148x + 2.4143$	1.0000
BKK_FS0590	03 Oct 23	$Y = 1.0088x + 0.8429$	1.0000
BKK_FS0591	02 Oct 23	$Y = 1.0733x - 88.805$	0.9989
BKK_FS0592	18 Oct 23	$Y = 1.0037x + 10.388$	1.0000
BKK_FS0593	02 Oct 23	$Y = 1.0538x - 60.63$	0.9996
BKK_FS0594	18 Oct 23	$Y = 1.0052x + 5.3238$	0.9999
BKK_FS0596	03 Oct 23	$Y = 1.0449x - 48.241$	0.9996
BKK_FS0597	03 Oct 23	$Y = 1.0697x - 83.62$	0.9994
BKK_FS1004	02 Oct 23	$Y = 0.9855x + 14.75$	0.9992
BKK_FS1005	02 Oct 23	$Y = 1.02x + 1.7167$	0.9996
BKK_FS1006	02 Oct 23	$Y = 1.1762x - 3.5619$	0.9999
BKK_FS1007	18 Oct 23	$Y = 1.1405x + 2.6044$	0.9993
BKK_FS1008	18 Oct 23	$Y = 1.1267x + 4.8333$	0.9991
BKK_FS1010	03 Oct 23	$Y = 1.0027x + 2.5832$	0.9986
BKK_FS1011	02 Oct 23	$Y = 1.3811x - 6.2068$	0.9998
BKK_FS1012	02 Oct 23	$Y = 1.0017x + 0.9$	1.0000
BKK_FS1013	02 Oct 23	$Y = 1.0593x - 46.02$	0.9994
BKK_FS1014	03 Oct 23	$Y = 1.0961x - 1.8895$	0.9983
BKK_FS1015	03 Oct 23	$Y = 0.9979x + 6.2595$	0.9993
BKK_FS1016	03 Oct 23	$Y = 1.0683x - 82.491$	0.9995
BKK_FS1017	06 Oct 23	$Y = 0.9981x - 2.2235$	0.9998
BKK_FS1018	06 Oct 23	$Y = 0.9817x - 20.653$	0.9999
BKK_FS1019	06 Oct 23	$Y = 1.0152x - 64.485$	0.9998
BKK_FS1020	02 Oct 23	$Y = 1.2691x - 2.4721$	0.9983
BKK_FS1021	02 Oct 23	$Y = 1.0036x + 2.3286$	0.9999
BKK_FS1022	02 Oct 23	$Y = 1.0633x - 73.266$	0.9990
BKK_FS1023	03 Oct 23	$Y = 1.0879x - 1.0694$	0.9984
BKK_FS1024	02 Oct 23	$Y = 1.0035x + 1.4857$	1.0000
BKK_FS1025	03 Oct 23	$Y = 1.0556x - 58.597$	0.9999
BKK_FS1026	02 Oct 23	$Y = 1.2894x - 1.497$	0.9970
BKK_FS1027	02 Oct 23	$Y = 1.0032x + 1.5167$	1.0000
BKK_FS1028	02 Oct 23	$Y = 1.0433x - 30.012$	0.9994

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ALS Laboratory Group



ROTA METER CALIBRATION RESULT OCTOBER 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS1029	02 Oct 23	$Y = 1.3494x - 3.5078$	0.9981
BKK_FS1030	02 Oct 23	$Y = 1.0015x + 1.2214$	1.0000
BKK_FS1031	02 Oct 23	$Y = 1.0516x - 56.996$	0.9994
BKK_FS1039	02 Oct 23	$Y = 0.9991x + 14.527$	0.9994
BKK_FS1040	02 Oct 23	$Y = 1.0049x - 2.4324$	1.0000
BKK_FS1041	02 Oct 23	$Y = 1.1682x - 2.1293$	1.0000
BKK_FS1042	02 Oct 23	$Y = 1.0051x + 6.2533$	0.9989
BKK_FS1043	02 Oct 23	$Y = 1.0022x + 3.96$	1.0000
BKK_FS1044	02 Oct 23	$Y = 1.0796x + 2.9806$	0.9993
BKK_FS1164	02 Oct 23	$Y = 1.2714x + 0.234$	0.9945
BKK_FS1165	02 Oct 23	$Y = 1.0029x + 3.3571$	0.9994
BKK_FS1166	02 Oct 23	$Y = 1.061x - 56.83$	1.0000
BKK_FS1200	02 Oct 23	$Y = 1.2803x - 1.4599$	0.9962
BKK_FS1201	02 Oct 23	$Y = 1.0374x - 6.1952$	1.0000
BKK_FS1202	02 Oct 23	$Y = 1.0486x - 44.05$	0.9997
PHK_FS0027	09 Oct 23	$Y = 1.1052x + 1.0293$	1.0000
PHK_FS0028	09 Oct 23	$Y = 1.0377x - 1.9833$	1.0000
PHK_FS0029	09 Oct 23	$Y = 1.0021x + 7.5248$	1.0000
RYG_FS0197	02 Oct 23	$Y = 1.0036x + 9.0133$	1.0000
RYG_FS0198	02 Oct 23	$Y = 0.9991x + 17.568$	1.0000
RYG_FS0199	02 Oct 23	$Y = 1.0814x - 1.2993$	0.9997
RYG_FS0654	02 Oct 23	$Y = 1.1168x - 2.1207$	1.0000
RYG_FS0655	02 Oct 23	$Y = 1.0086x + 6.2733$	0.9991
RYG_FS0656	02 Oct 23	$Y = 1.0009x + 8.48$	1.0000
RYG_FS0657	02 Oct 23	$Y = 1.0435x + 2.6459$	0.9999
RYG_FS0658	02 Oct 23	$Y = 0.9788x + 10.283$	0.9992
RYG_FS0659	02 Oct 23	$Y = 1.0074x - 6.621$	1.0000
SGK_FS0135	18 Oct 23	$Y = 0.9831x + 14.843$	0.9994
SGK_FS0138	06 Oct 23	$Y = 1.0831x - 0.8401$	0.9998
SGK_FS0139	06 Oct 23	$Y = 0.9826x + 8.6567$	1.0000
SGK_FS0140	06 Oct 23	$Y = 1.0011x + 7.8095$	1.0000
SGK_FS0141	06 Oct 23	$Y = 1.125x - 1.2259$	0.9998
SGK_FS0142	06 Oct 23	$Y = 0.9956x + 10.257$	0.9997
SGK_FS0143	06 Oct 23	$Y = 1.004x + 3.3105$	1.0000

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

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

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ALS Laboratory Group

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Agilent CrossLab Compliance Services

Certificate of System Qualification
GC-OQ

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

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

CDS Logon Verification - GC

Logon: Soenguthai Tarak

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: -0.1 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

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System ID: CN11461066

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

Inlet Pressure: 25.0 psi Actual 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7890

Back SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: 0.0 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Back SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: 0.0 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

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Setpoint Status: **Pass**

Init Pressure: Setpoint 25.0 psi Actual 24.8 psi

Accuracy: 0.2 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Front FID

Setpoint Status: **Pass**

Flow Type: Fuel

Setpoint: 30.0 mL/min Measured Flow: 28.9 mL/min

Accuracy: 1.1 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (3.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status: **Pass**

Flow Type: Oxidizer

Setpoint: 400.0 mL/min Measured Flow: 400 mL/min

Accuracy: 0.0 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (40.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status: **Pass**

Flow Type: Makeup

Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min

Accuracy: 0.1 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (2.5 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

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Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Back FID

Setpoint Status: **Pass**

Flow Type: Fuel

Setpoint: 30.0 mL/min Measured Flow: 30.7 mL/min

Accuracy: 0.7 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (3.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status: **Pass**

Flow Type: Oxidizer

Setpoint: 400.0 mL/min Measured Flow: 399 mL/min

Accuracy: 1.0 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (40.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status: **Pass**

Flow Type: Makeup

Setpoint: 25.0 mL/min Measured Flow: 24.6 mL/min

Accuracy: 0.4 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (2.5 mL/min)

Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: April 21, 2023 3:26:38 PM
System ID: CN11451066

Setpoint Status: **Pass**

Zone: Oven

Temperature: Setpoint/Actual 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

Temperature: Setpoint/Actual 100.0 / 100.9 °C

Accuracy: 0.9 °C

Agilent Recommended: ≥ -1.0 % setpoint in K (-3.7 °C)
 ≤ 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: **Pass**

Temperature: Setpoint/Average 100.0 / 100.8833 °C

Stability: 0.1 °C

Agilent Recommended: ≤ 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1 Front SSL / Front FID

Injection Tower

Name: 7693A

Date: April 21, 2023 3:26:38 PM
System ID: CN11451066

Setpoint Status: **Completed**

Injection Volume on Column: 1.0 µL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1 Front SSL / Front FID

Name: 7890

Setpoint Status: **Pass**

Base Signal: 22.7 pA

ASTM Noise: 0.06 pA

Drift: 0.05 pA/hr

Agilent Recommended: ≤ 0.10 pA ≤ 2.50 pA/hr

Status: **Pass** **Pass**

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 Front SSL / Front FID

Name: 7693A

Setpoint Status: **Pass**

Injection Volume on Column: 1.0 µL

Area RSD: 0.32 %

Retention Time RSD: 0.07 %

Agilent Recommended: ≤ 3.00 % ≤ 1.00 %

Overall Injection Precision Test Status

Pass

Signal to Noise

Date: April 21, 2023 3:26:38 PM
System ID: CN11451066

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

Scouting Run

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7693A
Setpoint Status: Completed
Injection Volume on Column: 1.0 μ L
Overall Scouting Run Status
Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID
Name: 7890
Setpoint Status: Pass
Base Signal: 22.6 pA
ASTM Noise pA 0.07
Agilent Recommended: ≤ 0.10
Status: Pass
Drift pA/hr 0.09
Agilent Recommended: ≤ 2.50
Status: Pass

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Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2 Back SSL / Back FID
Name: 7693A
Setpoint Status: Pass
Injection Volume on Column: 1.0 μ L
Area RSD: 1.28 %
Agilent Recommended: ≤ 3.00
Retention Time RSD: 0.83 %
Agilent Recommended: ≤ 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2 Back SSL / Back FID
Injection Tower
Name: 7890
Setpoint Status: Pass
Signal to Noise: 2404308
Agilent Recommended: ≥ 300000

Overall Signal to Noise Test Status

Pass

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	CN11461066
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Injection Tower
Sampler Identifier	Sampler 2
Inlet	Front
Detector	Front
LTM Included?	No

Tested Combination2

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

Sampler 1

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

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Sampler 2

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16290126
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Front
Syringe Volume (μ L)	10

Sampler 3

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

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
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
Adaptor	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Detector 2

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

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Electronic Signature

Purpose

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Details

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

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User Name: saenguthai.tarak
Host Name: LAPTOP-Q33RQ3WY
System ID: CN11481068
Print Date: April 21, 2023 3:26:43 PM

GC-5_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:21:36 AM	Auth	Session Created	Session	None
April 21, 2023 11:21:36 AM	Start	Configuration	Session	None
April 21, 2023 11:21:36 AM	Auth	Enrollment	Licensing	User is Marjory and does not require an unlock code
April 21, 2023 11:22:01 AM	Auth	ExpLoaded	Session	DGP details for priority technique (DGP) - File path: [ProtocolPackerGoConfig\rom02.S04G.02.S2.req]. DGP File Name: [GC-5_BKK_EN0127_ALS]. DGP Name: [AgilentCrossLabComplianceProtocolRevision (Cv.02.02)]
April 21, 2023 11:22:09 AM	End	Configuration	Session	None
April 21, 2023 11:22:14 AM	Start	Qualification	Session	DQ
April 21, 2023 11:22:14 AM	Start	Execution	CDS Logon Verification - QC	None - Qualitative test
April 21, 2023 11:22:14 AM	End	Execution	CDS Logon Verification - QC	Run Count: 1 - Qualitative test
April 21, 2023 11:22:16 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890	None Qualitative Test - No setpoints associated
April 21, 2023 11:22:25 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890	Run Count: 1 Qualitative Test - No setpoints associated
April 21, 2023 11:22:27 AM	Start	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet	None - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi

