

ภาคผนวก ค

ใบรับรองการสอบเทียบเครื่องมือ



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Stand	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Stand	-	-	-	-
Stack (CEMs)	Oxygen	Analyzer , System calibration, Stand	-	-	-	-
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS1093	6-Jul-24	6-Jan-25	6
Stack	Total Suspended Particulate	Probe	BKK_FS1113	3-Jun-24	3-Dec-24	6
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	30-Nov-23	30-Nov-24	12
Stack	Flow Rate	Console Control Unit	BKK_FS0496	4-Jun-24	4-Dec-24	6
Stack	Flow Rate	Pitot Tube	BKK_FS0541	5-Jul-24	5-Jan-25	6
Stack	Flow Rate	Flue gas Analyzer	BKK_FS1156	10-Jan-24	9-Jan-25	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0186	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0667	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0665	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0666	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0394	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0663	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0393	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0177	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0463	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0461	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0457	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0459	3-Jul-24	3-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0462	5-Jul-24	5-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0460	5-Jul-24	5-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0456	5-Jul-24	5-Jan-25	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0458	5-Jul-24	5-Jan-25	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0328	18-Aug-23	18-Feb-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0544	21-Jul-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0610	26-Jun-24	26-Dec-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0545	21-Jul-23	21-Jan-25	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS1338	9-Apr-24	8-Apr-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS1339	18-Mar-24	17-Mar-25	12
Noise	Noise Annoyance	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS1338	9-Apr-24	8-Apr-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS1339	18-Mar-24	17-Mar-25	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0630	22-Jan-24	21-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS1340	19-Mar-24	18-Mar-25	12
Noise	Leq 12 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 12 hrs	Sound Level Meter	RYG_FS0301	12-Jan-24	11-Jan-25	12
Noise	Leq 12 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 12 hrs	Sound Level Meter	RYG_FS0389	5-Jan-24	4-Jan-25	12
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Nitrate	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Phenol	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Temperature	pH meter	RYG_FS0595	1-Jul-24	1-Jul-25	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Water Lab	Benzene	Gas Chromatography (MSD)	BKK_EN0059	13-Dec-23	13-Jun-25	18



Lot No. 2480058-1

ANALYZER CALIBRATION DATA

Client : Map Ta Phut Olefins Co., Ltd. Location : ផ្ទះសំបែងស្រោច (H-100H) (Naphtha Cracking Heater Stack (H-100H))
Date : 15 Aug 24 Test Operator : Boonyarith I.
O₂ ANALYZER :
Model : TELEDYNE API T903 Serial No. : 81
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	8.02	8.00	8.01	0.04
Span Gas	16.02	16.03	16.02	0.04

NO_x ANALYZER :
Model : TELEDYNE API T200H Serial No. : 482
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	56.16	50.20	50.27	0.07
Span Gas	79.77	81.77	81.64	0.13

SO₂ ANALYZER :
Model : TELEDYNE API T100H Serial No. : 324
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	55.55	50.22	50.23	0.01
Span Gas	79.09	79.35	79.30	0.05

CO ANALYZER :
Model : TELEDYNE API T300M Serial No. : 377
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	54.22	54.15	54.11	0.07
Span Gas	79.90	79.58	79.50	0.02

Calibrated by

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO. F 06-062 REVISION NO. 3 ISSUE DATE 2011/23

ALS Laboratory Group



Lot No. 2480058-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Map Ta Phut Olefins Co., Ltd. Location : ផ្ទះសំបែងស្រោច (H-100H) (Naphtha Cracking Heater Stack (H-100H))
Date : 15 Aug 24 Test Operator : Boonyarith I.

O₂ ANALYZER :
Cylinder Conc. (%) : 16.02 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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	16.03	16.07	0.16	0.00	16.12	0.36	0.20	0.20

NO_x ANALYZER :
Cylinder Conc. (ppm) : 79.77 Span (ppm) : 100

	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	81.77	79.56	1.91	0.00	79.80	1.97	0.05	0.05

SO₂ ANALYZER :
Cylinder Conc. (ppm) : 79.09 Span (ppm) : 100

	SO 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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	79.35	79.22	0.13	0.00	79.25	0.09	0.04	0.04

CO ANALYZER :
Cylinder Conc. (ppm) : 79.90 Span (ppm) : 100

	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	79.58	79.51	0.03	0.00	79.55	0.07	0.04	0.04

Calibrated by

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO. F 06-063 REVISION NO. 3 ISSUE DATE 2011/23

ALS Laboratory Group



EMISSION TEST RESULT

Run # 1
Client : Map Ta Phut Olefins Co., Ltd. Location : ផ្ទះសំបែងស្រោច (H-100H) (Naphtha Cracking Heater Stack (H-100H))
Date : 15 Aug 24 Test Operator : Boonyarith I.
Start Time : 12:00 Finish Time : 12:20
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 324
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 482
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 377

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:00	5.87	7.83	33.17	0.46	0.37	
12:01	5.72	7.77	33.20	0.45	0.34	
12:02	5.19	7.73	33.27	0.43	0.34	
12:03	5.71	7.62	33.34	0.42	0.38	
12:04	5.84	7.78	33.40	0.41	0.39	
12:05	6.05	7.58	33.31	0.47	0.47	
12:06	6.06	7.51	33.17	0.47	0.43	
12:07	5.82	7.47	33.12	0.47	0.48	
12:08	5.48	7.41	33.17	0.46	0.40	
12:09	5.65	7.35	33.13	0.47	0.45	
12:10	5.67	7.41	33.08	0.50	0.47	
12:11	5.80	7.33	33.07	0.49	0.45	
12:12	6.05	7.29	32.94	0.47	0.41	
12:13	6.07	7.22	32.80	0.46	0.43	
12:14	5.85	7.21	32.78	0.45	0.41	
12:15	5.73	7.19	32.21	0.43	0.38	
12:16	5.73	7.13	33.31	0.42	0.39	
12:17	5.76	7.13	33.27	0.41	0.43	
12:18	5.77	7.10	33.13	0.43	0.35	
12:19	5.91	7.07	33.01	0.39	0.31	
12:20	6.05	7.08	32.78	0.38	0.40	
Average	5.84	7.38	33.14	0.44	0.40	

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO. F 06-116 REVISION NO. 3 ISSUE DATE 2011/23

ALS Laboratory Group



EMISSION TEST RESULT

Run # 2
Client : Map Ta Phut Olefins Co., Ltd. Location : ផ្ទះសំបែងស្រោច (H-100H) (Naphtha Cracking Heater Stack (H-100H))
Date : 15 Aug 24 Test Operator : Boonyarith I.
Start Time : 12:21 Finish Time : 12:41
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 324
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 482
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 377

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:21	6.09	7.11	32.76	0.38	0.37	
12:22	5.92	7.07	32.94	0.35	0.38	
12:23	5.81	7.07	33.18	0.35	0.38	
12:24	5.85	7.05	33.26	0.35	0.40	
12:25	5.84	7.04	33.26	0.33	0.38	
12:26	5.74	7.02	33.19	0.32	0.42	
12:27	5.71	7.01	33.01	0.33	0.45	
12:28	6.00	6.98	32.81	0.30	0.49	
12:29	6.32	6.97	32.83	0.29	0.54	
12:30	5.83	6.95	32.93	0.27	0.45	
12:31	5.77	6.95	33.00	0.28	0.48	
12:32	5.80	6.97	32.95	0.27	0.48	
12:33	5.72	6.97	32.98	0.25	0.52	
12:34	5.93	6.95	33.01	0.25	0.42	
12:35	6.10	6.94	33.12	0.28	0.49	
12:36	6.15	6.92	33.15	0.50	0.45	
12:37	5.78	6.92	33.07	0.51	0.38	
12:38	5.62	6.93	33.07	0.53	0.40	
12:39	5.72	6.93	33.11	0.50	0.35	
12:40	5.84	6.92	33.22	0.47	0.34	
12:41	6.09	6.91	33.27	0.47	0.29	
Average	5.87	6.98	33.05	0.36	0.42	

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO. F 06-116 REVISION NO. 3 ISSUE DATE 2011/23

ALS Laboratory Group



EMISSION TEST RESULT

Client	Map Ta Phut Olefins Co., Ltd.	Run #	3
Date	15 Aug 24	Location	ปิโตรเลียมท่าพิบูลย์ (H-100H) (Naphtha Cracking Heater Stack (H-100H))
Start Time	12:42	Test Operator	Boonyarith I.
SO ₂ Analyzer Model	TELEDYNE API T100H	Finish Time	13:02
NO _x /O ₂ Analyzer Model	TELEDYNE API T200H	Serial No.	324
CO/CO ₂ Analyzer Model	TELEDYNE API T300M	Serial No.	482
		Serial No.	377

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:42	6.15	6.95	33.22	0.47	0.33	
12:43	5.98	6.95	33.17	0.46	0.37	
12:44	5.71	6.93	33.12	0.47	0.42	
12:45	5.64	6.94	33.19	0.44	0.39	
12:46	5.70	6.93	33.24	0.44	0.34	
12:47	5.89	6.90	33.32	0.42	0.38	
12:48	6.10	6.93	33.36	0.41	0.32	
12:49	6.13	6.94	33.27	0.41	0.37	
12:50	5.89	6.94	33.18	0.42	0.29	
12:51	5.76	6.13	33.09	0.40	0.35	
12:52	5.78	6.94	33.01	0.40	0.35	
12:53	5.72	6.93	33.05	0.38	0.37	
12:54	5.91	6.99	33.08	0.37	0.37	
12:55	6.08	6.94	33.01	0.36	0.40	
12:56	5.89	6.90	32.89	0.38	0.36	
12:57	5.78	6.91	32.90	0.36	0.32	
12:58	5.89	6.94	33.04	0.36	0.31	
12:59	5.94	6.94	33.14	0.36	0.31	
13:00	5.95	6.97	33.14	0.35	0.31	
13:01	5.95	6.97	33.05	0.34	0.31	
13:02	5.93	7.86	33.08	0.32	0.36	
Average	5.89	6.98	33.12	0.40	0.35	

Boonyarith I.