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Date: April 21, 2023 3:26:38 PM
System ID: CN11481068

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User Name: saenguthai.tarak
Host Name: LAPTOP-Q33RQ3WY
System ID: CN11481068
Print Date: April 21, 2023 3:28:40 PM

GC-5_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:24:01 AM	End	Session	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet	Run Count: 1 - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi
April 21, 2023 11:24:04 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet	None - S: 25.0 psi - L: <= 1.2 psi
April 21, 2023 11:24:04 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet	Run Count: 1 - S: 25.0 psi - L: <= 1.2 psi
April 21, 2023 11:24:11 AM	Start	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet	None - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi
April 21, 2023 11:24:13 AM	End	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet	Run Count: 1 - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi
April 21, 2023 11:24:15 AM	Start	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet	None - S: 25.0 psi - L: <= 1.2 psi
April 21, 2023 11:24:15 AM	End	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet	Run Count: 1 - S: 25.0 psi - L: <= 1.2 psi
April 21, 2023 11:24:53 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:23 AM	Auth	Date	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:25 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1

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Date: April 21, 2023 3:26:38 PM
System ID: CN11481068

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User Name: xiang@ral.larak
Host Name: LAPTOP-CQ38KQWYSystem ID: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BROK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:25:25 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:40 AM	Auto	Data	Detector Flow Accuracy - Front FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:42 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:25:44 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:01 AM	Auto	Data	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:04 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:08 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:19 AM	Auto	Data	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:22 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:24 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:38 AM	Auto	Data	Detector Flow Accuracy - Back FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry

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System ID: CN11461066

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User Name: xiang@ral.larak
Host Name: LAPTOP-CQ38KQWYSystem ID: CN11461066
Print Date: April 21, 2023 3:26:48 PM

GC-6_BROK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:26:43 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: On/Off - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:45 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:27:01 AM	Auto	Data	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:27:05 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:27:07 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 21, 2023 11:27:33 AM	Auto	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
April 21, 2023 11:27:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
April 21, 2023 11:27:37 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 21, 2023 11:27:54 AM	Auto	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: April 21, 2023 3:26:39 PM
System ID: CN11461066

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User Name: xiang@ral.larak
Host Name: LAPTOP-CQ38KQWYSystem ID: CN11461066
Print Date: April 21, 2023 3:25:49 PM

GC-6_BROK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:27:57 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
April 21, 2023 11:27:59 AM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
April 21, 2023 11:28:07 AM	Auto	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
April 21, 2023 11:28:10 AM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
April 21, 2023 11:28:12 AM	Start	Execution	GC Security Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:30:27 AM	Auto	Data	GC Security Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Data File Path: C:\Users\Public\Documents\GC6_BROK_EN0127_ALS_2023-04-20_OO_GC-6_2023-04-20_14-35-06P_S001.D\FID1A.ch
April 21, 2023 11:31:04 AM	End	Execution	GC Security Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Run Count: 1
April 21, 2023 11:31:07 AM	Start	Execution	Injection Prediction - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None

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Date: April 21, 2023 3:29:38 PM
System ID: CN11461066

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User Name: xiang@ral.larak
Host Name: LAPTOP-CQ38KQWYSystem ID: CN11461066
Print Date: April 21, 2023 3:26:40 PM

GC-6_BROK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:31:43 AM	Auto	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data File Path: C:\Users\Public\Documents\GC6_BROK_EN0127_ALS_2023-04-20_OO_GC-6_2023-04-20_14-35-06P_S001.D\FID1A.ch
April 21, 2023 11:32:00 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1
April 21, 2023 11:32:03 AM	Start	Execution	Injection Prediction - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:32:23 AM	Start	Execution	Injection Prediction - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:33:05 AM	Auto	Data	Injection Prediction - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\GC6_BROK_EN0127_ALS_2023-04-20_OO_GC-6_2023-04-20_14-35-06P_S001.D\FID1A.ch
April 21, 2023 11:33:55 AM	Auto	Data	Injection Prediction - Injection Tower, Front SSI, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\GC6_BROK_EN0127_ALS_2023-04-20_OO_GC-6_2023-04-20_14-35-06P_S001.D\FID1A.ch

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: ssenguthai.tarak
Hostname: LAPTOP-CC3SKOMV

System Id: CN11481068
Print Date: April 21, 2023 3:26:40 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:33:55 AM	Audit	Data	Injection Prediction - Injection Tower, Front SQL, Front PID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemStation\Data\DOO_GCA_19_2023-04-20\DOO_GCA_19_2023-04-20_14-36-09\FrontL-015F.D\FrontL15A.tch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Prediction - Injection Tower, Front SQL, Front PID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemStation\Data\DOO_GCA_19_2023-04-20\DOO_GCA_19_2023-04-20_14-36-09\FrontL-015F.D\FrontL15A.tch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Prediction - Injection Tower, Front SQL, Front PID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemStation\Data\DOO_GCA_19_2023-04-20\DOO_GCA_19_2023-04-20_14-36-09\FrontL-015F.D\FrontL15A.tch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Prediction - Injection Tower, Front SQL, Front PID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemStation\Data\DOO_GCA_19_2023-04-20\DOO_GCA_19_2023-04-20_14-36-09\FrontL-015F.D\FrontL15A.tch
April 21, 2023 11:35:00 AM	End	Execution	Injection Prediction - Injection Tower, Front SQL, Front PID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count : 1
April 21, 2023 11:36:04 AM	Start	Execution	Signal to Note - Injection Tower, Front SQL, Front PID - Detector PID - L >= 10.00%	None

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System ID: CN11461086

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User Name: msengulhalarak
Hostname: LAPTOP-CQ18K0NV

System ID: CN19481058
Print Date: April 21, 2023 3:26:40 PM

GC-5_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:55:28 AM	Audit	Date	Signal to Noise - Injection Tower, Front SSL, Front FID - Database FID - L1 => SC0030	Data Base Path : C:\Users\Fulda\Documents\hem\bin\rd\04\00Q_QC_ALS_2023-04-20\0Q_QC_2023-2023-04-20\14-36-0950_F-raw\FID0111.ch
April 21, 2023 11:36:00 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L1 => SC0030	Run Count : 1
April 21, 2023 11:36:03 AM	Start	Execution	GC Sampling Run - Injection Tower, Blank SSL, Back FID - Part of System Preparation - No bins associated	Note
April 21, 2023 11:36:26 AM	Audit	Date	GC Sampling Run - Injection Tower, Blank SSL, Back FID - Part of System Preparation - No bins associated	Data Base Path : C:\Users\Fulda\Documents\hem\bin\rd\04\00Q_QC_ALS_2023-04-20\0Q_QC_2023-2023-04-20\14-36-0960_SC01\FID0231.ch
April 21, 2023 11:37:30 AM	End	Execution	GC Sampling Run - Injection Tower, Blank SSL, Back FID - Part of System Preparation - No bins associated	Run Count : 1
April 21, 2023 11:37:32 AM	Start	Execution	Noise and DBS - Back FID - Detector FID - L1 Bonus => 0.10 pH - L1 GPR => 2.80 gA/HR	None

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Date: April 21, 2023 3:28:36 PM
System ID: CN11461088

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Username: saadgullal@urak
Hostname: LAPTOP-CQ33KQNV

System ID: CN11461066
Print Date: April 21, 2023 3:25:42 PM

GC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 25, 2023 11:58:06 AM	Auto	Data	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (DRG) <= 2.50 pA/hour	Data File Path : C:\Users\Public\Documents\hemidion\23\data\GC_0C_2023_04_25\GC_0C_2023_2022-04-26 14:35-09\ND-01--0015.D\FID 20.0h
April 21, 2023 11:58:22 AM	End	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (DRG) <= 2.50 pA/hour	Run Count : 1
April 21, 2023 11:58:52 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Peak) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:58:51 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Peak) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:58:17 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Peak) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemidion\23\data\GC_0C_2023_04_25\GC_0C_2023_2023-04-21 16:35-55\Part 1--0948.D\FID 20.0h
April 21, 2023 11:58:17 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Peak) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\hemidion\23\data\GC_0C_2023_04_25\GC_0C_2023_2023-04-21 16:37-52\Part 1--0958.D\FID 20.0h

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

Page 21 / 23

User Name: soengulal.jarik
 Hostname: LAPTOP-CO2SKO8TV

System Id: CN11661066
Print Date: April 24, 2023 3:28:40 PM

GC-6_BKK_EN0127_ALS Transaction log

Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSI, Back FID - GC - I (Area) == 3.00% - L (Rel. Time) == 1.00%	Data File Path : C:\Users\Public\Documents\hamilton\01\GC_OG_AIS_2023-04-20\GC_OG_2023_Prec 2023-04-21 10-37-32\FID11-6008.D\FID28.D
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSI, Back FID - GC - I (Area) == 3.00% - L (Rel. Time) == 1.00%	Data File Path : C:\Users\Public\Documents\hamilton\01\GC_OG_AIS_2023-04-20\GC_OG_2023_Prec 2023-04-21 10-37-32\FID11-6018.D\FID25.D
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSI, Back FID - GC - I (Area) == 3.00% - L (Rel. Time) == 1.00%	Data File Path : C:\Users\Public\Documents\hamilton\01\GC_OG_AIS_2023-04-20\GC_OG_2023_Prec 2023-04-21 10-37-32\FID11-6028.D\FID25.D
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSI, Back FID - GC - I (Area) == 3.00% - L (Rel. Time) == 1.00%	Data File Path : C:\Users\Public\Documents\hamilton\01\GC_OG_AIS_2023-04-20\GC_OG_2023_Prec 2023-04-21 10-37-32\FID11-6038.D\FID25.D
April 21, 2023 11:41:23 AM	End	Execution	Injection Precision - Injection Tower, Back SSI, Back FID - GC - I (Area) == 3.00% - L (Rel. Time) == 1.00%	Run Count : 1
April 21, 2023 11:41:33 AM	Start	Execution	Signal to Helix - Injection Tower, Back SSI, Back FID - Detector FID - L, == 300000	None

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Date: April 21, 2023 3:25:38 PM
System ID: CN11461050

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User Name: xiangzhuai.lauk
Host Name: LAPTOP-G3356QWY

System ID: CN1461056
Print Date: April 21, 2023 3:25:40 PM

GC-6_RKK_RN127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:42:22 AM	Audit	Data	Signal to Noise - Injection Tower, Back SSL, Back PID - Detector FID - L: W-200000	Date Rec Path: C:\Users\Puho\OneDrive\Documents\NIST40750_90-6_ALS_2023-04-2020_GC-6_2023 0523-04-20 14-28-08\EN_BackPID\FID020.ch
April 21, 2023 11:42:50 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back PID - Detector FID - L: W-200000	Run Count: 1
April 21, 2023 11:42:55 AM	End	Qualification	Session	OQ
April 21, 2023 11:42:55 AM	Start	Reporting	Session	None
April 21, 2023 12:05:47 PM	Audit	Not Closed	Session	None
April 21, 2023 3:16:07 PM	Audit	Not Restored	Session	None
April 21, 2023 3:16:10 PM	Audit	Session Restored	Session	None
April 21, 2023 3:16:31 PM	Start	Qualification	Session	OQ
April 21, 2023 3:20:09 PM	Audit	Not Restored	Session	None
April 21, 2023 3:21:00 PM	Audit	Session Restored	Session	None
April 21, 2023 3:21:07 PM	Start	Qualification	Session	OQ
April 21, 2023 3:25:45 PM	Audit	Reporting	Session	Report Generated: Certificate

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Date: April 21, 2023 3:25:38 PM
System ID: CN1461056

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Jiranatee Associates Co., Ltd.
17/15-15, 17/15-16
Pattana 7, 21, 18, 18/1, 18/2, 18/3, Bangkok
Bangkok 10600 (Thailand)
Tel: +66(0)80812
Mobile: +66(0)8099551
E-mail: jnac@jiranatee.com
Web site: www.jiranatee.com

Certificate Number

CU-011-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Wind Direction Sensor
MANUFACTURER: Novalltype
MODEL/TYPE: Sensor: WS-02F
Data logger: 200-WS-250L
SERIAL NUMBER: Sensor:
Data logger: A4987
ID NUMBER: RYG_150089
CONDITION AS-RECEIVED: Used item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

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

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

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

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

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

Calibrated by:
☒ Mr. Sorawat Jiranatee
☐ Miss Jiranatee Jiranatee

Remarks:
1. Notice calibration area of the wind tunnel
2. Projected cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Note 1 to 1



Approved signature:

Pratima P.
Mr. Pratima Booncharon
Calibration Department Manager

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

Certificate Number

CU-011-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

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

Remarks:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place² Direction of standard³ Direction of Unit Under Calibration

End of certificate of calibration



Jiranatee Associates Co., Ltd.
17/15-15, 17/15-16
Pattana 7, 21, 18, 18/1, 18/2, 18/3, Bangkok
Bangkok 10600 (Thailand)
Tel: +66(0)80812
Mobile: +66(0)8099551
E-mail: jnac@jiranatee.com
Web site: www.jiranatee.com

Certificate Number

CU-011-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novalltype
MODEL/TYPE: Sensor: WS-02F
Data logger: 200-WS-250L
SERIAL NUMBER: Sensor:
Data logger: A4987
ID NUMBER: RYG_150089
CONDITION AS-RECEIVED: Used item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

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

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

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

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (23.5) °C, (52.5) %RH and (1014.1) hPa.