(Mr.Boonyarith Iamted)

Environmental Field Scientist (2)

FORM NO. F-06-116 REVISION NO. 3 ISSUE DATE 2011/03
ALS Laboratory Group



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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE
(THAILAND) LTD
Part Number: E04N189E3HA0002
Cylinder Number: GN0027212
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: 650
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 800P-120331, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NOX	80.00 PPM	79.77 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	80.00 PPM	79.90 PPM	G1	+/- 0.6% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	79.77 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	79.09 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022, 02/11/2022
NITROGEN	Balance				

CALIBRATION STANDARDS					Expiration Date
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	09210212	KAL024777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200510-15	CC733105	98.81 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200810-04	CC705044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206899139	CC323707	4.087 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL024813	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

ANALYTICAL EQUIPMENT			Last Multipoint Calibration
Instrument/Make/Model	Analytical Principle		
Nicolet iS50 FTIR AUP2010245 CO	FTIR		Feb 03, 2022
Nicolet iS50 FTIR AUP2010245 NO	FTIR		Feb 10, 2022
Nicolet iS50 FTIR AUP2010245 NO2	FTIR		Jan 27, 2022
Nicolet iS50 FTIR AUP2010245 SO2	FTIR		Jan 20, 2022

Triad Data Available Upon Request

NOTES: Gross Weight: 48.5 Kg

Net Weight: 8.1 Kg



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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N189E3HA0066
Cylinder Number: ND11215
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12021
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402138464-1
Cylinder Volume: 247.2 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Jul 15, 2029

Expiration Date: Jul 15, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800P-120331, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NOX	55.00 PPM	56.15 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	55.00 PPM	54.22 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	55.00 PPM	56.16 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.1% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					Expiration Date
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	11010130	KAL024535	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12398	D85025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 06, 2026
NTRM	200610-50	CC733426	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003835	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

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

Triad Data Available Upon Request

NOTES:

Gross Weight: 47.9 Kg

Net Weight: 7.8 Kg



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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE
(THAILAND) LTD
Part Number: E02N184E3HA0001
Cylinder Number: GN0027207
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12022
Gas Code: O2,BALN

Reference Number: 160-402340010-1
Cylinder Volume: 249.8 CF
Cylinder Pressure: 2214 PSIG
Valve Outlet: 580
Certification Date: Feb 02, 2022

Expiration Date: Feb 02, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800P-120331, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
OXYGEN	16.00 %	16.02 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				

CALIBRATION STANDARDS					Expiration Date
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	08010230	K005228	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2022

ANALYTICAL EQUIPMENT			Last Multipoint Calibration
Instrument/Make/Model	Analytical Principle		
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Jan 27, 2022

Triad Data Available Upon Request

NOTES: Gross Weight: 46.8 Kg

Net Weight: 8.2 Kg



Approved for Release

Page 1 of 160-402340010-1

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E02N192E3HA0000 Reference Number: 160-01948144-1
Cylinder Number: GN0025083 Cylinder Volume: 248.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PCVP Number: A12020 Valve Outlet: 590
Gas Code: OZ,BALN Certification Date: Nov 11, 2020

Expiration Date: Nov 11, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 8200-B-13-031, using the assay process as 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 in mole/mole basis unless otherwise noted.

Do Not Use This Cylinder before 102 days, i.e. 9.7 megapascals

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
OXYGEN	8.000 %	8.019 %	G1	+/- 0.3% NIST Traceable
NITROGEN	Balance			
Assay Date: 11/11/20				
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	10210502	1038055	9.957 % OXYGEN/NITROGEN	+/- 0.3%
Expiration Date: Apr 19, 2022				
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration	
SIEMENS OXYMAT 6 - N1-WS-551 - O2	PARAMAGNETIC		Oct 26, 2020	

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.1 Kg
Net Weight: 8.2 Kg



Approved for Release

Page 1 of 160-401948

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 6 Jul 24
Next Cal Date : 6 Jan 25

Barometric Pressure (mmHg) : 760
Relative Humidity (%) : 64.0
Temperature (°C) : 33.0

Console Control Meter Data

Calibration No : C-060724-BKK_FS1093
Dry Gas Meter ID : BKK_FS1093
Serial No. : 1706090
Model No. : XC-572-V
Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A2003240
Correction Factor (Y) : 0.9824
Next Calibration Date : 7 Nov 24

AH	Θ	Reference Dry Gas Meter Calibration					Console Control Dry Gas Meter					Dry Gas Meter	
		Flow	Temp	Pressure	Flow	Temp	Flow	Temp	Pressure	Flow	Temp	Correction Factor	Offset
15	12.40	150.00	0.00	150.00	20.00	63.67/0.4	150.40	20.00	28.00	0.9751	47.0353	47.0353	
25	9.02	150.00	0.00	150.00	30.00	63.69/0.2	150.20	20.00	28.00	0.9755	47.2421	47.2421	
50	6.90	150.00	0.00	150.00	31.00	63.68/0.2	150.20	31.00	31.00	0.9764	47.3887	47.3887	
100	4.81	150.00	0.00	150.00	31.00	63.66/0.2	150.20	31.00	31.00	0.9777	47.3416	47.3416	
150	3.95	150.00	0.00	150.00	31.00	63.65/0.0	150.00	31.00	31.00	0.9683	47.4903	47.4903	
Avg												0.9734	47.2842

Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average
Avg : Office pressure differential : tolerance for individual values ± 21.24 in. of air @ 25°C and 760 mm of mercury, mmH₂O : tolerance for individual values ± 5.68 from average

Procedure: 40 CFR 60.409 A.M.E.T.H. SEC 5.3.1.7
Calibrated by: Boonyanth I.
(Mr. Boonyanth Iamied)
Field Scientist (2)

Approved by:

(Mr. Samart Roo-ngan)

Field Specialist (1)

Revision: 1706090 Revision No. 2 Field Date: 30 Jun 22



Stopwatch Calibration Test Report

Calibration Date : 6 Jul 24 Next Cal. Date : 6 Jan 25
Barometric Pressure (mmHg) : 760 Temperature (°C) : 33.0
Relative Humidity (%) : 64.0

Reference Stopwatch Data Console Control Meter Data
Stopwatch ID No. : RVG_FS0540 Dry Gas Meter No : BKK_FS1093
Model : F808 Model : XC-572-V
Serial No. : E18061 Serial No. : 1706090
Calibration Date : 4 Jul 24
Certificate No. : E-2407022

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00.11	5:00	11	0.00018
2	5:00.10	5:00	10	0.00017
3	5:00.11	5:00	11	0.00018
4	5:00.10	5:00	10	0.00017
5	5:00.12	5:00	12	0.00020
6	5:00.12	5:00	12	0.00020
7	5:00.10	5:00	10	0.00017
8	5:00.10	5:00	10	0.00017
9	5:00.08	5:00	8	0.00013
10	5:00.09	5:00	9	0.00015
Average			0.00017	
SD			0.00002	

Calibrate by: Boonyanth I.
Mr. Boonyanth Iamied
Field Scientist (2)

Approved by: S. P.
Mr. Samart Roo-ngan
Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :		6 Jul 24	Ambient Temperature (°C) :		33
Calibration sheet No. : C-060724-BKK_FS1093			Relative Humidity (%) :		64
Digital Temperature ID BKK_FS1093			Reference Temperature ID		BKK_FS1144
Serial No. : 1706090			Serial No. :		201090006013
Model : XC-572-V			Model :		Digicon-CC-VT-MS
Next Calibrate :					16 Jan 25
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	249	-1	±3	Pass
	300	299	-1	±3	Pass
	500	498	-2	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
Oven	100	100	0	±3	Pass
	120	120	0	±3	Pass
Filter	140	141	1	±3	Pass
	100	100	0	±3	Pass
Exit	120	120	0	±3	Pass
	140	141	1	±3	Pass
Meter	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) มาตรฐานการวัดอุณหภูมิ

Calibrated by: Boonyanth I.
(Mr. Boonyanth Iamied)
Field Scientist (2)

Approved by: S. P.
(Mr. Samart Roo-ngan)
Spec. al. (1)



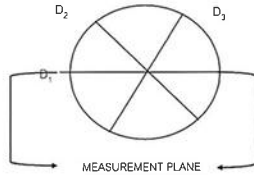
PROBE NOZZLE DIAMETER
CALIBRATION DATA SHEET

Calibration Date	6 Jul 24	Nozzle Set ID :	BKK_FS1093
Calibration Sheet No. :	C-060724-BKK_FS1106	Vernier Caliper ID :	RYG_FS0539

Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.300	0.300	0.300	0.000	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.600	0.600	0.600	0.000	0.600
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.090	1.090	1.090	0.000	1.090
7	1.250	1.250	1.250	0.000	1.250
8	1.600	1.600	1.600	0.000	1.600

Where :

- D_1, D_2, D_3 : There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
- ΔD : Maximum distance between any two diameters, must be ≤ 0.100 mm.
- D_{avg} : $(D_1 + D_2 + D_3) / 3$



Calibrated by : Boonyanth I.
(Mr. Boonyanth Iamrit)
Field Scientist (2)

Approved by : [Signature]
(Mr. Samart Roon-ghan)
Field Specialist (1)

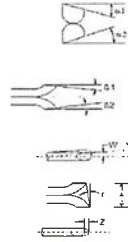
FORM NO. : F-05-124 REVISION NO. : 0 ISSUE DATE : 25/12/23



Type S Pitot Tube Calibration

Date Calibration : 3-Jun-24
Pitot ID : BKK_FS1113
Pitot SN : -

Due Date : 3-Dec-24
Inclinometer ID : BKK_FS1131
Vernier ID : SGK_FS0113



Parameter	Value	Allowable Range	Check
$\alpha 1$	2.2	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	-2.4	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-1.7	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	-0.1	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	1.6	-	-
θ	-0.4	-	-
$Z = A \tan \gamma$	0.026	$Z \leq 0.125"$	OK
$W = A \tan \theta$	-0.006	$W \leq 0.031"$	OK
Dt	0.310	$0.188" \text{ to } 0.375"$	OK
$A/2Dt$	1.484	$1.05 \leq A/Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84 . See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Prasert S.
(Mr. Prasert Surakhan)
Enviro Field Services Scientist (3)