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

Calibrated by:
☒ Mr. Sorawat Jiranatee
☐ Miss Jiranatee Jiranatee

Remarks:
1. Notice calibration area of the wind tunnel
2. Projected cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Note 1 to 1



Approved signature:

Pratima P.
Mr. Pratima Booncharon
Calibration Department Manager

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

Certificate Number
CL-013-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
0.583	23.50	23.45	0.8	-0.2	0.17
2.035	23.44	23.45	1.9	-0.1	0.16
3.045	23.50	23.45	2.9	-0.2	0.19
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.2	0.19
9.30	23.26	23.45	9.0	-0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.20	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.0	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.25
16.31	23.24	23.45	16.1	-0.2	0.24

Remark:

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

² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.025	24.30	24.95	0.9	-0.1	0.31
2.028	24.86	24.95	1.9	-0.1	0.31
2.997	25.00	24.95	2.9	-0.1	0.31
4.126	25.00	24.95	4.0	-0.1	0.31
5.02	24.90	24.95	4.9	-0.1	0.31
6.00	24.88	24.95	5.9	-0.1	0.31
7.05	24.90	24.95	7.0	-0.1	0.31
8.18	24.74	24.95	8.0	-0.1	0.31
9.08	24.84	24.95	9.0	0.0	0.31
10.07	24.70	24.95	10.0	-0.1	0.31
11.14	24.78	24.95	11.1	-0.1	0.31
12.13	24.70	24.95	12.0	-0.1	0.31
13.17	24.70	24.95	13.1	0.0	0.35
14.24	24.70	24.95	14.0	0.0	0.31
15.20	24.70	24.95	15.0	0.0	0.44
16.28	24.70	24.95	16.2	-0.1	0.31

Remark:

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

² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

Certificate Number

CC-008-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Cup anemometer

MANUFACTURER

: Novalyx

MODEL/TYPE

: Sensor: WS-03F

Data logger: 200-WS-25DL

SERIAL NUMBER

: Sensor: W50-A4985

Data logger: A4985

ID NUMBER

: RYB_750085

CONDITION AS RECEIVED

: Used Item

CUSTOMER

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

RECEIVED DATE

: 16 Jun 2023

MEASUREMENT DATE

: 19 Jun 2023

ISSUE DATE

: 19 Jun 2023

ENVIRONMENTAL CONDITIONS:

: Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

: Wind tunnel cross-section area¹ 900 cm²

Win direction frontal area² 100 cm²

Diameter of mounting pipe³ - mm

Blockage ratio of test object⁴ 0.111 [-]

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (25.0) °C, (42.7) %RH and (1011.7) hPa.

TABULATION OF RESULTS:

: The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thachulad

☐ Miss Nitragorn Lertsomphol



Approved signatory:

[Signature]
Mr. Pailiny Buncharoen
Calibration Department Manager

Remark:

¹ Nozzle cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio: %

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

Certificate Number

CC-008-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Wind Direction Sensor

MANUFACTURER

: Novalyx

MODEL/TYPE

: Sensor: WS-03F

Data logger: 200-WS-25DL

SERIAL NUMBER

: Sensor: W50-A4985

Data logger: A4985

ID NUMBER

: RYB_750085

CONDITION AS RECEIVED

: Used Item

CUSTOMER

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

RECEIVED DATE

: 16 Jun 2023

MEASUREMENT DATE

: 19 Jun 2023

ISSUE DATE

: 19 Jun 2023

ENVIRONMENTAL CONDITIONS:

: Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

: Wind tunnel cross-section area¹ 900 cm²

Win direction frontal area² 129 cm²

Diameter of mounting pipe³ - mm

Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (24.1) °C, (55.4) %RH and (1008.5) hPa.

TABULATION OF RESULTS:

: The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thachulad

☐ Miss Nitragorn Lertsomphol



Approved signatory:

[Signature]
Mr. Pailiny Buncharoen
Calibration Department Manager

Remark:

¹ Nozzle cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio: %

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

Certificate Number

CL-004-65

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D _{cal} Degree (°)	D _{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	45.000	44	-1	1.0
	90.001	87	-3	1.0
	135.000	132	-3	1.0
	180.000	175	-5	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	319	4	1.0
	360.000	359	-1	1.0

Remarks:

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

⁶ Direction of standard.

⁷ Direction of Unit Under Calibration.

End of Certificate of Calibration



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

Air speed measurement laboratory
Calibration services department.

Jirantee Associates Co., Ltd.
6/314 15, 6275-36
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Bangkok 10600 (Thailand)
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E-mail: jirantee@jirantee.com
Website: www.jirantee.com



Certificate Number

CL-004-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Wind Direction Sensor
Novelty
Sensor: WS-02F
Data logger: 110-WS-250L-D
Sensor: WSD-014
Data logger: AS912
RNG, F50611
New Item
ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

09 Nov 2022
17 Nov 2022
23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.6 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 129 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.113 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.5°C, (48.1) %RH and (1012.4) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
[1] Mr. Sornwit Thuchaiad
[2] Miss Atsaranee Lertkongsakul



Approved signatory:

[Signature]
Mr. Parinya Booncharan
Calibration Department Manager

Remarks:

¹ Nozzle cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio "a/b"

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AERODITS-DMD P3 S 00 in an open test-section of Effel-type wind tunnel with 900 cm² cross test-section area. The Win CL 007 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electrically producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognize the national standards, and to realization of the international system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate number: GA 0041-22.

Uncertainty of Measurement:

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

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

Certificate Number

CL-004-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D _{cal} Degree (°)	D _{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.001	0	0	0.58
	45.000	45	0	0.74
	90.001	89	-1	0.68
	135.000	134	-1	0.74
	180.000	180	0	0.74
	225.000	227	2	0.74
	270.001	272	2	0.74
	315.000	318	3	0.68

Remarks:

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

² Direction of standard.

³ Direction of Unit Under Calibration.

End of Certificate of Calibration



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

Air speed measurement laboratory
Calibration services department.

Jirantee Associates Co., Ltd.
6/314 15, 6275-36
Phrasukarn 2, 7/1, Rd. Phrasukarn Bangkok
Bangkok 10600 (Thailand)
Tel: +6681-999111
Mobile: +6681-999111
E-mail: jirantee@jirantee.com
Website: www.jirantee.com

Certificate Number

CL-004-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Cup anemometer
Novelty
Sensor: WS-02F
Data logger: 110-WS-250L-D
Sensor: WSD-014
Data logger: AS912
RNG, F50611
New Item
ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

09 Nov 2022
17 Nov 2022
23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 100 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.113 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.8) °C, (50.9) %RH and (1011.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
[1] Mr. Sornwit Thuchaiad
[2] Miss Atsaranee Lertkongsakul



Approved signatory:

[Signature]
Mr. Parinya Booncharan
Calibration Department Manager

Remarks:

¹ Nozzle cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio "a/b"

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: R555-12 and pitot tube with previous differential pressure meter model: DPM-2500 in an open test-section of Effel-type wind tunnel with 900 cm² cross test-section area. The Win CL 007 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electrically producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognize the national standards, and to realization of the international system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate number: MW 0052-21 and MW 0056-22.

Uncertainty of Measurement:

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

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

Certificate Number

C-004-65

Page 2 of 2 Pages

MEASUREMENT RESULTS

The cup anemometer, Unit Under Calibration (UUC) was exposed at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 35 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both doing and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc} (m/s)	Error (m/s)	$U(k=2)$ (m/s)
0.988	23.70	23.80	0.8	-0.2	0.15
2.253	23.90	23.80	1.8	-0.2	0.16
3.040	23.85	23.80	2.8	-0.2	0.18
4.227	23.86	23.80	3.8	-0.4	0.19
5.63	23.70	23.80	4.8	-0.2	0.19
6.62	23.84	23.80	5.8	-0.3	0.18
7.67	23.70	23.80	6.8	-0.2	0.18
8.19	23.90	23.80	7.9	-0.3	0.20
9.12	23.66	23.80	8.9	-0.2	0.20
10.12	23.82	23.80	9.9	-0.3	0.20
11.16	23.50	23.80	10.9	-0.3	0.21
12.15	23.90	23.80	11.8	-0.4	0.23
13.21	23.48	23.80	12.9	-0.3	0.23
14.27	23.74	23.80	13.9	-0.4	0.25
15.26	23.56	23.80	14.9	-0.3	0.25
16.32	23.62	23.80	16.0	-0.3	0.26

Remark:

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

* Uncertainty of standard

* Uncertainty of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



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

Calibration No.: R4-04112022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novatex
Model/Type : 110 WS 25DL D
Serial Number : A5912
ID No. : 1091 F59611
Customer : A.S. Laboratory group (Thailand) Co., Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Rhet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (26±3)°C, and relative humidity of (60±15)%.

Measurement Method:

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

Traceability:

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

Measurement Date : Nov 18, 2022

Issued Date : Nov 23, 2022

Measurement Results:

This equipment was connected with indoor air quality probe and displayed RH% on display. Model: HM760, Serial number: U3911247

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

The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	19.97	18.5	-1.5	0.51
50	50.25	48.0	-2.3	0.51
80	80.30	78.3	-2.0	0.52

Performed by
☒ Mr. Sorawat Thachalad
☐ Miss Jitraporn Lerboromphol



Approved Signatory:
Mr. Parinya Booncharoen,
Calibration Department Manager

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



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
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CALIBRATION REPORT

Calibration Number : R4-02112022
Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger
Manufacturer : Data logger: Novatex,
Rain gauge: Novatex
Model/Type : Data logger: 110 WS 25DL D
Rain gauge: 110 WS 25403
Serial Number : Data logger: A5912
Rain gauge: R4-008
ID NO : R40_F59611
Customer : A.S. Laboratory group (Thailand) Co., Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Rhet Suan Luang, Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (26±3)°C, and relative humidity of (60±15)%.

Measurement Method:

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

- Obtain rain gauge inlet area:
Rain gauge precise diameter in cm = $\text{Diameter}^2 \div 4$ (radius)
Rain gauge area = $\text{PI} \times \text{Rain gauge diameter}^2 \div 4$ (radius)
Rain gauge area = 32.36 cm^2
- Obtain theoretical correct rain gauge answer (number of tipping) using 32.36 cm^2 inlet area and 0.6 L of rain.
a) $10000 \text{ mm}^3 \div 32.36 \text{ cm}^2$ inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
b) $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$ (in of rain over 1 m^2 surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.
c) Number of tipping = $15.45 \div 0.25 \text{ mm} = 62$ tipplings.

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

Measurement Date : Nov 18, 2022
Issued Date : Nov 23, 2022

Performed by
☒ Mr. Sorawat Thachalad
☐ Miss Jitraporn Lerboromphol



Approved Signatory:
Mr. Parinya Booncharoen,
Calibration Department Manager



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand.
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Continuation of Calibration of Calibration Number

Calibration Number: R4-02112022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

The results of calibration are reported in table below.