Approved by : [Signature]
(Mr. Samart Roon-ghan)
Enviro Field Services Specialist (1)

FORM NO. : F-05-124 REVISION NO. : 0 ISSUE DATE : 25/12/23

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

Model Number : SECURA224-1S
Description : Analytical Balance
Serial Number : 0038304165
ID No. : BKK_EN0309
Manufacturer : Sartorius

Certificate No. : 23BCI0468
Issued Date : Friday, December 01, 2023
Reference No. : 223958
Page No. : 1 of 2

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

Calibrated Place : Lab Room

Calibrated By : Mr. Chonchal Inthana
Calibration Date : Thursday, November 30, 2023

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

Metrological data :
Capacity : 220 g Readability : 0.0001 g

Ambients Conditions :
Temperature : 21.1 °C \pm 5.0 °C
Humidity : 58.0 % RH \pm 10.0 % RH
Pressure : \pm
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 form 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	TCS	M23081975	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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

Mr. Chonchal Inthana (Technical Manager)



Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6 Fax: +66 2643-8387, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : SECURA224-1S
Description : Analytical Balance
Serial Number : 0038304165
ID No. : BKK_EN0309
Manufacturer : Sartorius

Certificate No. : 23BCI0468
Issued Date : Friday, December 01, 2023
Reference No. : 223958
Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.	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 R119).
Nominal Value : (Low Load) 20 g Tolerance 0.0001 g	Nominal value : 100 g Tolerance 0.0004 g
Nominal Value : (High Load) 200 g Tolerance 0.0001 g	
Standard Deviation 0.00005 0.00005	Difference 1 2 3 4 5 6

Linearity

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

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
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
200	200.0000	200.0000	0.0000	0.00029

End of Report



Stopwatch Calibration Test Report

Calibration Date : 4 Jun 24
Barometric Pressure (mmHg) : 760
Relative Humidity (%) : 67.0
Next Cal. Date : 4 Dec 24
Temperature (°C) : 31.0

Reference Stopwatch Data

Stopwatch ID No. : RYG_FS0540
Model : F806
Serial No. : E18061
Calibration Date : 9 Dec 22
Certificate No. : E-2212032-1/S1

Console Control Meter Data

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

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00.09	5:00	9	0.00015
2	5:00.10	5:00	10	0.00017
3	5:00.11	5:00	11	0.00018
4	5:00.10	5:00	10	0.00017
5	5:00.09	5:00	9	0.00015
6	5:00.09	5:00	9	0.00015
7	5:00.08	5:00	8	0.00013
8	5:00.10	5:00	10	0.00017
9	5:00.09	5:00	9	0.00015
10	5:00.10	5:00	10	0.00017
			Average	0.00016
			SD	0.00001

Calibrate by :

S.Thong-on

(Mr Suwicha Thong-On)

Field Scientist (2)

Approved by :

S.P.

Mr. Samart Roo-ngan

Specialist (1)

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration to Date : 4 Jun 24
Next Cal. Date : 4 Dec 24

Console Control Meter Data

Calibration No. : C-040624-BKK_FS0496
Dry Gas Meter ID : BKK_FS0496
Serial No. : 1412087
Model No. : XC-572-V

Barometric Pressure (mmHg) : 759
Relative Humidity (%) : 67.0
Temperature (°C) : 33.0

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK_FS0629
Serial No. : 1607009
Correction Factor (%) : 1.0004
Next Calibration Date : 9 Jun 24

ΔH (mm H ₂ O)	Θ	Reference Dry Gas Meter Calibration						Console Control : Drygas Meter						Dry Gas Meter		Oiler's Calibration Factor ΔH ₀
		V ₁ (liters)			T ₁ (°C)	V ₂ (liters)			T ₂ (°C)	To (°C)	Avg Im (°C)	Correction Factor (%)				
		Final	Initial	Total		Final	Initial	Total								
15	11.48	150.00	0.00	150.00	35.0	107.393.0	107.392.0	1.4700	35.0	35.0	1.0109	44.0260				
25	9.16	150.00	0.00	150.00	35.0	107.409.0	107.394.0	1.4800	35.0	35.0	1.0111	43.5967				
50	6.42	150.00	0.00	150.00	35.0	107.424.0	107.409.0	1.4700	35.0	35.0	1.0105	42.7065				
100	4.50	150.00	0.00	150.00	35.0	107.413.0	107.425.0	1.4600	35.0	35.0	1.0105	42.0020				
150	3.67	150.00	0.00	150.00	35.0	107.457.0	107.413.0	1.4600	35.0	35.0	1.0160	41.8911				
											Avg	1.0159	42.8662			

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.021 from average
ΔH₂ : Critical pressure differential that equates to 21.24 in. of air at 25 °C and 760 mm of mercury, mmH₂O : tolerance for individual values ± 5.08 from average

Procedure: 40 CFR 60.404 APP A METH- SEC 5.3.8.7
Calibrated by : S.Thong-on
(Mr Suwicha Thong-On)
Field Scientist (2)

Approved by : S.P.
(Mr Samart Roo-ngan)
Field Specialist (1)

FORM NO. 1-06-027 REVISION NO. 2 ISSUE DATE: 10-24-97



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :		4 Jun 24	Ambient Temperature (°C)		31
Calibration sheet No. : C-040624-BKK_FS0497			Relative Humidity (%) :		67
Digital Temperature ID BKK_FS0497			Reference Temperature ID BKK_FS1144		
Serial No. : 1412087			Serial No. : 201080006013		
Model : XC-572-V			Model : Digicon-CC-VT-MS		
Next Calibrate :				14 Aug 24	
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	1	1	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	151	1	±3	Pass
	200	199	-1	±3	Pass
Probe	250	249	-1	±3	Pass
	300	300	0	±3	Pass
	500	499	-1	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	1	1	±3	Pass
	25	26	1	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนของค่าที่วัดได้

Calibrated by : S.Thong-on
(Mr Suwicha Thong-On)
Field Scientist (2)
Approved by : S.P.
(Mr Samart Roo-ngan)
Specialist (1)

FORM NO. : F-06-027 REVISION NO. : 2 ISSUE DATE: 9 Feb 23



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	4 Jun 24	Nozzle Set ID :	BKK_FS0502
Calibration Sheet No. :	C-040624-BKK_FS0502	Vernier Caliper ID :	RYG_FS0539

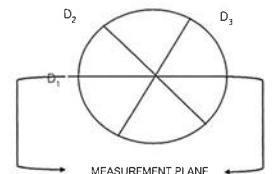
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D ₁	D ₂	D ₃		
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.530	0.530	0.530	0.000	0.530
4	0.635	0.635	0.635	0.000	0.635
5	0.790	0.790	0.790	0.000	0.790
6	0.950	0.950	0.950	0.000	0.950
7	1.110	1.110	1.110	0.000	1.110
8	1.270	1.270	1.270	0.000	1.270
9	1.600	1.600	1.600	0.000	1.600

Where :

D₁, D₂, D₃ = The 3 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 : S.Thong-on
(Mr Suwicha Thong-On)
Field Scientist (2)
Approved by : S.P.
(Mr Samart Roo-ngan)
Field Specialist (1)

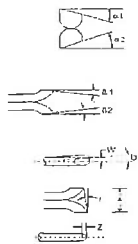
FORM NO. : F-06-027 REVISION NO. : 2 ISSUE DATE: 10-24-97



Type S Pitot Tube Calibration

Date Calibration: 5-Jul-24
 Pitot ID: BKK_FS0541
 Pitot SN: -

Due Date: 5-Jan-25
 Inclinator ID: BKK_FS1131
 Vernier ID: BKK_FS1405



Parameter	Value	Allowable Range	Check
$\alpha 1$	3.7	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	2.3	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-0.7	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	5.3	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	4.6	-	-
θ	1.2	-	-
$Z = A \tan \gamma$	0.085	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.022	$W \leq 0.031"$	OK
Dt	0.375	$0.188" \text{ to } 0.375"$	OK
A/2Dt	1.413	$1.05 \leq A/2Dt \leq 1.5$	OK
A	1.06	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/probe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification factor of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by: Prasert S.
 (Mr. Prasert Surakhan)
 Enviro Field Services Scientist (3)

Approved By: S. P.
 (Mr. Samart Roo-ngan)
 Enviro Field Services Specialist (1)

FORM NO: F 06-124 REVISION NO: 0 ISSUE DATE: 25/12/23



Calibration Certificate



Certificate No: G 670023
 Date of issue: 10-Jan-24

Instrument description: Flue Gas Analyzer
 Instrument model: Testo 350 New
 Control unit serial no.: 0359090/1121
 Instrument serial no.: 62985022/1121
 ID no. or control no.: BKK_FS1156
 Manufacturer: Testo SE & Co. KGAA
 Probe description: -
 Probe model: -
 Probe serial no.: -
 Customer name: ALS LABORATORY GROUP (THAILAND) CO., LTD.
 Customer address: 1M Phatthanan Road, Phatthanan Road, Kiatwong Phatthanan, Khet Suan Luang, Bangkok, 10250 Thailand

Total pages of certificate: 2 Pages
 Receiving no.: L-240106
 Receiving date: 08-Jan-24
 Parameter of calibration: Gas Calibration (Oxygen 2.50, 10.04, 21.02 %Vol, Carbon Monoxide 80.14, 302, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)

Condition of UUC: Used
 Ambient condition: All of the Measurement were carried out the stabilized laboratory
 Temperature: 23 \pm 5 $^\circ$ C
 Humidity: 55 \pm 15 %RH
 Calibration place: 17/121 Soi Ngamwongwan 47 Yack 4B, Toongsonghong, Lakki, Bangkok 10210

Calibration procedure no.: This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction 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 items under test Environmental condition.
 This Calibration Certificate may not be repurchased other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid and the results relate only to the items tested/calibrated.
 This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration: 10-Jan-24

Kwanchoi P.
 Mr. Kwanchoi Khamdoun
 Calibration Technician

O. Wuttar
 Mrs. Nongluck Wongsetten
 Technical Manager

FM-CL-09-C Rev.8

Page 1 of 2

Issued Date 25/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Ngamwongwan 47 Yack 4B, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
 Tax ID: 0105536035931 www.entech.co.th



Calibration Certificate



Certificate No.: G 670023

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 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) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature: 23.3 $^\circ$ C Humidity: 59.1 %RH Pressure: 1012.4 mbar

Calibration conditions

Gas Temperature: 23 $^\circ$ C Flow rate: 1,200 ml/min Gas pressure: 1018.5 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (\pm)
O ₂ (%Vol)	2.50	2.44	-0.06	0.15
O ₂ (%Vol)	10.04	9.93	-0.11	0.20
O ₂ (%Vol)	21.02	21.11	0.09	0.30
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	302	305	3	6.0
CO (ppm)	1003	1008	5	12
NO ₂ (ppm)	30.34	28.6	-1.74	6.0
NO ₂ (ppm)	80.96	81.2	0.24	8.0
NO ₂ (ppm)	201.9	202.7	0.8	12
NO (ppm)	30.01	30	0.01	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO ₂ (ppm)	50.36	51	0.64	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	600.8	599	-1.8	12

Remark: 1 cm³/mol = 1 %Vol, 1 μ mol/mol = 1 ppm.