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

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water (500 ml) is added to its cover. We suggest that the number of tipping should be within ±2% different from the 62 tipping (average range 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable test.

End of calibration report



CERTIFICATE OF CALIBRATION

Certificate No.: CL-159-65
Page 1 of 2

Equipment Name: Data Logger with temperature
Sensor
Manufacturer: Novelynx
Model: 110 WS 25BLD
Serial No.: A5912
ID No.: RYG_FS0611

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

Received date: 09 Nov 2022
Calibration date: 18 Nov 2022
Issue date: 23 Nov 2022

Calibration Condition
Temperature: (23.43) °C
Relative Humidity: (55.15)%

Reference Used During Calibration
1. Standard Temperature Probe Model: STS 100 A5GG,
Serial No.: 607682 09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI 1000-A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT 0034-22. Certificate number: ER 0092
22

Calibrated by
[1] Mr. Sorawit Thachalad
[1] Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Panyai Booncharoen
Calibration Department Manager

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Certificate No.: CL-159-65
Page 2 of 2

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

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: U3911247.

Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	19.99	19.9	0.1	0.30
60	24.98	24.7	0.2	0.30
60	30.00	29.8	0.2	0.30
60	35.01	34.6	0.4	0.30
60	39.99	39.5	0.5	0.30

UUC*: Unit Under Calibration

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

★ End of Certificate ★



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

Pressure measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No.: CL-017-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novelynx
MODEL/TYPE : 110-WS-25BP
SERIAL NUMBER : A5912
ID NUMBER : RYG_FS0611
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phattanasak 40, Phattanasak Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 22 Nov 2022
ISSUE DATE : 23 Nov 2022

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	41001811	201479	13 Sep 2022

2. Calibration effort for calibration sequence A

3. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:

4. Condition: ☒ Normal ☐ Abnormal
Pressure transmitting medium: Air
p₁ (20°C, 1 bar): 1.19 kg/m³
p_{rel}: (55.15)%
t_{amb}: (23.43) °C
p_{amb}: (1010.130) mbar

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

Calibration procedure:

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

Traceability:

The measurement results are traceable to the international system of units (SI) through MRA/NSC which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCIS 2540-1 via Certificate number: 201479

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

Calibrated by:
[1] Mr. Sorawit Thachalad
[1] Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Panyai Booncharoen
Calibration Department Manager

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

Pressure measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No.: CL-017-65

Page 2 of 2 Pages

MEASUREMENT RESULTS: ☒ Without adjustment ☐ With adjustment
CALIBRATION IN THE RANGE OF: 950 - 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.6	0.6	0.83
970.00	970.4	0.4	0.55
990.00	990.1	0.1	0.45
1010.00	1010.0	0.0	0.38
1030.00	1029.8	-0.2	0.46
1050.00	1049.6	-0.4	0.59

Note: UUC* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

End of certificate



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novatym
MODEL/TYPE : Sensor: WS-029
Data logger: 110 WS-250L-D
SERIAL NUMBER : Sensor: W50-013
Data logger: AS011
ID NUMBER : RVG_F50610
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Soan Luang,
Khet Soan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 17 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION : Effel-type wind tunnel of Jirante Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 100 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1) °C, (48.8) %RH and (1015.4) hPa.

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

Calibrated by:
[1] Mr. Sorawat Thachalad
[2] Miss Jitaporn Lertsomphol

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



Approved signature: *Mr. Pannu Boonchuen*
Calibration Department Manager

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Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

v_{ref} [m/s]	Temp. wind tunnel [°C]	Temp. room [°C]	v_{UUC} [m/s]	Error [m/s]	U (k=2) [m/s]
0.994	24.08	24.05	0.8	-0.2	0.17
2.036	24.10	24.05	1.8	-0.2	0.17
3.044	24.09	24.05	2.9	-0.2	0.17
4.217	24.10	24.05	3.9	-0.4	0.19
5.02	23.92	24.05	4.9	-0.1	0.17
6.00	24.24	24.05	5.9	-0.1	0.18
7.08	23.88	24.05	6.8	-0.2	0.20
8.20	24.12	24.05	7.9	-0.3	0.20
9.13	23.74	24.05	8.8	-0.3	0.19
10.11	24.04	24.05	9.8	-0.3	0.19
11.17	23.89	24.05	10.9	-0.3	0.20
12.15	23.98	24.05	11.8	-0.3	0.21
13.20	23.78	24.05	12.9	-0.3	0.26
14.25	23.80	24.05	14.0	-0.2	0.26
15.25	23.80	24.05	14.9	-0.3	0.23
16.30	23.80	24.05	16.0	-0.3	0.23

Remark:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novatym
MODEL/TYPE : Sensor: WS-029
Data logger: 110 WS-250L-D
SERIAL NUMBER : Sensor: W50-013
Data logger: AS011
ID NUMBER : RVG_F50610
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Soan Luang,
Khet Soan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 17 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION : Effel-type wind tunnel of Jirante Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 100 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1) °C, (48.8) %RH and (1015.4) hPa.

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

Calibrated by:
[1] Mr. Sorawat Thachalad
[2] Miss Jitaporn Lertsomphol

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



Approved signature: *Mr. Pannu Boonchuen*
Calibration Department Manager

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Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

v_{ref} [m/s]	Temp. wind tunnel [°C]	Temp. room [°C]	v_{UUC} [m/s]	Error [m/s]	U (k=2) [m/s]
0.994	24.08	24.05	0.8	-0.2	0.17
2.036	24.10	24.05	1.8	-0.2	0.17
3.044	24.09	24.05	2.9	-0.2	0.17
4.217	24.10	24.05	3.9	-0.4	0.19
5.02	23.92	24.05	4.9	-0.1	0.17
6.00	24.24	24.05	5.9	-0.1	0.18
7.08	23.88	24.05	6.8	-0.2	0.20
8.20	24.12	24.05	7.9	-0.3	0.20
9.13	23.74	24.05	8.8	-0.3	0.19
10.11	24.04	24.05	9.8	-0.3	0.19
11.17	23.89	24.05	10.9	-0.3	0.20
12.15	23.98	24.05	11.8	-0.3	0.21
13.20	23.78	24.05	12.9	-0.3	0.26
14.25	23.80	24.05	14.0	-0.2	0.26
15.25	23.80	24.05	14.9	-0.3	0.23
16.30	23.80	24.05	16.0	-0.3	0.23

Remark:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



CERTIFICATE OF CALIBRATION

Certificate No. : CL-010-05

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : 119 WS 25BP
SERIAL NUMBER : A5911
ID NUMBER : RYG_FS0610
CONDITION AS RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Phatthanakan Rd.,
Khwang Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.
RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 22 Nov 2022
ISSUE DATE : 23 Nov 2022

Calibration procedure:
The pressure calibration was done by in-house calibration method as WI-CL-001 according to comparison method with Digital pressure calibrator based on DKD-R 6-1

Traceability:
The measurement results are traceable to the international system of units (SI) through NIST 1000 A which complies with the requirements of ISO/IEC 17025:2017, JMS/NSC 2540-1 via Certificate number: 201479

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG-2500	41001811	201479	13 Sep 2022

2. Calibration effort for calibration sequence A

2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal
Pressure transmitting medium : Air
 p_1 (20°C, 1 bar) : 1.19 kg/m³
 H_{avg} : (55±15) %
 t_{amb} : (23±3) °C
 p_{amb} : (1010±10) mbar

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

Calibrated by:
[x] Mr. Sorwut Thachalad
[] Miss Jitraporn Lertsomphol



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CL-010-55

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.0	0.9	0.37
970.00	969.8	0.2	0.49
990.00	989.6	-0.4	0.62
1010.00	1009.5	-0.4	0.64
1030.00	1029.1	-0.9	1.1
1050.00	1049.0	-1.0	1.2

Note: UUC* Unit Under Calibration

To convert the result in report unit to Pa should be multiply by 100

End of certificate



CERTIFICATE OF CALIBRATION

Certificate No.: CL-158-05
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor

Manufacturer: Novalynx
Model: 110 WS 25DL-D
Serial No.: A5911
ID No.: RYG_FS0610

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

Received date: 09 Nov 2022
Calibration date: 18 Nov 2022
Issue date: 23 Nov 2022

Reference Used During Calibration

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

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology (NIM) Certificate number: IT 0034-22. Certificate number: ER-0092-22

Calibrated by:
[x] Mr. Sorwut Thachalad
[] Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate No.: CL-158-05
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: U3911245.

Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.01	19.9	-0.1	0.30
60	25.02	24.9	-0.2	0.30
60	29.99	29.8	-0.2	0.30
60	35.00	34.6	-0.4	0.30
60	40.00	39.4	-0.6	0.30

UUC*: Unit Under Calibration

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

* End of Certificate *





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

CERTIFICATE OF CALIBRATION

Calibration No.: RB-03112022
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novolyne
Model/Type: 110-W5-250L-D
Serial Number: A5911
ID No.: RYG_F50610
Customer: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±0.1)°C and relative humidity of (60±1.5)%.

Measurement Method:

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

Traceability:

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

Measurement Date: Nov 18, 2022
Issued Date: Nov 23, 2022

Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (URI) on display Model: HMF60, Serial number: U3911245

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

The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.07	18.0	-2.0	0.55
50	50.29	48.2	-2.1	0.62
80	80.24	78.4	-1.8	0.55

Performed by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *28/Nov*
Mr. Parinya Booncharoen
Calibration Department Manager

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



63/14-15,67/35-36, Soi Petchkasem 7/1, Petchkasem Rd,
Wathapra, Banghokya, Bangkok 10600 Thailand.
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CALIBRATION REPORT

Calibration Number: RB-01112022
Page 1 of 2 Pages

Measurement Item: Rain gauge with data logger

Manufacturer: Data logger: Novolyne,
Rain gauge: Novolyne

Model/Type: Data logger: 110-W5-250L-D
Rain gauge: 110-W5-250-R

Serial Number: Data logger: A5911
Rain gauge: 98-0037

ID NO: RYG_F50610

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

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±0.1)°C and relative humidity of (50±1.5)%.

Measurement Method:

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

- Obtain rain gauge inlet area:
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = πR^2 3.14 (UUC diameter: 20.3 cm, UUC radius: 10.15 cm)
Rain gauge area = 325.6 cm²
- Obtain theoretical correct rain gauge shower (number of tipping) using 325.6 cm² inlet area and 0.5 l of rain:
a) $10,000 \text{ cm}^3 / 325.6 \text{ cm}^2$ inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
b) $30.90 \times 0.5 \text{ l}$ volume = 15.45 mm (mm of rain over 1 m² surface) 800 ml of rain volume on the rain gauge area = 15.45 mm of rain.
c) Number of tipping = 15.45 / 0.25 mm = 62 tipings.

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

Measurement Date: Nov 18, 2022
Issued Date: Nov 23, 2022

Performed by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *28/Nov*
Mr. Parinya Booncharoen
Calibration Department Manager

10 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250, Thailand.
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Continuation of Calibration of Calibration Number

Calibration Number: RB-03112022
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	63	60 - 64
500	62	61	60 - 64
500	62	63	60 - 64
500	62	63	60 - 64
500	62	61	60 - 64

Remark: The procedure is made to verify the correct result of the Unit Under Calibration rain gauge when a precise volume of water (less than 500 ml) is used. We suggest that the number of tipping should be within ±2% different from the 62 tipping (correct range 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



JIRANATEE ASSOCIATES CO., LTD.
Branch Associates Co., Ltd.
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Tel: (66) 02-8680812
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-750-TS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



Certificate Number

CC-015-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novolyne
MODEL/TYPE: Sensor: WS-02FA
Data logger: 110-W5-250L-D
SERIAL NUMBER: Sensor: WS0-A5980
Data logger: A5980
ID NUMBER: RYG_F50649
CONDITION AS-RECEIVED: New item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE: 18 Jun 2023
MEASUREMENT DATE: 20 Jun 2023
ISSUE DATE: 20 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 0.3 °C
Relative Humidity: 55.0 ± 1.5 %RH
Atmospheric Pressure: 1010 ± 10 hPa

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

CALIBRATION CONDITIONS: Wind tunnel cross-section area: 900 cm²
Win direction frontal area: 100 cm²
Diameter of mounting pipe: 11 mm
Blockage ratio of test object: 0.11 [-]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (24.4) °C, (41.8) %RH and (1011.5) hPa.

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

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



Approved signatory: *28/Nov*
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
* Stable cross-section area of the wind tunnel
* Projected cross-section area of the tested object include mounting pipe
* Diameter of mounting pipe
* Ratio "a/b"

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

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

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: V1920214.
Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.057	20.0	-0.1	0.099
70	25.051	24.9	-0.2	0.099
70	30.044	29.8	-0.2	0.099
70	35.039	34.8	-0.2	0.099
70	40.034	39.7	-0.3	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No.: RH-08062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalyne
Model/Type : 110-W5-250L-D
Serial Number : A5980
ID No. : RYG_P80649
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260 Thailand.

Environmental Condition:
The measurement was carried out in an ambient temperature of (26±3)°C, and relative humidity of (50±15)%.

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

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

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

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (UR) on display. Model: HMP60. Serial number: V1920214.

Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (RH)	Standard Reading (RH)	UUC Reading (RH)	Error (RH)	Uncertainty ±(k=2)
20	20.04	19.3	-0.7	0.52
50	50.25	49.6	-0.8	0.52
80	80.33	80.5	0.2	0.52

Performed by:
☐ Mr. Borawit Thachaid
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangsri Poommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No.: CP-009-66

Page 2 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalyne
MODEL/TYPE : Sensor: 110-W5-250P
Data logger: 110-W5-250L-D
SERIAL NUMBER : Sensor: BP-A5980
Data logger: A5980
ID NUMBER : RYG_P80649
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	41001269	MP-0205-22	02 Dec 2023

2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition: ☒ Normal ☐ Abnormal
Pressure transmitting medium: Air
 ρ_{air} (20°C, 1 bar): 1.19 kg/m³
 ρ_{water} : (55±15) %
 ρ_{oil} : (2283) %
 ρ_{oil} : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibration procedure:
The pressure calibration was done by in-house calibration method as WJ-CL-003 according to comparison method with digital pressure calibrator based on OJWD 6.1

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0205-22
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Calibrated by:
☒ Mr. Borawit Thachaid
☐ Miss Jitraporn Lertsomphol

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CERTIFICATE OF CALIBRATION

Certificate No.: CP-009-66

Page 2 of 2 Pages

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

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.13	950.8	0.6	0.84
970.04	970.4	0.4	0.60
990.10	990.3	0.2	0.46
1010.08	1010.1	0.0	0.37
1030.10	1029.8	-0.3	0.50
1050.08	1049.5	-0.5	0.73

Note: UUC* Unit Under Calibration

*To convert the result in report unit to Pa should be multiply by 100

End of certificate



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Amiection condition in the laboratory are as follow:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thakulad

Miss Jittaporn Lertsomphol

Remarks:

1. Valid cross-section area of the wind tunnel

2. Projected cross-section area of the tested object include mounting pipe

3. Diameter of mounting pipe

4. Ratio γ_{air}

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Amiection condition in the laboratory are as follow:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thakulad

Miss Jittaporn Lertsomphol

Remarks:

1. Valid cross-section area of the wind tunnel

2. Projected cross-section area of the tested object include mounting pipe

3. Diameter of mounting pipe

4. Ratio γ_{air}

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Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{ref} (m/s)	Error (m/s)	U (m/s) (m/s)
0.584	23.80	23.65	0.8	-0.2	0.15
2.031	23.50	23.65	1.9	-0.2	0.16
3.044	23.80	23.65	2.9	-0.2	0.19
4.139	23.80	23.65	3.9	-0.2	0.19
4.97	23.60	23.65	4.8	-0.1	0.19
5.98	23.84	23.65	5.9	-0.1	0.18
7.04	23.58	23.65	6.9	-0.2	0.18
8.18	23.78	23.65	7.9	-0.3	0.21
9.08	23.44	23.65	9.0	-0.1	0.20
10.07	23.50	23.65	9.9	-0.1	0.28
11.14	23.26	23.65	10.9	-0.2	0.22
12.13	23.42	23.65	11.9	-0.2	0.21
13.20	23.30	23.65	12.9	-0.3	0.21
14.25	23.34	23.65	13.9	-0.3	0.22
15.17	23.30	23.65	14.9	-0.2	0.24
16.29	23.26	23.65	16.0	-0.3	0.26

Remarks:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



End of Certificate of Calibration

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D_{ref} Degree (°)	D_{ref} Degree (°)	Error Degree (°)	U (m/s) Degree (°)
	0.000	0	0	0.58
	44.999	42	-3	0.58
	90.000	87	-3	0.60
	135.000	133	-2	0.58
4.99	180.001	180	0	0.68
	225.000	228	3	0.74
	270.001	274	4	0.74
	315.000	319	4	0.74

Remarks:

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

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS RECEIVED
CUSTOMER

Wind Direction Sensor
Novolyne
Sensor: WS-02F
Data logger: 110-WS-2SDI-D
Sensor: WSD-011
Data logger: AS600
RYO, J50330
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:
The wind direction sensor was calibrated against
Standard Rotary Encoder model AS600975
DMA04 P3-5-UD in an close proximity of Eiffel
type wind tunnel with 900 cm² cross section
area. The WI-CL-008 based on IEC 61000-12-1,
Wind energy generation systems - Part 12-1:
Power performance measurements of electricity
producing wind turbines, March 2017 was used as
a calibration guideline.

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

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

16 Jan 2023
19 Jan 2023
20 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1020 ± 10 hPa

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

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

Preconditioning
Measurement Condition

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

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

Calibrated by:
[X] Mr. Sorawit Jirachai
[X] Miss Jiraporn Jirachai

Approved signatory: *Signature*
Mr. Parinya Boonchaisan
Calibration Department Manager

Remarks:
1. Ambient condition area of the wind tunnel
2. Projected cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio 1 to 1

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

Certificate Number
CL-012-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D ¹ _{me} Degree (°)	D ¹ _{std} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.000	0	0	0.39
	45.000	42	-3	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.88
	180.000	179	-1	0.74
	225.000	226	1	0.74
270.000	270	0	0.74	
315.000	316	1	0.74	

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

End of Certificate of Calibration

J NAC
JIRANATEE ASSOCIATES CO., LTD.

Accredited calibration laboratory
ISO/IEC 17025:2017
KSC-TIS-115 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Review by: *Random?*
Approved by: *Signature*
Next Cal. Date: 19/7/24

Certificate Number
CL-012-66

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS RECEIVED
CUSTOMER

Cup anemometer
Novolyne
Sensor: WS-02F
Data logger: 110-WS-2SDI-D
Sensor: WSD-011
Data logger: AS600
RYO, J50330
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:
The cup anemometer was calibrated against
Standard air velocity transducer model AS600975
DMA04 P3-5-UD in an close proximity of Eiffel
type wind tunnel with 900 cm² cross section
area. The WI-CL-008 based on IEC 61000-12-1,
Wind energy generation systems - Part 12-1:
Power performance measurements of electricity
producing wind turbines, March 2017 was used as
a calibration guideline.

Traceability:
This certificate provides a traceability of the
measurement to recognized the national
standards, and to realization of the international
system of units (SI) through the NIMT (National
Metrology Institute of Thailand) via Certificate
number: IMV-0052-21 and IMV-0055-22

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

16 Jan 2023
18 Jan 2023
20 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1020 ± 10 hPa

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

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

Preconditioning
Measurement Condition

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

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

Calibrated by:
[X] Mr. Sorawit Jirachai
[X] Miss Jiraporn Jirachai

Approved signatory: *Signature*
Mr. Parinya Boonchaisan
Calibration Department Manager

Remarks:
1. Ambient condition area of the wind tunnel
2. Projected cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio 1 to 1

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

Certificate Number
CL-012-66

Page 2 of 2 Pages

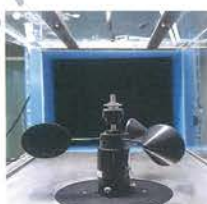
MEASUREMENT RESULTS⁵

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

U _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	U _{me} (m/s)	Error (m/s)	U (k=2) (m/s)
0.979	23.56	23.70	0.8	-0.2	0.16
2.025	23.80	23.70	1.8	-0.2	0.16
3.046	23.50	23.70	2.8	-0.2	0.20
4.120	23.64	23.70	3.9	-0.1	0.20
5.01	23.44	23.70	4.8	-0.2	0.18
5.98	23.60	23.70	5.8	-0.2	0.18
7.05	23.78	23.70	6.9	-0.1	0.19
8.17	23.60	23.70	8.0	-0.2	0.19
9.09	23.20	23.70	9.0	0.0	0.21
10.09	23.52	23.70	9.9	-0.2	0.20
11.13	23.20	23.70	10.9	-0.2	0.21
12.13	23.50	23.70	11.9	-0.2	0.21
13.19	23.20	23.70	13.0	-0.2	0.22
14.25	23.46	23.70	14.9	0.0	0.24
15.22	23.20	23.70	15.1	-0.1	0.34
16.31	23.30	23.70	16.1	-0.2	0.29

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

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Certificate No.: CL-005-66
Page 1 of 2

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

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

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

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

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

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

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



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

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

CERTIFICATE OF CALIBRATION

Calibration No.: RH-C5012023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novolyx
Model/Type : 110-WS-25DL-D
Serial Number : A5660
ID No. : RYG_FS0530
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Conditions
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

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

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

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

Measurement Results
This equipment was connected with indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial num-
ber: 64620631.
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.03	17.8	-2.2	0.58
50	50.26	48.6	-1.7	0.57
80	80.29	79.8	-0.5	0.58

Performed by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



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

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

Certificate No.: CL-005-66
Page 2 of 2

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

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: S4620631.
Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.065	19.8	-0.3	0.099
60	25.058	24.6	-0.5	0.14
60	30.052	29.5	-0.6	0.099
60	35.047	34.5	-0.5	0.099
60	40.038	39.4	-0.6	0.099

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

★ End of Certificate ★



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Tel: +66(0)28680812
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E-mail: jrac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NAC-TS-15 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 19/12/24

Certificate Number
CC 012 66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novolyx
MODEL/TYPE : Data logger 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5974
Data logger: A5974
ID NUMBER : BKK_FS1374
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 2023

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

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

CALIBRATION CONDITIONS : Wind tunnel cross-section area: 900 cm²
Win direction frontal area¹: 100 cm²
Diameter of mounting plate²: - mm
Blockage ratio of test object³: 0.111 [-]

Preconditioning : 24 hours at ambient condition.
Measurement Condition : The average values during measurement are (24.0) °C, (46.8) %RH and (1007.8) hPa.

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

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



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

Remarks:
¹Wing cross-section area of the wind tunnel
²Projected cross-section area of the tested object include mounting plate
³Diameter of mounting plate
⁴Ratio "to"

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

Certificate Number

CC-012-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 36 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
1.024	23.32	24.00	0.9	-0.1	0.31
2.029	24.10	24.00	1.9	-0.1	0.31
3.019	23.78	24.00	2.9	-0.1	0.31
4.125	24.08	24.00	4.0	-0.1	0.31
5.01	23.64	24.00	4.9	-0.1	0.31
5.97	24.02	24.00	5.9	-0.1	0.31
7.05	23.50	24.00	7.0	-0.1	0.31
8.15	24.10	24.00	8.0	-0.2	0.31
9.08	23.60	24.00	9.0	-0.1	0.31
10.07	24.00	24.00	10.0	-0.1	0.31
11.14	23.68	24.00	11.0	-0.2	0.31
12.13	23.94	24.00	12.0	-0.1	0.31
13.17	23.70	24.00	13.0	-0.2	0.31
14.23	23.86	24.00	14.0	-0.1	0.31
15.23	23.70	24.00	15.0	-0.2	0.31
16.28	23.74	24.00	16.0	-0.2	0.31

Remarks:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



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JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
417/4 B5, 27/25 36,
Noida House, 7/71, Rd. Wattana, Bangkok,
Bangkok 10600 (Thailand)
Tel: +662 680812
Mobile: +662 680812
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-159-16 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CD-012-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Actual cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Parameter of mounting pipe

⁴ Rate: %

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

Certificate Number

CD-012-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D^{+}_{ref} Degree (°)	D^{-}_{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	42	-3	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
	180.000	181	1	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0

Remarks:

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

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



J
NAC
JIRANATEE ASSOCIATES CO., LTD.