End of Report

Calibrated by: Panuwat W.
 (Mr. Panuwat Wanghong)
 Field Scientist (1)

Approved by: N. Pong
 (Mr. Nongpong Jantarapan)
 Enviro Field Coordinator Scientist (3)

FM-CL-09-C Rev.8

Page 2 of 2

Issued Date 25/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Ngamwongwan 47 Yack 4B, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
 Tax ID: 0105536035931 www.entech.co.th

High Volume Air Sampler Calibration Worksheet

Project Site: Map T Phut Oldies Co., Ltd. Barometric Pressure (mm Hg): 756.7

Calibrate Location: วัดบ้านหมาก (บ้านหมาก) Temperature ($^\circ$ C): 32.8

Calibrate Date: 14-Aug-24 High Volume ID: RYG FS0186

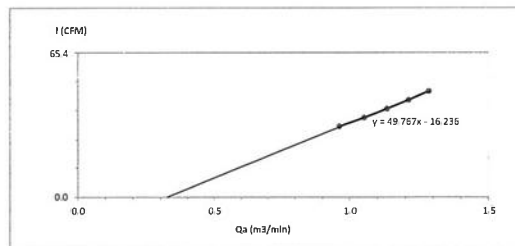
Calibration Sheet No.: C-140824-RYG FS0186 High Volume Model: TE-S009X

Calibrator ID: RYG FS0205 High Volume S/N: 4794

Calibrator Model: TE-S028A Calibrator Slope: 0.95561

Calibrator S/N: 1166 Calibrator Intercept: -0.02266

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.963	32	Slope: 49.7665
2	2.4	1.053	36	Intercept: -16.2365
3	2.8	1.136	40	Correlation Coefficient: 0.9991
4	3.2	1.213	44	
5	3.6	1.285	48	



Calibrated by: Panuwat W.
 (Mr. Panuwat Wanghong)
 Field Scientist (1)

Approved by: N. Pong
 (Mr. Nongpong Jantarapan)
 Enviro Field Coordinator Scientist (3)

FORM NO: F 06-074 REVISION NO: 2 ISSUE DATE: 10/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Map T Phat Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7

Calibrate Location : บ้านนาบอน Temperature (°C) : 32.8

Calibrate Date : 14-Aug-24 High Volume ID : RYG-FS0667

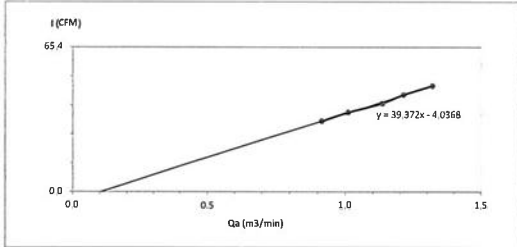
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Calibrator ID : RYG-FS0205 High Volume S/N : 6266

Calibrator Model : TE-5028A Calibrator Slope : 0.95561

Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.915	32	Slope : 39.3716 Intercept : -4.0368 Correlation Coefficient : 0.9980
2	2.2	1.009	36	
3	2.8	1.136	40	
4	3.2	1.213	44	
5	3.8	1.319	48	



Calibrated by : Panuwat W.
(Mr. Panuwat Wanghong)
Field Scientist(1)

Approved by : [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

FORM NO : F 06-074 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Map T Phat Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7

Calibrate Location : บ้านนาบอน Temperature (°C) : 32.8

Calibrate Date : 14-Aug-24 High Volume ID : RYG-FS0665

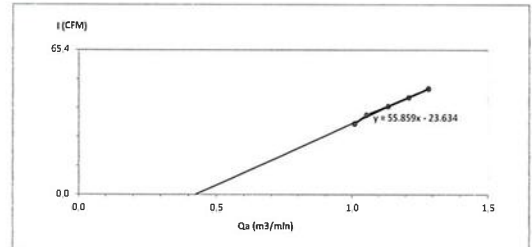
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Calibrator ID : RYG-FS0205 High Volume S/N : 6264

Calibrator Model : TE-5028A Calibrator Slope : 0.95561

Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	1.009	32	Slope : 55.9593 Intercept : -23.6343 Correlation Coefficient : 0.9960
2	2.4	1.053	36	
3	2.8	1.136	40	
4	3.2	1.213	44	
5	3.6	1.265	48	



Calibrated by : Panuwat W.
(Mr. Panuwat Wanghong)
Field Scientist(1)

Approved by : [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

FORM NO : F 06-074 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Map T Phat Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7

Calibrate Location : บ้านนาบอน Temperature (°C) : 32.8

Calibrate Date : 14-Aug-24 High Volume ID : RYG-FS0666

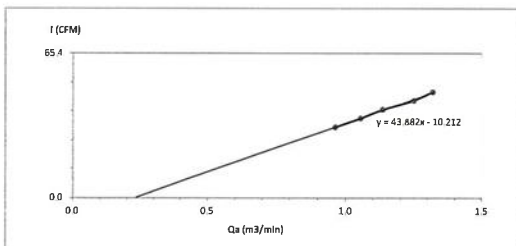
CalibrationSheet No : C-140824-RYG-FS0666 High Volume Model : TE-5009X

Calibrator ID : RYG-FS0205 High Volume S/N : 6265

Calibrator Model : TE-5028A Calibrator Slope : 0.95561

Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.963	32	Slope : 43.0623 Intercept : -10.2122 Correlation Coefficient : 0.9981
2	2.4	1.053	36	
3	2.8	1.136	40	
4	3.4	1.249	44	
5	3.8	1.319	48	



Calibrated by : Panuwat W.
(Mr. Panuwat Wanghong)
Field Scientist(1)

Approved by : [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

FORM NO : F 06-074 REVISION NO:2 ISSUE DATE: 20/11/23

Sartorius (Thailand) Co., Ltd.
128 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8391-8, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BC10068

Description : Analytical Balance Issued Date : Friday, February 23, 2024

Serial Number : 25409864 Reference No. : 229196

ID No. : RYG-EN0001

Manufacturer : Sartorius Page No. : 1 of 1

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)

618/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)

618/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchal Inthana

Calibration Date : Thursday, February 22, 2024

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

Metrological data : Capacity : 150 g Readability : 0.0001 g

Ambients Conditions: Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure : ±

Reasons for calibration

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the 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 form 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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.

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

SOP FM 33 03 February 2022

Mr.Chonchal Inthana(Technical Manager)

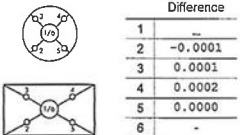




Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BCI0068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409654 Reference No. : 229196
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			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 R110).		
Nominal Value : (Low Load)	10.0000	99.9999	Nominal value :	50	g
10 g	10.0000	100.0000	Tolerance	0.0004	g
Tolerance	10.0000	100.0001			
0.0001 g	10.0000	100.0001			
	9.9999	100.0000			
Nominal Value : (High Load)	10.0000	100.0001			
100 g	10.0000	100.0000			
Tolerance	10.0000	100.0001			
0.0001 g	9.9999	100.0002			
	9.9999	100.0001			
Standard Deviation	0.00005	0.00008			

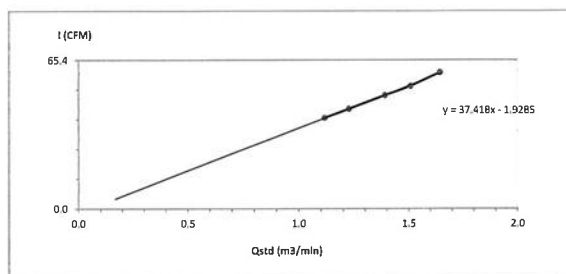
Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance 0.0002 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00020
0.05	0.0500	0.0500	0.0000	0.00021
0.1	0.1000	0.1000	0.0000	0.00021
0.5	0.5000	0.5000	0.0000	0.00021
1	1.0000	1.0000	0.0000	0.00021
2	2.0000	2.0000	0.0000	0.00021
5	5.0000	5.0000	0.0000	0.00021
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00021
100	100.0000	99.9999	-0.0001	0.00024
End of Report.				