63/14-15, 67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Wattana, Bangkok, Bangkok 10600 Thailand.

Tel: (66) 02-680812#13 Fax: (66) 02-680860 www.jiranatee.com



CERTIFICATE OF CALIBRATION

Certificate No.: CT-022-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novallux

Model: 110 WS-25DL-D

Serial No.: A5974

ID No.: BKK_FS1374

Customer

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

Address: 104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Suan Luang, Khet Suan Luang, Bangkok

10250 Thailand.

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,

Serial No.: 667682-09. Due date: 28 Mar 2024

2. Digital Temperature Indicator Model: DTI-1000-A MK

II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Procedure

The temperature calibration was done by In-House

calibration method as WI-CI-001 according to

comparison method with standard digital temperature

indicator and standard temperature probe. The

temperature scale use was based on ITS-90.

Received date: 16 Jun 2023

Calibration date: 19 Jun 2023

Issue date: 22 Jun 2023

Calibration Condition

Temperature: (23±3) °C

Relative Humidity: (55±15)%

Traceability

The measurement results are traceable to the

international system of units (SI) through National

Institute of Metrology Thailand (NIMT) Certificate

number: TT-0038-23, Certificate number: ER 0092-

22

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

Calibrated by:

☒ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Certificate No.: CT-022-66
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function: This equipment was connected with temperature sensor Model: HMP60 S/N: V1920211.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.057	20.1	0.0	0.099
70	25.052	25.0	-0.1	0.099
70	30.044	29.9	-0.1	0.099
70	35.039	34.8	-0.2	0.099
70	40.034	39.8	-0.2	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No. : RH-05062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5974
ID No. : BKK_F51374
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phothanokan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 186G-3 in the humidity generator chamber to determine the errors.

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

Measurement Date : Jun 19, 2023
Issued Date : Jun 22, 2023

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (LRF) on display. Model: HMP60, Serial number: V1920211.

Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.07	19.3	-0.8	0.51
50	50.28	48.9	-1.4	0.51
80	80.22	79.1	-1.2	0.64

Performed by:
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Fluangrumpal Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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



Pressure measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CP-006-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A5974
Data logger: A5974
ID NUMBER : BKK_F51374
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 2023

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CP62500	4100126P	MP-0205-22	02 Dec 2023

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:

4. Condition:
☒ Normal ☐ Abnormal
Pressure transmitting medium : Air
 ρ_1 (20°C, 1 bar) : 1.19 kg/m³
 H_{temp} : (55±15) %
 T_{amb} : (23±1) °C
 P_{amb} : (1010±10) mbar

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

Calibration procedure:
The pressure calibration was done by the house calibration method as WJ-CL-003 according to comparison method with Digital pressure calibrator based on DKD-B 6-1

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

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



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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

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



Pressure measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CP-006-66

Page 2 of 2 Pages

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

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.10	950.9	0.8	0.97
970.09	970.6	0.5	0.70
990.10	990.4	0.2	0.47
1010.09	1010.1	0.0	0.37
1030.06	1029.8	-0.3	0.49
1050.06	1049.7	-0.4	0.60

Note: UUC* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

End of certificate





JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
63/74-15, 47/35-36
Ponchaikorn 27/1, Rd. Watthana, Bangkok,
Bangkok 10600 (Thailand)
Tel: +662 0508012
Mobile: +6686 7959433
E-mail: jira-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TS-175 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

REVIEW BY: *Phachon P.*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 21/8/24

Certificate Number

CL-023-66

CERTIFICATE OF CALIBRATION

Page 1 of 7 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novolyra

Sensor: WS-02F

Data logger: 200-WS-25UB

Sensor: -

Data logger: AS578

BKX_130918

Used item

ALIS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

15 Feb 2023

21 Feb 2023

21 Feb 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area

900 cm²

Win direction frontal area

100 cm²

Diameter of mounting pipe

- mm

Blockage ratio of test object

0.111 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.4) °C, (42.0) %RH and (1015.0) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
[x] Mr. Sorawat Thakhalad
[x] Miss Jittaporn Eertsongkol



Approved signatory:

[Signature]
Mr. Pinyas Booncharoen
Calibration Department Manager

Remarks:
1. Sample cross-section area of the wind tunnel.
2. Projected cross-section area of the tested object include mounting pipe.
3. Diameter of mounting pipe.
4. Ratio "a".

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

Certificate Number

CL-023-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

V _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
0.954	24.00	23.95	0.7	-0.3	0.15
2.035	23.86	23.95	1.7	-0.3	0.16
3.045	23.92	23.95	2.8	-0.3	0.17
4.119	24.00	23.95	3.9	-0.2	0.19
4.98	23.72	23.95	4.8	-0.2	0.20
5.97	23.81	23.95	5.7	-0.2	0.18
7.05	23.60	23.95	6.8	-0.2	0.18
8.16	24.00	23.95	7.8	-0.3	0.20
9.08	23.52	23.95	8.8	-0.2	0.19
10.08	23.58	23.95	9.8	-0.2	0.19
11.14	23.64	23.95	10.9	-0.2	0.23
12.13	23.80	23.95	11.9	-0.2	0.23
13.19	23.80	23.95	12.9	-0.3	0.21
14.24	23.70	23.95	13.9	-0.3	0.22
15.17	23.74	23.95	14.9	-0.3	0.22
16.30	23.70	23.95	16.0	-0.3	0.23

Remark:

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

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
63/74-15, 47/35-36
Ponchaikorn 27/1, Rd. Watthana, Bangkok,
Bangkok 10600 (Thailand)
Tel: +662 0508012
Mobile: +6686 7959433
E-mail: jira-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TS-175 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-021-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novolyra

Sensor: WS-02F

Data logger: 200-WS-25UB

Sensor: -

Data logger: AS578

BKX_130918

Used item

ALIS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

15 Feb 2023

21 Feb 2023

21 Feb 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area

900 cm²

Win direction frontal area

129 cm²

Diameter of mounting pipe

- mm

Blockage ratio of test object

0.143 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.6) °C, (52.1) %RH and (1013.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
[x] Mr. Sorawat Thakhalad
[x] Miss Jittaporn Eertsongkol



Approved signatory:

[Signature]
Mr. Pinyas Booncharoen
Calibration Department Manager

Remarks:
1. Sample cross-section area of the wind tunnel.
2. Projected cross-section area of the tested object include mounting pipe.
3. Diameter of mounting pipe.
4. Ratio "a".

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

Certificate Number

CL-021-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D _{std} Degree (°)	D _{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	42	-3	0.66
	90.000	87	-3	0.66
	135.000	131	-4	0.68
5.00	180.001	179	-1	0.74
	225.000	227	2	0.58
	270.000	273	3	0.68
	315.000	318	3	0.68

Remark:

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

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



REVIEW BY *Prasanna P*
APPROVED BY *Prasanna P*
NEXT CAL DATE *19/12/24*

Certificate Number
CC-009-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Cup anemometer
Novalyne
Sensor: WS-02FA
Data logger: 110-WS-25DL-D

SERIAL NUMBER

Sensor: WSO-AS966
Data logger: AS966

ID NUMBER

BKK_F51371

CONDITION AS-RECEIVED

New Item

CUSTOMER

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

RECEIVED DATE

16 Jun 2023

MEASUREMENT DATE

19 Jun 2023

ISSUE DATE

19 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 100 cm²
Diameter of mounting pipe³ - mm
Blockage ratio of test object⁴ 0.113 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.0) °C, (45.2) %RH and (1008.4) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

M. Sorawit Thacholad
M. Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

- ¹ Nozzle cross-section area of the wind tunnel
- ² Projected cross-section area of the tested object include mounting pipe
- ³ Diameter of mounting pipe
- ⁴ Ratio = $\frac{A_2}{A_1}$

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Certificate Number
CD-009-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor
Novalyne
Sensor: WS-02FA
Data logger: 110-WS-25DL-D

SERIAL NUMBER

Sensor: WSO-AS966
Data logger: AS966

ID NUMBER

BKK_F51371

CONDITION AS-RECEIVED

New Item

CUSTOMER

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

RECEIVED DATE

16 Jun 2023

MEASUREMENT DATE

19 Jun 2023

ISSUE DATE

19 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 129 cm²
Diameter of mounting pipe³ - mm
Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.3) °C, (44.7) %RH and (1010.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

M. Sorawit Thacholad
M. Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

- ¹ Nozzle cross-section area of the wind tunnel
- ² Projected cross-section area of the tested object include mounting pipe
- ³ Diameter of mounting pipe
- ⁴ Ratio = $\frac{A_2}{A_1}$

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

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D _{air} Degree (°)	D _{air} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	43	-2	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
5.01	180.000	182	2	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



Jiranatee Associates Co., Ltd.

CERTIFICATE OF CALIBRATION

Certificate No. : CT-019-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novalyne
Model: 110-WS-25DL-D
Serial No.: AS966
ID No.: BKK_F51371

Customer

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

Received date:

16 Jun 2023

Calibration date: 19 Jun 2023

Issue date: 22 Jun 2023

Reference Used During Calibration

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

Calibration Condition

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

Calibration Procedure

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

Traceability

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

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

Calibrated by

M. Sorawit Thacholad
M. Miss Jitraporn Lertsomphol
M. Miss Ruangrumpai Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: V1920207.
Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.058	20.0	-0.1	0.099
70	25.051	24.9	-0.2	0.099
70	30.044	29.9	-0.1	0.099
70	35.040	34.9	-0.1	0.099
70	40.034	39.8	-0.2	0.099

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No.: RH-02062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novolyte
Model/Type : 110-W5-25DL-D
Serial Number : A5966
ID No. : BKK_F51371
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

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

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

Measurement Date : Jun 19, 2023
Issued Date : Jun 22, 2023

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (UFI) on display. Model: HMP60, Serial number: V1920207.

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

The results of calibration are reported in table below.

Determined (RH%)	Standard Reading (RH%)	UUC Reading (RH%)	Error (RH%)	Uncertainty ±(RH%)
20	20.06	19.6	-0.6	0.53
60	60.22	60.4	0.2	0.53
80	80.21	81.6	1.3	0.53

Performed by
☐ Mr. Surawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangruep Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Certificate No.: CP-003-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novolyte
MODEL/TYPE : Sensor: 110-W5-25BP
Data logger: 110-W5-25DL-D
SERIAL NUMBER : Sensor: BP-A5966
Data logger: A5966
ID NUMBER : BKK_F51371
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 2023

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CP62500	4100126P	MP-0205-22	02 Dec 2023

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal
Pressure transmitting medium : Air
 p_{ts} (20°C, 1 bar) : 1.19 kg/m³
 ρ_{unc} : (55±15) %
 T_{unc} : (28±5) °C
 p_{unc} : (1010±10) mbar

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

Calibration procedure:
The pressure calibration was done by in-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1
Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0205-22
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Calibrated by:
☒ Mr. Surawit Thachalad
☐ Miss Jitraporn Lertsomphol

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

CERTIFICATE OF CALIBRATION

Certificate No.: CP-003-66

Page 2 of 2 Pages

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

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.03	950.6	0.6	0.77
970.14	970.4	0.3	0.51
990.04	990.1	0.1	0.39
1010.12	1010.1	-0.1	0.38
1030.09	1029.8	-0.3	0.50
1050.07	1049.6	-0.5	0.70

Note: UUC* Unit Under Calibration

To convert the result in report unit to Pa should be multiply by 100

End of certificate



SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC23005
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG_FS0496

Condition As Found : GOOD

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

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

Received Date : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

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. : ACC23005
Job No. : VC66AC0024
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

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

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	93.98	-0.02	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1000.0	0.0	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACT.22227
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplicifier NH-24
Serial No.: 00623388 / 198635 / 26416
ID No.: -