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site : Map Ta Phu Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7
Calibrate Location : อนุบาลนครราชสีมา (อนุบาลนครราชสีมา) Temperature (°C) : 32.8
Calibrate Date : 14-Aug-24 High Volume ID : RYG_FS0394
CalibrationSheet No. : C-140824-RYG_FS0394 High Volume Model : TE-5170D
Calibrator ID : RYG_FS0205 High Volume S/N : 5690
Calibrator Model : TE-5028A Callibrator Slope : 1.52567
Calibrator S/N : 1166 Callibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1165	40	Slope : 37.4176
2	3.4	1.2266	44	Intercept : -1.9285
3	4.4	1.3904	50	Correlation Coefficient : 0.9991
4	5.2	1.5084	54	
5	6.2	1.6437	60	



Calibrated by : 
(Mr. Panuwat Wanghong)
Field Scientist(1)
Approved by : 
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

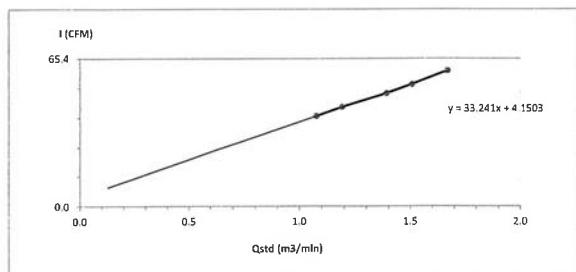
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Map Ta Phu Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7
Calibrate Location : อนุบาลนครราชสีมา Temperature (°C) : 32.8
Calibrate Date : 14-Aug-24 High Volume ID : RYG_FS0663
CalibrationSheet No. : C-140824-RYG_FS0663 High Volume Model : TE-5009X
Calibrator ID : RYG_FS0205 High Volume S/N : 6260
Calibrator Model : TE-5028A Callibrator Slope : 1.52567
Calibrator S/N : 1166 Callibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0772	40	Slope : 33.2406
2	3.2	1.1911	44	Intercept : 4.1503
3	4.4	1.3904	50	Correlation Coefficient : 0.9992
4	5.2	1.5084	54	
5	6.4	1.6694	60	



Calibrated by : 
(Mr. Panuwat Wanghong)
Field Scientist(1)
Approved by : 
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

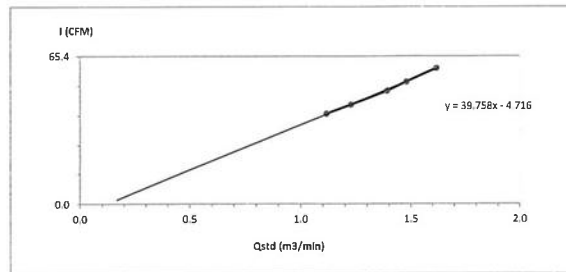
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Map Ta Phu Olefins Co., Ltd. Barometric Pressure (mm Hg) : 756.7
Calibrate Location : อนุบาลนครราชสีมา Temperature (°C) : 32.8
Calibrate Date : 14-Aug-24 High Volume ID : RYG_FS0393
CalibrationSheet No. : C-140824-RYG_FS0393 High Volume Model : TE-5170D
Calibrator ID : RYG_FS0205 High Volume S/N : 5682
Calibrator Model : TE-5028A Callibrator Slope : 1.52567
Calibrator S/N : 1166 Callibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1165	40	Slope : 39.7578
2	3.4	1.2266	44	Intercept : -4.7160
3	4.4	1.3904	50	Correlation Coefficient : 0.9998
4	5.0	1.4798	54	
5	6.0	1.6176	60	



Calibrated by : 
(Mr. Panuwat Wanghong)
Field Scientist(1)
Approved by : 
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Map Ta Phu Olefins Co., Ltd. Barometric Pressure (mm Hg): 756.7

Calibrate Location: ถนนพหลโยธิน 2 Temperature (°C): 32.8

Calibrate Date: 14-Aug-24 High Volume ID: RYG_FS0177

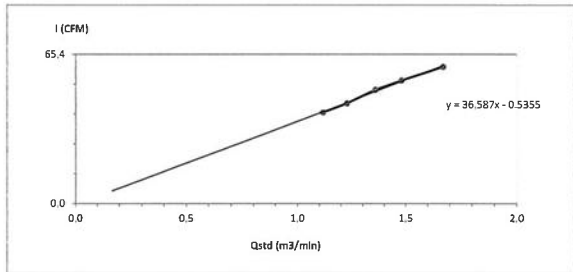
Calibration Sheet No.: C-140B24-RYG_FS0177 High Volume Model: TE-5170D

Calibrator ID: RYG_FS0205 High Volume S/N: 4803

Calibrator Model: TE-5028A Calibrator Slope: 1.52567

Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1165	40	Slope : 36.5968 Intercept : -0.5355 Correlation Coefficient : 0.9974
2	3.4	1.2266	44	
3	4.2	1.3593	50	
4	5.0	1.4798	54	
5	6.4	1.6694	60	



Calibrated by: Panuwat W.
(Mr. Panuwat Wangbong)
Field Scientist(1)

Approved by: 2. Pong
(Mr. Noppong Juntaruphan)
Enviro Field Coordinator Scientist (3)

FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24 Equipment Name: NOx Analyzer

Manufacturer: HORIBA Model: APNA-370

Serial No.: R06K0177 Equipment ID: RYG_FS0463

Calibrator Manufacturer: Teledyne API Model: 700

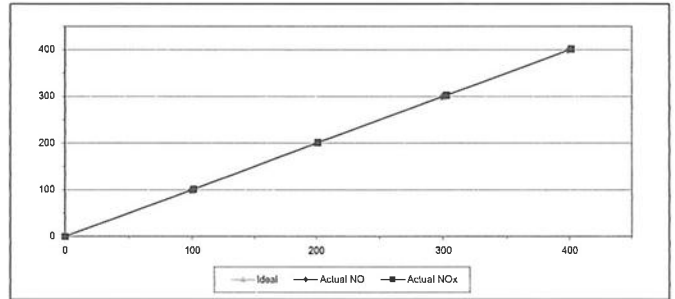
Serial No.: 947

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	98.80	-1.20	-1.20	101.30	1.30	1.30
2	200.00	201.30	1.30	0.65	201.20	1.20	0.60
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.70	-1.30	-0.33	401.50	1.50	0.38
AVERAGE (%)				-0.20			0.65



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

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

ALS Laboratory Group
FORM NO: F 06-056 REVISION NO: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24 Equipment Name: NOx Analyzer

Manufacturer: HORIBA Model: APNA-370

Serial No.: T95HWM41 Equipment ID: RYG_FS0461

Calibrator Manufacturer: Teledyne API Model: 700

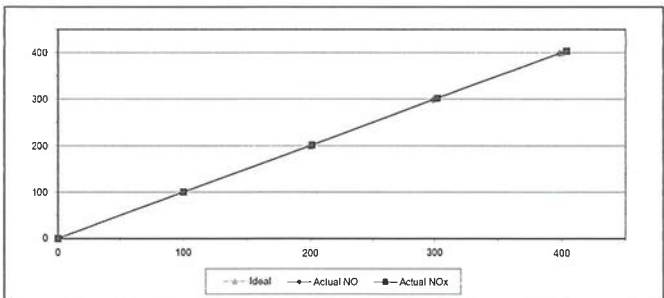
Serial No.: 947

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	98.70	-1.30	-1.30	100.10	0.10	0.10
2	200.00	201.00	1.00	0.50	201.10	1.10	0.55
3	300.00	298.70	-1.30	-0.43	302.10	2.10	0.70
4	400.00	398.40	-1.60	-0.40	403.70	3.70	0.92
AVERAGE (%)				-0.31			0.47



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

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

ALS Laboratory Group
FORM NO: F 06-056 REVISION NO: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24 Equipment Name: NOx Analyzer

Manufacturer: HORIBA Model: APNA-370

Serial No.: T2T8YRLL Equipment ID: RYG_FS0457

Calibrator Manufacturer: Teledyne API Model: 700

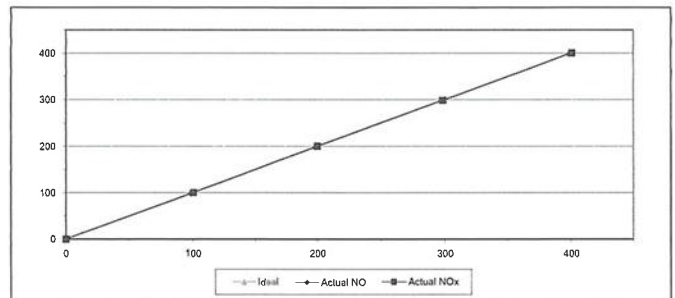
Serial No.: 947

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	98.30	-1.70	-1.70	100.30	0.30	0.30
2	200.00	198.40	-1.60	-0.80	199.80	-0.20	-0.10
3	300.00	297.90	-2.10	-0.70	298.50	-1.50	-0.50
4	400.00	398.60	-1.40	-0.35	400.80	0.80	0.20
AVERAGE (%)				-0.69			0.00



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

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

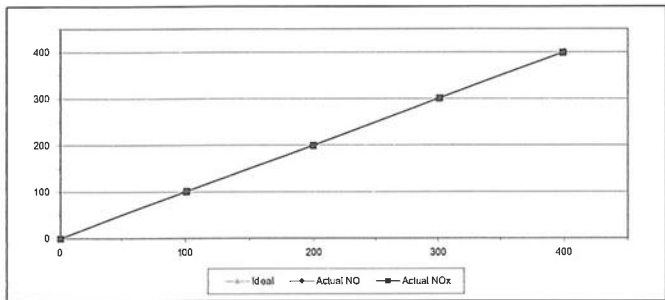
ALS Laboratory Group
FORM NO: F 06-056 REVISION NO: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	NV0ER3YH	Equipment ID	RYG_FS0459
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.20	1.20	1.20
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.40	1.40	0.47
4	400.00	400.30	0.30	0.08	398.80	-1.20	-0.30
AVERAGE (%)				-0.13			0.26



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

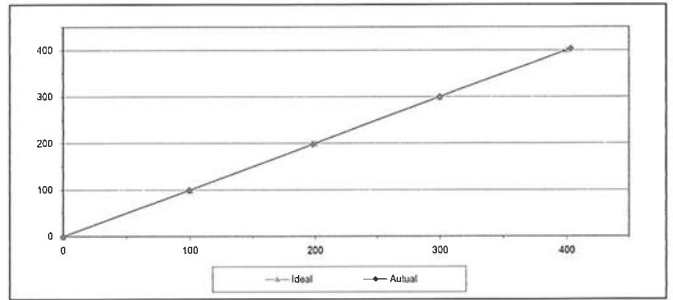
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	XL29Y85B	Equipment ID	RYG_FS0462
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90
2	200.00	198.00	-2.00	-1.00
3	300.00	299.30	-0.70	-0.23
4	400.00	403.20	3.20	0.80
AVERAGE (%)				-0.21



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

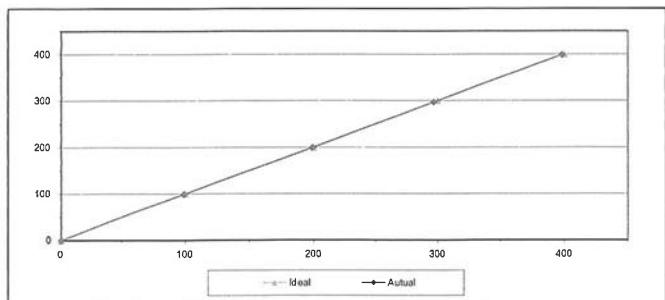
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	VABF9LSH	Equipment ID	RYG_FS0460
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30
2	200.00	198.80	-1.20	-0.60
3	300.00	296.90	-3.10	-1.03
4	400.00	398.20	-1.80	-0.45
AVERAGE (%)				-0.66



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

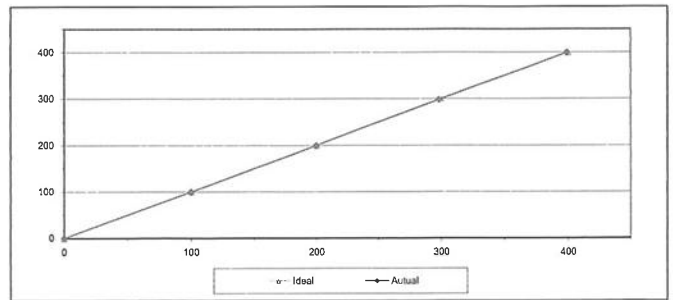
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	R0HWYDWW	Equipment ID	RYG_FS0456
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.70	-0.30	-0.30
2	200.00	199.50	-0.50	-0.25
3	300.00	298.00	-2.00	-0.67
4	400.00	398.80	-1.20	-0.30
AVERAGE (%)				-0.28



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

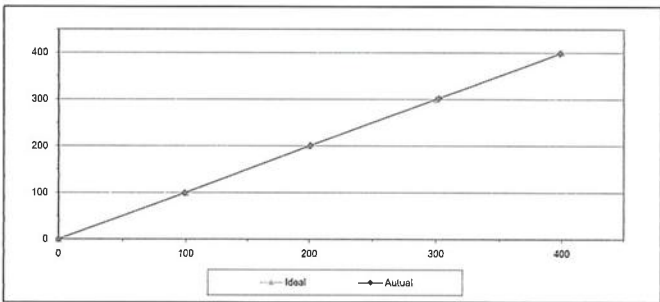
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	PAUY07A	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Taledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	201.00	1.00	0.50
3	300.00	302.30	2.30	0.77
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)			-0.02	



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrannoi)
Assistant General Manager

ALS Laboratory Group

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

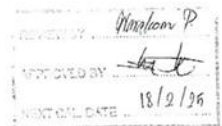


JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
62/14 15, 17/35-36
Pattanasarn J.J.T., Rd. Wattana, Bangkok, Thailand
Bangkok 10000 (Thailand)
Tel: +662-010-112
Fax: +662-010-112
E-mail: jirantee@jirantee.com
Web site: www.jirantee.com

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

Air speed measurement laboratory
Calibration services department.



Certificate Number

CWS-004-56

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Cup anemometer

: Novak

: Sensor: WS-02F

: Data logger: 200 WS-25LB

: Sensor: WSD-A5191

: Data logger: AS191

: RYG_FS0328

: Used item

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

: 104 Phatthanasarn 40, Phatthanasarn Rd., Khwaeng Suan Luang,

: Khut Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: 6455-12 and pilot tube with precision differential pressure meter model: DP42500 in an open test section of Eiffel type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

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

Uncertainty of Measurement:

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

RECEIVED DATE : 11 Aug 2023

MEASUREMENT DATE : 18 Aug 2023

ISSUE DATE : 21 Aug 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 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 0.111 [-]

Preconditioning : 24 hours at ambient conditions.

Measurement Condition : The average values during measurement are (24.1) °C, (44.3) %RH and (1005.44) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.



Approved signatory

Mr. Pannoy 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 Diameter of mounting pipe: ⁴ Ratio "a" to "b"

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



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
62/14 15, 17/35-36
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Bangkok 10000 (Thailand)
Tel: +662-010-112
Fax: +662-010-112
E-mail: jirantee@jirantee.com
Web site: www.jirantee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number

CWD-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

: Novak

: Sensor: WS-02F

: Data logger: 200 WS-25LB

: Sensor: WSD-A5191

: Data logger: AS191

: RYG_FS0328

: Used item

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

: 104 Phatthanasarn 40, Phatthanasarn Rd., Khwaeng Suan Luang,

: Khut Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: 6447919-DMG4 P3-S-100 in an close test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

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

Uncertainty of Measurement:

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

RECEIVED DATE : 11 Aug 2023

MEASUREMENT DATE : 18 Aug 2023

ISSUE DATE : 21 Aug 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 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 0.143 [-]

Preconditioning : 24 hours at ambient conditions.

Measurement Condition : The average values during measurement are (23.0) °C, (41.2) %RH and (1009.3) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sorawit Thairakul
Miss Jittrapee Jittrannoi



Approved signatory:

Mr. Pannoy 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 Diameter of mounting pipe: ⁴ Ratio "a" to "b"

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 : Cup anemometer
MANUFACTURER : Novalyx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5662
Data logger: AS662
ID NUMBER : RYG-F50544
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 0.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION : Eiffel-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 : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.0) °C, (41.7) %RH and (1003.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sorawit Thachaiad
Miss Jitraporn Lertsumpol



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 $\frac{A_o}{A_t}$

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 : Wind Direction Sensor
MANUFACTURER : Novalyx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-A5662
Data logger: AS662
ID NUMBER : RYG-F50544
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 0.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION : Eiffel-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 : 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8) °C, (49.0) %RH and (1011.6) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sorawit Thachaiad
Miss Jitraporn Lertsumpol



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 $\frac{A_o}{A_t}$

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 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_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.004	23.84	23.95	0.8	-0.2	0.31
2.079	24.08	23.95	1.8	-0.3	0.31
3.019	24.04	23.95	2.8	-0.2	0.31
4.150	24.12	23.95	3.8	0.3	0.31
5.00	23.72	23.95	4.8	-0.7	0.31
5.99	23.68	23.95	5.8	-0.2	0.31
7.04	23.68	23.95	6.9	-0.3	0.31
8.15	23.64	23.95	7.9	-0.3	0.31
9.09	23.30	23.95	9.0	-0.1	0.31
10.05	23.40	23.95	9.9	0.1	0.31
11.13	23.48	23.95	11.0	-0.2	0.31
12.11	23.40	23.95	12.0	-0.1	0.31
13.16	23.30	23.95	13.0	-0.3	0.31
14.22	23.40	23.95	14.0	-0.2	0.31
15.22	23.50	23.95	15.0	-0.2	0.31
16.27	23.44	23.95	16.1	-0.2	0.31

Remark:

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

² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirantee 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.



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.

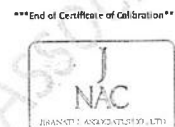
Air speed m/s	D^{+}_{ref} Degree (°)	D^{-}_{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
	180.000	180	0	1.0
5.00	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0
	360.000	359	-1	1.0

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration



CERTIFICATE OF CALIBRATION

Certificate No : CDT 037 66
Page 1 of 2

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

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

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

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No : 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 6/1407-00591 Due date: 22 July 2023

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

Calibration Procedure

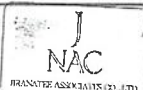
The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability

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

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

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangsumpai Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Certificate No : CDT 037 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: T2320591.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.050	19.6	-0.5	0.099
70	25.054	24.6	-0.5	0.099
70	30.050	29.7	-0.3	0.14
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	0.14

UUC* : Unit Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No. : NH-01072023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalyx
Model/Type : 110-WS-25DL-D
Serial Number : A5662
ID No. : RYG_FS0544
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition.

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

Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 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: 20096-001, Due date: Sep 26, 2024.

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

Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (URI) on display, Model: HMP60, Serial number: T2320591.

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

The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.07	16.3	-3.8	0.61
50	50.23	45.0	-5.2	0.51
80	80.23	73.5	-6.7	0.51

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



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TIS-TIS 17025
CALIBRATION 0367
Air speed measurement laboratory
Calibration services department

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TIS-TIS 17025
CALIBRATION 0367
Air speed measurement laboratory
Calibration services department



Certificate Number

CWS-016-67

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

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 900 cm²
Wind direction frontal area² 100 cm²
Diameter of mounting pipe³ 1 mm
Blockage ratio of test object⁴ 0.111 [%]

Preconditioning

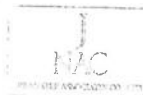
Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (24.6)°C, (41.4) %RH and (1002.0) hPa.

TABULATION OF RESULTS:

The table on next page give the obtained values.

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



Approved signatory
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks

¹ Nozzle cross-section area of the wind tunnel
² Frontal cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio 10%

Calibration procedure:
The cup anemometer was calibrated against
Standard air velocity transducer model: 8455-12
and pitot tube with precision differential pressure
meter model: DPM1500 in an open jet-section of
Eiffel-type wind tunnel with 900 cm² cross
section area. The WGL-4007 based on IEC 61558-
12-1, Wind energy generation systems - Part 12-1:
Power performance measurements of
electricity producing wind turbines, March 2017
was used as a calibration guideline.

Traceability
This certificate provides a traceability of the
measurement to recognized the national
standards and to realization of the international
system of units (SI) through the NIMT (National
Metrology Institute of Thailand) via Certificate
number: MW-2007-24 and MW-0059-23

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).

Handwritten signature and date: 26/12/25

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BEEN OBTAINED IN WRITING FROM THE LABORATORY.