Condition As Found : GOOD

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

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

Received Date : 28 SEPTEMBER 2022
Calibration Date : 12-17 OCTOBER 2022
Date of Issue : 18 OCTOBER 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

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
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

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
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. : ACL22227
Job No. : VC65AC0086
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.4
Flat	23.2

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.8	0.9	0.9	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	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	93.9	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	93.9	0.0	±0.1
Leq	94.0	0.0	±0.1

6. Long - term stability

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

QF-TS12-04-04-020664

Cert. No. : ACL22227
Job No. : VC65AC0086
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	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	28.0	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

QF-TS12-04-04-020664

Cert. No. : ACL22227
Job No. : VC65AC0086
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
	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
SEI	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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

Cert. No. : ACL22227
Job No. : VC65AC0086
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

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. : ACL23042
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00900071 / 188464 / 01733
ID No. : RYG_FS0492

Condition As Found : GOOD

Customer : ALS 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 : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
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

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
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. : ACL23042
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.9
Flat	23.9

3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

T. Petchur

Cert. No. : ACL23042
Job No. : VC66AC0024
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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

T. Petchur

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload indication

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

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., Bangumru, Bangplud Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiphorn.com http://www.sithiphorn.comCert. No. : ACL23043
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00900072 / 188465 / 01734
ID No. : RYG FS0493

Condition As Found : GOOD

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

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

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23043
Job No. : VC66AC0024
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

Continuation of Calibration Certificate

Cert. No. : ACL23043
Job No. : VC66AC0024
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. : ACL23043
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	22.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.9	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23043
Job No. : VC66AC0024
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

Cert. No. : ACL23043
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

T. Petchurai

Cert. No. : ACL23043
Job No. : VC66AC0024
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 _{peak} (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. Petchurai

Cert. No. : ACL23043
Job No. : VC66AC0024
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. Petchurai

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



Cert. No. : ACL22237
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173611 / 172173 / 74023
ID No.: RYG_FS0390

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG 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 : 03 OCTOBER 2022
Calibration Date : 18-19 OCTOBER 2022
Date of Issue : 20 OCTOBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)



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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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. : ACL22237
Job No. : VC65AC0088
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)
15.4

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

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

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.4	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.2	-0.2	-0.1	± 5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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	0.1	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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
Pages : 6 of 8

7. Level linearity on the reference level range

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

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	± 1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	± 1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	± 1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.4	-1.0	± 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	135.2	-0.2	± 2.0
Negative half cycle	135.4	135.2	-0.2	± 2.0

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22237
Job No. : VC65AC0088
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. Petchur

451-451/1 Sirinthorn Rd., Bangbunru, Bangkok Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23078
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00296515 / 179119 / 87526
ID No. : RYG_FS0432

Condition As Found : GOOD

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

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

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
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. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
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. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.4

3. Acoustical signal tests of frequency weightings

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

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
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7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

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

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23078
Job No. : VC66AC0031
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACC23009
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178121
ID No. : RYG_FS0213

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 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 : 24 JANUARY 2023
Calibration Date : 26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23009
Job No. : VC66AC0031
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).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23009
Job No. : VC66AC0031
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	94.16	0.16	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.2	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.97	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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



Cert. No. : ACL23332
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NT-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00222601 / 195913 / 15433
ID No.: NKH_FS0120

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHIWAENG 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 : 20 OCTOBER 2023
Calibration Date : 01-02 NOVEMBER 2023
Date of Issue : 03 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
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-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL.BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL.BP 29/0266	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL.BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QF-TS12-04-04-020664

T. Peth

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.5
Flat	22.3

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	0.2	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. Peth

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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T. Peth

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
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	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

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T. Peth

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
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, T _b (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
	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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QI-TS12-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23332
Job No. : VC67AC0013
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.8	89.5	-0.3	±1.5

12. High level stability

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

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

End of Calibration Certificate

QI-TS12-04-04-020664

T. Petchurai

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



Cert. No. : ACL23331
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Pre-amplifier NH-24
Serial No.: 00222553 / 195865 / 15385
ID No.: NKH_FS0116

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHAENG 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 : 20 OCTOBER 2023
Calibration Date : 01-02 NOVEMBER 2023
Date of Issue : 03 NOVEMBER 2023



Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)

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QI-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
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-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

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

QI-TS12-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	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	9.9
C - weight	16.4
Flat	22.3

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	0.0	0.0	0.0	±1.0
8000	0.8	0.9	0.9	±5.0

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
Pages : 6 of 8

7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
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, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
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

S. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23331
Job No. : VC67AC0013
Pages : 8 of 8

11. Overload indication

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

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

S. Petch.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2716-9484

Cert. No.: 23CH552
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : B712869298
ID No. : RYG_FS0298
Condition As-Received: Used item
Received Date : 26 April 2023
Calibration Date : 02 May 2023
Reference : 2304-0759DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
816/10 Moo 5, T. Maenam Khu.,
A. Phukdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

REVIEW BY: P. Petch.
APPROVED BY: S.P.
NEXT CAL. DATE: 02/05/24

Calibrated by : Warakorn Lernagatrakul

Approved by :
Approved Signatory

(/) Malee Butkrues
() Sathip Moangmai
() Warakorn Lernagatrakul

Issue Date : 8 May 2023

The Uncertainties are for a confidence probability of approximately 95 %

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0053786

Cert. No.: 23CH552
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -
Instrument Serial No. ID No. Cert. No. Due Date
1) Document Process Calibrator 54030049 130RC116 22E2769 24 Aug 2023
This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT
2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1935

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	26 Dec 2024
pH 6.867	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	26 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: B712869298	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 8455109	4.008	4.01	180	0.0079	2.00
	6.867	6.99	7	0.011	2.00
	10.010	10.01	-167	0.0095	2.00

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

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Malee.

a 1159704



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TEL. 0-2717-3000-29 FAX. 0-2715-9484



Cert. No.: 23LM91
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : B712869298
ID No. : RYG_FS0299
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
618/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 28 April 2023
Calibrated Date : 03 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Kunchit Promrat
Approved by :
() Pornthipha Tameyakul
(/) Malee Bulkruea
() Suwit Imjai
Issue Date : 8 May 2023

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 0053787



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2304-0759DSC-3
Procedure Used :-

Cert. No.: 23LM91
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	1502A	A7B843	23124	04 Jan 2024

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.: 8455109

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.003	25.2	0.197	0.16	2.00
30.0	100	30.000	30.3	0.300	0.16	2.00
40.0	100	40.003	40.3	0.297	0.16	2.00
50.0	100	50.002	50.3	0.298	0.16	2.00

UUC* : Unit Under Calibration

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

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a 1159703



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Cert.No.: 23CH442
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go pH/mV S2
Serial No. : C202355606
ID No. : RYG_FS0574
Condition As-Received : Used Item
Received Date : 31 March 2023
Calibration Date : 03 April 2023
Reference : 2303-1133DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
618/10 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 Lerngagitrakul
Approved by :
(/) Malee Bulkruea
() Saithip Meangmai
() Warakorn Lerngagitrakul
Issue Date : 5 April 2023



The Uncertainties are for a confidence probability of approximately 95 %

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0052954



Cert. No.: 23CH442
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

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

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: C202355606	4.00	177.48	177	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 2015870	4.008	4.01	170	0.0071	2.00
	6.987	7.00	-5	0.011	2.00
	10.010	10.01	-181	0.0095	2.00

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

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a 1156432



Cert. No.: 23LM86
Page: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : SevenGoTM pHmV S2
Serial No. : C202355606
ID No. : RYG_FS0574
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 31 March 2023
Calibrated Date : 05 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Procha Hlahib
Approved by :
() Pornthippa Tamayakul
() Maloo Butkruea
() Suwit Imjai
Issue Date : 21 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0053338



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2303-1133DSC-4
Procedure Used :-

Cert. No.: 23LM86
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	1502A	A52847	2211325	31 Oct 2023
2) This certificate is valid only to the item calibrated on date and place of calibration.				
3) This certification is traceable to the International System of Unit.				

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 2015870

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.002	25.1	0.098	0.16	2.00
40.0	100	40.001	40.2	0.199	0.16	2.00
60.0	100	60.005	60.5	0.495	0.16	2.00

UUC* : Unit Under Calibration

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

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a 1157393



Cert.No.: 23CH275
Page: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact S220
Serial No. : C104059460
ID No. : RYG_EN0183
Condition As-Received : Used Item
Received Date : 24 February 2023
Calibration Date : 27 February 2023
Reference : 2302-0886DSC-2
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

REVIEW BY
APPROVED BY
NEXT CAL. DATE 27/2/24

Calibrated by : Walalak Sirithien

Approved by :
Approved Signatory

() Maloo Butkruea
(✓) Sathip Meangmai
() Warakorn Lemngtrakul

Issue Date : 28 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0051538



Cert.No.: 23CH275
Page: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211306	27 Oct 2023

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

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

a 1149925



Cert.No.: 23CH275
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.: 1453404	4.008 6.987 10.010	4.008 6.988 10.013	179.1 4.7 -172.4	0.0046 0.0084 0.0069	2.00 2.00 2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLabExpert Pro-ISM

- Serial No. : 1453404

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.001	24.8	-0.201	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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Sailip

a 1149924



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10219
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23E753
Page: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact S220
Serial No.: C104059460
ID No.: RYG_END163

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Condition As-Received: Used Item
Received Date: 24 February 2023
Calibration Date: 28 February 2023

Reference: 2302-0888DSC
Ambient Temperature: (23 \pm 2) °C
Relative Humidity: (50 \pm 10) %
Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
816/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	8440007	22E1670	18 May 2023

2. This result of calibration was made on request at the point specified by customer.
3. The certificate is valid only to the item calibrated on date and place of calibration.
4. This Calibration is traceable to the International System of Unit maintained at:-
- National Institute of Metrology Thailand (NIMT)

Calibrated by: Wulcharaporn Wongchulkrano
Issue Date: 02 March 2023
Approved Signatory: [Signature]

[] Phalinee Pratsapaipal
[x] Nuntanont Khamchai
[] Pornthippa Tameyakul

B 0309672



Cert. No.: 23E753
Page.: 2 of 2

Result of calibration:- (*) Without adjustment () After adjustment

Function: DC voltage measurement	Range: 2000 mV	Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (\pm μ V)
		-200.0000	-200.0	0.0	72
		-150.0000	-150.0	0.0	69
		-100.0000	-100.0	0.0	65
		-50.0000	-50.0	0.0	62
		0.0000	0.0	0.0	58
		50.0000	50.0	0.0	62
		100.0000	99.9	-0.1	65
		150.0000	149.9	-0.1	69
		200.0000	199.9	-0.1	72

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

UUC* = Unit Under Calibration.

-000-

Sailip

a 1150477



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000 FAX. 0-2719-9484

Certificate of Testing

Cert.No.: 23TW168
Page.: 1 of 2

Equipment : DO Meter
Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG_EN0032

Received Date : 21 July 2023

Test Date : 24 July 2023

Reference : 2307-0713DSC-1

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

Rayong Branch

816/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,

Rayong 21140, Thailand

Laboratory Condition : Temperature (25 \pm 5) °C

Humidity (50 \pm 20) %

Test Procedure : In - house method : CP-CH9

by Comparison Technique with Azide Modification Method

Tested by : Walaiak Sirithean

Approved by : [Signature]

Approved Signatory

() Malee Butkruea

(x) Sailip Meangmai

() Warakorn Lemgagrakul

Issue Date : 28 July 2023

REVIEW BY: [Signature]
APPROVED BY: [Signature]
NEXT CAL DATE: 24/01/25

B 0320211



Cert.No.: 23TW168
Page: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.18	8.17	0.0055

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

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Switj

a 1172155



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250
TEL: 0-2717-8000-29 FAX: 0-2719-9484



Cert. No.: 23LM125
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. Pluakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 25 July 2023
Calibrated Date : 27 July 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Preecha Hahib

Approved by :
Approved Signatory

() Pongthippa Tamayakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 31 July 2023

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 0053615



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713DSC-2

Cert. No.: 23LM125
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	221285	TPA	21 Oct 2023

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

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

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with : temperature sensor, S/N.: 1226475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101 °	0.15	2.00

UUC* : Unit Under Calibration

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

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Switj

a 1159515



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TEL: 0-2717-8000-29 FAX: 0-2719-9484



Cert. No.: 23TM962
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : VB18.0084
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 : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattansongpaiboon

Approved by :
Approved Signatory

() Pongthippa Tamayakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 7 June 2023

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 0054967



Equipment : Low Temp. incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Cert. No.: 23TM962
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	34972A	MY57013711	22LM93	02 Jul 2023

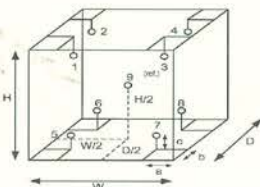
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.60 m
W = 1.0 m
H = 1.2 m
Capacity = 0.75 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	23
REL.Humid. (%)	54	56
AC Supply (Volt)	223	222

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

a 1165130



Equipment : Low Temp. incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Cert. No.: 23TM962
Page : 3 of 3

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.116	0.30

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

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

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

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

UUC* : Unit Under Calibration

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

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

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a 1165129



Certificate of Calibration

Equipment : SPECTROPHOTOMETER

Model : DR6000

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.