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 which was installed 150 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of 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)	$U(R=2)$ (m/s)
0.993	24.50	24.60	0.8	-0.2	0.31
2.014	24.70	24.80	1.7	-0.3	0.31
2.985	24.58	24.60	2.8	-0.2	0.31
4.131	24.64	24.60	3.8	-0.3	0.31
4.97	24.50	24.60	4.9	-0.1	0.31
5.98	24.46	24.60	6.0	0.0	0.31
7.01	24.50	24.60	7.1	0.0	0.31
7.56	24.32	24.60	8.1	0.1	0.31
9.02	24.70	24.60	9.1	0.1	0.31
9.94	24.30	24.60	10.2	0.2	0.31
11.02	24.70	24.60	11.3	0.3	0.31
11.99	24.30	24.60	12.3	0.3	0.31
13.03	24.70	24.60	13.3	0.3	0.31
14.05	24.30	24.60	14.4	0.4	0.31
15.05	24.70	24.60	15.4	0.4	0.31
15.99	24.46	24.60	16.4	0.4	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.



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-250L-D
Sensor: WSD-AS911
Data logger: AS911
RYG, JS0610
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 history Encoder model: AK40713-DMM-P15-10 in an close test section of Lijeh-type wind tunnel with 300 cm² cross test section area. The W-CL-DMM based on IEC 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DN-0339-23.

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

10 Jun 2024

26 Jun 2024

26 Jun 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 0.5 °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: 800 cm²
Wind direction frontal area²: 129 cm²
Diameter of measuring pipe³: 6 mm
Blockage ratio of test object⁴: 0.143 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (24.0)°C, (53.0) %RH and (1005.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Soravit Thachalad
☐ Miss Mittraiporn 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 Diameter of measuring pipe.
⁴ Ratio S_{obj}/S_{wind} .

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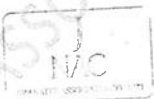
MEASUREMENT RESULTS¹

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 ¹ ₄₅ Degree (°)	D ² ₄₅ Degree (°)	Error Degree (°)	U (R=2) Degree (°)
5.00	0.000	0	0	0.80
	45.000	45	0	0.80
	90.000	89	-1	0.80
	135.000	132	-3	0.80
	180.000	177	-3	0.80
	225.000	223	-2	0.80
	270.000	270	0	0.80
	315.000	318	3	0.80

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CPR-006-67

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Digital barometer
Novolyne
Sensor: 110-WS-25DP
Data logger: 110-WS-250L-D
Sensor: BP AS911
Data logger: AS911
RYG, JS0610
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 Digital barometer was calibrated against Digital pressure calibrator. The WP-CL-D-3 was used as a calibration guideline.

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-0009-24

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

10 Jun 2024

25 Jun 2024

25 Jun 2024

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	1190126P	MP-0009-24	27 Dec 2024

2. Calibration effort for calibration sequence B

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
Pressure transmitting medium: Air
 p_0 (20°C, 1 bar): 1.19 kg/m^3
 H_{room} : (50±15) m
 T_{room} : (23±3) °C
 p_{atm} : (1010±10) mbar

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

Calibrated by:
☒ Mr. Soravit Thachalad
☐ Miss Mittraiporn Lertsomphol



Approved signatory
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CPR-006 67

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)
950.15	951.6	1.5	0.17
970.11	971.0	0.9	0.37
990.06	990.7	0.7	0.37
1010.08	1010.4	0.3	0.37
1030.07	1030.1	0.0	0.37
1050.07	1049.8	-0.3	0.37

Note: UUC* Unit Under Calibration

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

End of certificate



Continuation of Certificate of Calibration Number CDT-103-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 3: 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)
80	20.054	19.8	-0.2	0.16
80	25.051	24.8	-0.2	0.16
80	30.046	29.9	-0.1	0.099
80	35.034	34.8	-0.2	0.099
80	40.043	39.8	-0.2	0.099

UUC*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CRT-015-67

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Data Logger with Temperature sensor

: Nuulynx

: 110-VS-25DL-D

: Sensor: HMP60

: Data Logger: AS911

: Sensor: U3911245

: RYS_F50610

: Used item

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

: 104 Phatthanakan Rd., Phatthanakan Rd.,

: Khwaeng Suan Luang, Khet Suan Luang,

: Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 10 Jun 2024

: 26 Jun 2024

: 26 Jun 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Calibration procedure:

The relative humidity and Air Temperature calibration was done by In-House calibration method as per CL 001 according to comparison method with standard Ethanol Vapor generator chamber.

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology (NIM) Certificate number: TH-0629-18, and through Jirante Associate Co., Ltd. Certificate number: CDT-003-67.

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".

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

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



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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IN WRITING FROM THE LABORATORY

Certificate Number
CWD-002-66

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 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 (°)
5.00	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	229	4	1.0
	270.001	273	3	1.0
	315.000	317	2	1.0
	360.000	359	-1	1.0

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



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



CERTIFICATE OF CALIBRATION

Certificate No.: CDT-034-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novalyx
Model: 110-WS-25DI-D
Serial No.: A5816
ID No.: RYG_FS0545

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

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

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

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

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

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

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

Calibrated by
☐ Mr. Sorawit Thachasid
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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BEEN OBTAINED IN WRITING FROM THE LABORATORY.



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 No.: CDT-036-66
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: T2320595.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.060	19.6	-0.5	0.099
70	25.055	24.6	-0.4	0.14
70	30.050	29.7	-0.4	0.099
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	0.099

UUC*: Unit Under Calibration

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

★ End of Certificate ★



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.: RH-02072023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalyx
Model/Type : 110-WS-25DI-D
Serial Number : A5816
ID No. : RYG_FS0545
Customer : ALS laboratory group (Thailand) Co., Ltd.
: 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

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

Measurement Method:

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

Traceability:

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

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

Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (URI) on display. Model: HMP60. Serial number: 12320696.
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	20.05	17.5	-2.6	0.62
50	50.23	46.5	-3.7	0.51
80	80.26	75.5	-4.8	0.51

Performed by
☐ Mr. Sorawit Thachasid
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL BP. 83/0267

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : Rion Relative Humidity : (50 ± 15) %
Model : NC-74 Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 34178121 (ID:RYG_FS0213)
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037,
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484,
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214,
4. Digital Multimeter Agilent 34401A S/N MY44005560,
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001,
6. Audio Analyzer Keithley 2015-P S/N 4106495,
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 19 Feb. 2024

Date of Calibration : 28 Feb. 2024

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SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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ASSOCIATESCert. No. : ACL24111
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No. : 00920825 / 22185 / 22214
ID No. : BKK_FS1338

Condition As Found : GOOD

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

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

Received Date : 03 APRIL 2024
Calibration Date : 09-11 APRIL 2024
Date of Issue : 12 APRIL 2024

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.



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL BP. 83/0267

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage

factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	94.01	0.01	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1003.1	3.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.80	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by :

(Mr. Weerachai Decchaiyae)

Approved by :

Director
Electrical and Electronic Standards Laboratory

Date of Calibration : 28 Feb. 2024

Date of Issue : 29 Feb. 2024

End of Certificate

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref: 2011267021900719001

2 / 2

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Job No. : VC67AC0075
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-4	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EELBP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EELBP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EELBP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

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Cert. No. : ACL24111
Job No. : VC67AC0075
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long-term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

T. Petch

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Cert. No. : ACL24111
Job No. : VC67AC0075
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	94.0	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	8.7
C-weight	14.6
Flat	20.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	±1.0
1000	0.1	0.1	0.1	±0.7
8000	0.1	0.2	0.2	+1.5, -2.5

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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	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+1.5, -2.5
16000	0.0	-1.2	-1.2	+2.5, -16.0

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	±0.1

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Job No. : VC67AC0075
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.1	0.1	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.1	0.1	±0.8
69.0	69.1	0.1	±0.8
64.0	64.0	0.0	±0.8
59.0	59.1	0.1	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.1	0.1	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.0	0.0	±0.8
25.0	25.0	0.0	±0.8

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Job No. : VC67AC0075
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	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	136.0	-0.4	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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Cert. No. : ACL24111
Job No. : VC67AC0075
Pages : 8 of 8

11. Overload indication

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

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

S. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL. BP. 87/0267

CALIBRATION CERTIFICATE

Submitted by : A.I.S Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-52A
Serial No. : 00920826 (ID : BKK FS1339)
Microphone : UC-59 No.22186
Preamplifier : NH-25 No.22215
Standards used :

Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

- Band Pass Filter Wavelek 752A S/N 90010494.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Fluke 8520A S/N 4985007.
- Pistonphone Rion NC-72 S/N 00402446.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 19 Feb. 2024

Date of Calibration : 18 Mar. 2024

1/9

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Request No. 21-67/0293

MTC No. EEL. BP. 87/0267

- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 18 Mar. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 87/0267

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.89	114.4	113.9	0.0	0.7	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
13.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	9.7	0.10	N/A
C-Weight	14.2	0.10	N/A
Flat	19.5	0.10	N/A

Date of Calibration : 18 Mar. 2024

3 / 9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 87/0267

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	-0.3	-0.2	-0.2	±1.0	0.45	0.6
1 000	-0.1	-0.1	-0.1	±0.7	0.45	0.6
8 000	-1.9	-1.8	-1.9	±1.5 ; -2.5	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.1	0.0	±1.0	0.20	0.6
125	0.0	0.1	0.1	±1.0	0.20	0.6
250	0.0	0.1	0.1	±1.0	0.20	0.6
500	0.0	0.1	0.1	±1.0	0.20	0.6
1 000	0.0	0.0	0.0	±0.7	0.20	0.6
2 000	-0.2	-0.1	-0.2	±1.0	0.20	0.6
4 000	-0.3	-0.3	-0.2	±1.0	0.20	0.6
8 000	0.0	0.0	0.0	±1.5 ; -2.5	0.20	0.7
16 000	-1.9	-1.9	-0.5	±2.5 ; -16.0	0.20	1.0

Date of Calibration : 18 Mar. 2024

4 / 9

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Request No. 21-67/0293

MTC No. EEL, BP, 87/0267

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.1	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 18 Mar. 2024

5 / 9

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Request No. 21-67/0293

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	0.8	0.30	0.3
136	136.1	0.1	0.8	0.30	0.3
135	135.1	0.1	0.8	0.30	0.3
134	134.1	0.1	0.8	0.30	0.3
129	129.1	0.1	0.8	0.30	0.3
124	124.0	0.0	0.8	0.30	0.3
119	119.1	0.1	0.8	0.30	0.3
114	114.1	0.1	0.8	0.30	0.3
109	109.0	0.0	0.8	0.30	0.3
104	104.1	0.1	0.8	0.30	0.3
99	99.0	0.0	0.8	0.30	0.3
94	94.0	0.0	0.8	0.30	0.3
89	89.0	0.0	0.8	0.30	0.3
84	84.1	0.1	0.8	0.30	0.3
79	79.1	0.1	0.8	0.30	0.3
74	74.0	0.0	0.8	0.30	0.3
69	69.0	0.0	0.8	0.30	0.3
64	64.0	0.0	0.8	0.30	0.3
59	59.0	0.0	0.8	0.30	0.3

Date of Calibration : 18 Mar. 2024

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MTC No. EEL, BP, 87/0267

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54.0	0.0	0.8	0.30	0.3
49	49.0	0.0	0.8	0.30	0.3
44	44.0	0.0	0.8	0.30	0.3
39	39.0	0.0	0.8	0.30	0.3
34	34.0	0.0	0.8	0.30	0.3
29	29.0	0.0	0.8	0.30	0.3
24	24.0	0.0	0.8	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	0.8	0.30	0.3

Date of Calibration : 18 Mar, 2024

7 / 9

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MTC No. EEL, BP, 87/0267

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35	35.0	0.0	0.8	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±0.5	0.20	0.3
	2	109.0	0.0	+1.0; -1.5	0.20	0.3
	0.25	99.9	-0.1	+1.0; -3.0	0.20	0.3
Slow	200	119.6	0.0	±0.5	0.20	0.3
	2	100.0	0.0	+1.0; -3.0	0.20	0.3
	0.25	90.9	-0.1	+1.0; -3.0	0.20	0.3
SEL	200	120.0	0.0	±0.5	0.20	0.3
	2	100.0	0.0	+1.0; -1.5	0.20	0.3
	0.25	90.9	-0.1	+1.0; -3.0	0.20	0.3

Date of Calibration : 18 Mar, 2024

8 / 9

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Request No. 21-67/0293

MTC No. EEL, BP, 87/0267

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	2.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	1.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	1.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
136.8	136.8	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.1	0.10	0.1
End	129.0				

Calibrated by :
Wittawat Supanich
(Mr. Wittawat Supanich)

Approved by :
Prasanna Klunpa
(Mr. Prasanna Klunpa)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Mar, 2024

Date of Issue : 19 Mar, 2024

Ref : 2011267021900720004

End of Certificate

9 / 9

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Cert. No. : ACL24084
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No. : 01120939 / 21940 / 22328
ID No. : RYG_FS0630

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHAENG 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 : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

Thanakul 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.

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Cert. No. : ACL24084
Job No. : VC67AC0054
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anchoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

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

Signature

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Cert. No. : ACL24084
Job No. : VC67AC0054
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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	0.3	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

Signature

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Cert. No. : ACL24084
Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A-weight	8.7
C-weight	14.0
Flat	19.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.6	0.6	0.6	+ 1.5, - 2.5

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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	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

Signature

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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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	63.9	-0.1	±0.8
59.0	59.0	0.0	±0.8
54.0	53.9	-0.1	±0.8
49.0	48.9	-0.1	±0.8
44.0	43.9	-0.1	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.8	-0.2	±0.8

T. Petch

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.1	0.1	±0.5

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
One	136.4	136.3	-0.1	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

T. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL BP. 88/0267

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A-Muang, Samutprakan 10280.

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-52A
Serial No. : 00920R27 (ID : BKK_FS1340)
Microphone : UC-59 No.22187
Preamplifier : NH-25 No.22216
Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

- Standards used :
- Band Pass Filter Wavelec 752A S/N 90010494.
 - Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
 - Decade Attenuator Ando AL-205 S/N 00464602.
 - Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
 - Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
 - Digital Multimeter Fluke 8520A S/N 4985007.
 - Pistonphone Rion NC-72 S/N 00402446.
 - Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 19 Feb. 2024

Date of Calibration : 19 Mar. 2024

1 / 9

The results relate only to the items presented, tested or value of goods.
Accepting the Report/Certificate and passing on the results to users, in full and without reservation, is the responsibility of the user.



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 88/0267

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 19 Mar, 2024

2 / 9

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FM/LMTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 88/0267

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.2	0.3	0.3	±1.0	0.45	0.6
1 000	-0.2	-0.2	-0.2	±0.7	0.45	0.6
8 000	-1.8	-1.8	-1.8	±1.5 ; ±2.5	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.0	0.1	±1.0	0.20	0.6
125	-0.1	0.1	0.1	±1.0	0.20	0.6
250	-0.1	0.0	0.1	±1.0	0.20	0.6
500	0.0	0.1	0.1	±1.0	0.20	0.6
1 000	0.0	0.0	0.0	±0.7	0.20	0.6
2 000	-0.2	-0.2	-0.2	±1.0	0.20	0.6
4 000	-0.3	-0.3	-0.2	±1.0	0.20	0.6
8 000	0.0	0.0	0.0	±1.5 ; ±2.5	0.20	0.7
16 000	-1.9	-1.9	-0.5	±2.5 ; ±16.0	0.20	1.0

Date of Calibration : 19 Mar, 2024

4 / 9

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FM/LMTC.002 Rev.5



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 88/0267

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.89	114.3	113.9	0.0	0.7	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
21.4	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	10.7	0.10	N/A
C-Weight	15.1	0.10	N/A
Flat	20.1	0.10	N/A

Date of Calibration : 19 Mar, 2024

3 / 9

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FM/LMTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL, BP, 88/0267

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.1	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 1 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 19 Mar, 2024

5 / 9

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FM/LMTC.002 Rev.5



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL BP. 88/0267

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	0.8	0.30	0.3
136	136.0	0.0	0.8	0.30	0.3
135	135.0	0.0	0.8	0.30	0.3
134	134.0	0.0	0.8	0.30	0.3
129	129.0	0.0	0.8	0.30	0.3
124	124.0	0.0	0.8	0.30	0.3
119	119.0	0.0	0.8	0.30	0.3
114	114.0	0.0	0.8	0.30	0.3
109	109.0	0.0	0.8	0.30	0.3
104	104.0	0.0	0.8	0.30	0.3
99	99.0	0.0	0.8	0.30	0.3
94	94.0	0.0	0.8	0.30	0.3
89	89.0	0.0	0.8	0.30	0.3
84	84.0	0.0	0.8	0.30	0.3
79	79.0	0.0	0.8	0.30	0.3
74	74.0	0.0	0.8	0.30	0.3
69	68.9	-0.1	0.8	0.30	0.3
64	63.9	-0.1	0.8	0.30	0.3
59	58.9	-0.1	0.8	0.30	0.3

Date of Calibration : 19 Mar. 2024

6 / 9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL BP. 88/0267

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	-0.1	0.8	0.30	0.3
49	48.9	-0.1	0.8	0.30	0.3
44	43.9	-0.1	0.8	0.30	0.3
39	38.9	-0.1	0.8	0.30	0.3
34	33.9	-0.1	0.8	0.30	0.3
29	28.9	-0.1	0.8	0.30	0.3
24	24.0	0.0	0.8	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	0.8	0.30	0.3

Date of Calibration : 19 Mar. 2024

7 / 9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0293

MTC No. EEL BP. 88/0267

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
30-130	35	35.0	0.0	0.8	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±0.5	0.20	0.3
	2	109.0	0.0	+1.0; -1.5	0.20	0.3
	0.25	99.9	-0.1	+1.0; -3.0	0.20	0.3
Slow	200	119.6	0.0	±0.5	0.20	0.3
	2	100.0	0.0	+1.0; -3.0	0.20	0.3
	0.25	91.0	0.0	+1.0; -3.0	0.20	0.3

Date of Calibration : 19 Mar. 2024

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Request No. 21-67/0293

MTC No. EEL BP. 88/0267

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	2.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	1.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	1.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
136.8	136.8	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class I (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.1	0.10	0.1
End	129.0				

Calibrated by: *Wittawat Supanich*
(Mr. Wittawat Supanich)

Approved by: *Mr. Prawat Klayman*
(Mr. Prawat Klayman)
Director

Date of Calibration : 19 Mar. 2024

Date of Issue : 20 Mar. 2024

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref: 2011267021900720005

End of Certificate

9 / 9

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Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472126 / 158778 / 88180
ID No.: RYG_FS0301

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHAENG 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 : 19 DECEMBER 2023
Calibration Date : 12 JANUARY 2024
Date of Issue : 16 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchur*
(Thanakul Petchurai)

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

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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	MY4801 7076	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	LF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

Summary of Measurement Result :

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.8

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.4
Flat	24.2

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.7	0.8	0.9	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	-2.5	-2.5	-2.5	± 5.0

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Tel: +66 2433 8331 Email: calibration@sithiporn.com

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associates



Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

7. Pethu

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Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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Job No. : VC67AC0044
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±3.0

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

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Cert. No. : ACL24027
Job No. : VC67AC0044
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

7. Pethu

Cert. No. : ACL24008
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173610 / 143485 / 22619
ID No.: RYG_FS0389

Condition As Found : GOOD

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

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

Received Date : 19 DECEMBER 2023
Calibration Date : 05-08 JANUARY 2024
Date of Issue : 09 JANUARY 2024

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.

Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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	EP-0011-23	08-FEB-24
Condensor 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).

Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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

Cert. No. : ACL24008
Job No. : VC67AC0044
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)
18.6

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

Frequency Weighting	Measured value (dB)
A-weight	16.2
C-weight	22.1
Flat	28.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.5	0.5	0.6	± 5.0