REVIEW BY : N.B. BANG

APPROVED BY : D.A. BANG

NEEDS CALIBRATION 27/13/24

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. Chutaphon Folthong

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. Chutaphon Folthong)

Person in charge

(Mr. Thalemgkiet Pongnam)

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 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.

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Prachinburi 10280
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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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 81d 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
	0.6693	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0046
	0.9823	0.983	-0.0007	0.0045

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CALFM-C06-13: 20 Jul 2022

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	-0.0026	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)	
260.87 +/- 0.11 nm	260.7	2.1	1.678	
391.94 +/- 0.11 nm	391.9	1.7	1.770	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.60	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.268		

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 5 ตำบลบางนา อำเภอบางนา กรุงเทพมหานคร 10280
Phone: +66 2543 7000 Email: info@dksh.co.th Website: www.dksh.co.th

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CALFM-C06-13: 20 Jul 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
27 Sep 2022		27 Sep 2022		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<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)
Spectrophotometer				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ (Battery Backup) >= 2.5 VDC
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. ตัวควบคุมอุณหภูมิความยาวคลื่น (Wavelength Control)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<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)
pH Meter and Conductivity Meter				
<input type="checkbox"/>	<input type="checkbox"/>	<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. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)
Turbidimeter				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการล้างตัวของแสง (>= 2.5 ไม่นาที 3.0)
Automatic titrator				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ 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. ระบบท่อส่งยาและอุปกรณ์ประกอบ

แจ้งผล/ข้อบกพร่อง:

Mr. Chattaphon Fothong
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 5 ตำบลบางนา อำเภอบางนา กรุงเทพมหานคร 10280
Phone: +66 2543 7000 Email: info@dksh.co.th Website: www.dksh.co.th

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CAL-FM-R31-03: 20 Jul 2022

RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10510
Tel: +66 2543 8391-6, e-mail: service.thailand@sartorius.com



SARTORIUS

REVIEW BY: *Thanaol*
APPROVED BY: *D.K.*
NEXT CAL. DATE: 01/03/24

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius

Certificate No.: 23BCI0112
Issued Date: Friday, March 03, 2023
Reference No.: 204833
Page No.: 1 of 2

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

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

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

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

Metrological data:

Capacity: 220 g Readability: 0.0001 g

Temperature: 23.6 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration

☐ New Installation ☐ Service / Received ☒ Re-calibration / Maintenance ☐ Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref : Lab 14

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 calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	SPC-RT	C02212585	14-Sep-2023
MHB-382SD	Humidity/Balometer/Temp. Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.
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Mr.chonchai Inthana(Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10510
Tel: +66 2543 8391-6 Fax: +66 2543 1067, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius

Certificate No.: 23BCI0112
Issued Date: Friday, March 03, 2023
Reference No.: 204833
Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability qualitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points / positions defined according to OIML R76.		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	199.9999	 Difference		
	20.0000	200.0000			
	20.0000	199.9999			
Nominal Value : (High Load)	20.0000	199.9999			
200 g	19.9999	200.0000			
Tolerance	0.0001 g	200.0000			
	20.0000	199.9999			
	20.0000	200.0000			
Standard Deviation	0.00003	0.00005			

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0001	0.0001	0.00014
20	20.0000	20.0000	0.0000	0.00014
30	30.0000	30.0000	0.0000	0.00015
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report

SOP FM 33 03 February 2022



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CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250
TEL: 0-2717-3099-27 FAX: 0-2719-9484



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 : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Man Pattanaspongpaiboon
Approved by :
() Ponthippa Tameyakul
(✓) 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 & Equipment Calibration and Testing Services.

A 0046908



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-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.

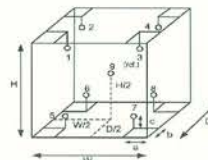
3. This certification is traceable to the International System of Unit.

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



Probe Installation Details :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :

D = 0.40 m
W = 0.56 m
H = 0.48 m
Capacity = 0.11 m³

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

a 1132466



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1517
Page: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.381	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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL: 0-2717-3099-21 FAX: 0-2719-9484



Cert. No.: 22TM1492
Page: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UM 400
Serial No. : b495.0899
ID No. : RYG_EN0006
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand
Location : Oven Room
Received Order : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Precha Hishib
Approved by :
() Ponthippa Tameyakul
(✓) 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 & Equipment Calibration and Testing Services.

A 0046905



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

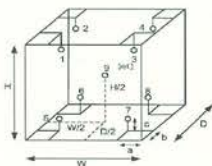
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
Capacity = 0.053 m ³	

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

a 1132473



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

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

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one 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 1132472

RYG_EN0061



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TEL. 0-2713-3000-27 FAX. 0-2719-0494



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)
816/10 Moo 5, T. Maenam Khu,
A. Piuakdaeng,
Rayong 21140, Thailand

Location : Wet Chemistry Lab

Received Order : 20 October 2022

Calibration Date : 20 October 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by :
Approved Signatory

() Pornhippa Tameyakul
() Malee Butkruea
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95 %

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A 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

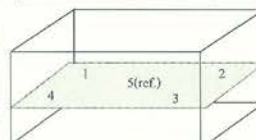
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Certificate of Calibration

Equipment: Block Digestion Unit Certificate No.: C29230010
 Model: KT-20s Issued Date: 18 March 2023
 Serial No. (or ID.): 5720210009/5770200073 Job No.: KSPR2304362
 Manufacturer: Gerhardt Page: 1 of 4
 Condition: In Condition Digestion Block: 20 holes.

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

Environment Condition: Temperature: 25 °C ± 0.5 °C
 Humidity: 65 %RH ± 3.7 %RH
 Voltage: 231 VAC ± 3.1 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. Nakin Ruenros
 Calibration Date: 15 March 2023

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.: TC22/0080

REVIEW BY:
 APPROVED BY:
 NEXT CAL. DATE: 15/03/24

(Mr. Nakin Ruenros)
 Person in charge

(Mr. Udon Srichana)
 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 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. 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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CAL-FM-C29-07: 20 Jul 2022



Equipment: Water Bath
 Condition As-Received: Used Item
 Reference: 2210-03760C-4
 Result of Calibration: (") Without Adjustment
 Function of UUC*: Temperature Source

Cert. No.: 22TM1491
 Page: 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
85.0	0.12	0.081	0.18	2

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

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

Stability: One-half of the greatest maximum difference of measured temperature at any one probe.

UUC*: Unit Under Calibration

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

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

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a 1132470



Certificate No.: C29230010

Page: 2 of 4

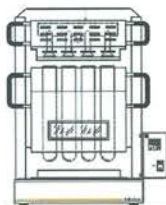
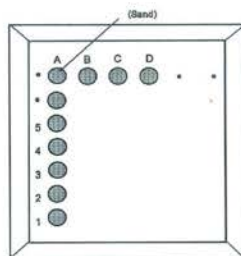


Fig. 1.: Front view



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.

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CAL-FM-C29-07: 20 Jul 2022



Certificate No.: C29230010

Page: 3 of 4

Calibration Results:
Before adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	380	380	380	375.1	-4.9	1.5
A2				374.3	-5.7	1.5
A3				374.6	-5.4	1.5
A4				376.3	-3.7	1.5
A5				373.2	-6.8	1.5
B1				374.4	-5.6	1.5
B2				374.3	-5.7	1.5
B3				374.6	-5.4	1.5
B4				375.2	-4.8	1.5
B5				375.1	-4.9	1.5
C1				373.5	-6.5	1.5
C2				372.8	-7.2	1.5
C3				372.1	-7.9	1.5
C4				372.2	-7.8	1.5
C5				374.5	-5.5	1.5
D1				374.7	-5.3	1.5
D2				375.3	-4.7	1.5
D3				375.5	-4.5	1.5
D4				375.8	-4.2	1.5
D5				375.1	-4.9	1.5

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CAL-FM-C29-07: 20 Jul 2022

Calibration Results: After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	380	380	380	379.0	-1.0	1.5
A2				378.7	-1.3	1.5
A3				379.4	-0.6	1.5
A4				379.2	-0.8	1.5
A5				379.2	-0.8	1.5
B1				379.8	-0.2	1.5
B2				379.2	-0.8	1.5
B3				379.5	-0.5	1.5
B4				378.9	-1.1	1.5
B5				379.1	-0.9	1.5
C1				379.1	-0.9	1.5
C2				377.7	-2.3	1.5
C3				378.4	-1.6	1.5
C4				378.2	-1.8	1.5
C5				378.0	-2.0	1.5
D1				379.5	-0.5	1.5
D2				378.7	-1.3	1.5
D3				379.7	-0.3	1.5
D4				379.5	-0.5	1.5
D5				379.4	-0.6	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2304382

ชนิดเครื่องมือ: Block Digestion Unit

รุ่น: KT-20s

หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
15 Mar 2023		15 Mar 2023		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
รายการตรวจสอบ				
General				
<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. การแสดงค่า 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. สภาพหน้าปัด	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>

ขอแนะนำ :

Mr. Nakin Ruenros
Service Engineer



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL: 0-2717-3000-21 FAX: 0-2719-9888



Cert.No.: 22CH1733
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 : 21 December 2022
Calibration Date : 22 December 2022
Reference : 2212-0602DSC-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)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :
Approved Signatory

(/) Malee Butkruea
() Saitthip Meangmai
() Warakorn Lemgagrakul

Issue Date : 26 December 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.



Cert.No.: 22CH1733
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	22I1308	27 Oct 2023

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
		pH	mV	mV	pH		
pH Meter	4.000	177.48	177.3	4.000	0.058	2.00	
S/N: B834291445	7.000	0.00	-0.1	7.000	0.058	2.00	
	10.000	-177.48	-177.5	10.000	0.058	2.00	



Cert.No.: 22CH1733
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 6.987 10.008	4.011 6.990 10.014	185.2 10.4 -166.5	0.0052 0.0068 0.0072	2.06 2.00 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	25.001	24.9	-0.101	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/49 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9181



Certificate of Calibration

Certificate No.: 22E4098
Page : 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No.: B834291445
ID No.: RYQ_EN0152

Condition As-Received: Used Item
Received Date: 21 December 2022
Calibration Date: 23 December 2022

Reference: Z212-060205G
Ambient Temperature: (23 \pm 2) °C
Relative Humidity: (50 \pm 10) %

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

610/10 Moo 5, T.Mae Nam Khu, A.Phuakdeeng,
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	6315011	22E1431	05 May 2023

2. This result of calibration was made on requested at the point specified by customer.
3. This 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: Wuthareeporn Wongchulkrane
Issue Date: 26 December 2022

Approved Signatory :
[] Phalinee Prabpaijal
[] Nuntawest Khamchai
[] Pornthippa Tameysakul

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Cert. No.: 22E4098
Page.: 2 of 2

Result of calibration :- (*) Without adjustment () After adjustment

Function: DC voltage measurement

Range: 2000

mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (\pm μ V)
-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	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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