

ภาคผนวก ง

เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Standard gas	-	-	-	-
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0496	4-Jan-22	4-Jul-22	6
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	16-Dec-21	16-Dec-22	12
Ambient	Total Suspended Particulate	High Volume	NKH_FS0050	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	NKH_FS0051	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	NKH_FS0049	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	NKH_FS0052	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Particulate Matter (PM-10)	High Volume	NKH_FS0046	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	NKH_FS0047	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	NKH_FS0048	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	NKH_FS0045	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	NKH_FS0080	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	NKH_FS0084	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	NKH_FS0082	4-Jan-22	4-Jul-22	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	NKH_FS0078	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	NKH_FS0081	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	NKH_FS0085	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	NKH_FS0083	4-Jan-22	4-Jul-22	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	NKH_FS0079	4-Jan-22	4-Jul-22	6



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	NKH_FS0054	20-Jul-21	18-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	NKH_FS0055	10-Jun-21	9-Dec-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	NKH_FS0056	24-Feb-21	25-Aug-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	NKH_FS0053	20-Jul-21	18-Jan-23	18
Ambient	Temperature	Temperature Sensor	NKH_FS0054	20-Jul-21	18-Jan-23	18
Ambient	Temperature	Temperature Sensor	NKH_FS0055	10-Jun-21	9-Dec-22	18
Ambient	Temperature	Temperature Sensor	NKH_FS0056	24-Feb-21	25-Aug-22	18
Ambient	Temperature	Temperature Sensor	NKH_FS0053	20-Jul-21	18-Jan-23	18
Noise	Leq 24 hrs	Sound Calibrator	NKH_FS0019	20-Aug-21	20-Aug-22	12
Noise	Leq 24 hrs	Sound Level Meter	NKH_FS0071	7-Jun-21	7-Jun-22	12
Noise	Leq 24 hrs	Sound Level Meter	NKH_FS0070	7-Jun-21	7-Jun-22	12
Noise	Leq 24 hrs	Sound Level Meter	NKH_FS0008	14-Jul-21	14-Jul-22	12
Noise	Leq 5 min	Sound Calibrator	NKH_FS0019	20-Aug-21	20-Aug-22	12
Noise	Leq 5 min	Sound Level Meter	NKH_FS0071	7-Jun-21	7-Jun-22	12
Noise	Leq 5 min	Sound Level Meter	NKH_FS0070	7-Jun-21	7-Jun-22	12
Noise	Leq 5 min	Sound Level Meter	NKH_FS0008	14-Jul-21	14-Jul-22	12
Noise	Leq 8 hrs	Sound Calibrator	NKH_FS0019	20-Aug-21	20-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0001	26-Apr-21	26-Apr-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0027	20-Aug-21	20-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0005	27-Apr-21	27-Apr-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0072	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0071	7-Jun-21	7-Jun-22	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0070	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0069	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0007	14-Jul-21	14-Jul-22	12
Noise	Leq 8 hrs	Sound Calibrator	NKH_FS0019	20-Aug-21	20-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0006	14-Jul-21	14-Jul-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0004	3-May-22	3-May-23	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0069	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0072	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0026	20-Aug-21	20-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0027	20-Aug-21	20-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0073	7-Jun-21	7-Jun-22	12
Noise	Leq 8 hrs	Sound Level Meter	NKH_FS0007	14-Jul-21	14-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0024	27-Jul-21	27-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0025	27-Jul-21	27-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0031	26-Jul-21	26-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0032	29-Jul-21	29-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0033	22-Jul-21	22-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0021	22-Jul-21	22-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0022	26-Jul-21	26-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0025	27-Jul-21	27-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0024	27-Jul-21	27-Jul-22	12
Heat	Heat Stress	Heat Stress Monitor	NKH_FS0031	26-Jul-21	26-Jul-22	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Illuminance	Illuminance	Lux Meter	NKH_FS0086	07-Jan-22	7-Jan-23	12
Illuminance	Illuminance	Lux Meter	NKH_FS0086	07-Jan-22	7-Jan-23	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0072	26-Mar-21	24-Sep-22	18
Water Lab	Ammonia Nitrogen	Discrete analyzer	BKK_EN0037	28-Jun-21	28-Jun-22	12
Water Lab	Dissolved Oxygen	Burette	BKK_EN0171	30-Mar-21	28-Sep-22	18
Water Lab	Dissolved Oxygen	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0003	3-Sep-21	3-Sep-22	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	31-Jan-22	1-Aug-23	18
Water Lab	Phosphate	Discrete analyzer	BKK_EN0037	28-Jun-21	28-Jun-22	12
Water Lab	Chlorite	Ion Chromatography	BKK_EN0069	12-Jan-22	12-Jan-23	12
Water Lab	Total Kjeldahl Nitrogen	Digestion Unit	BKK_EN0223	1-Feb-22	1-Feb-23	12
Water Lab	Total Kjeldahl Nitrogen	Discrete analyzer	BKK_EN0037	28-Jun-21	28-Jun-22	12
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0003	3-Sep-21	3-Sep-22	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0273	22-Jul-21	20-Jan-23	18
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BKK_EN0003	3-Sep-21	3-Sep-22	12
Water Lab	Total Dissolved Solids 180°C	Oven	BKK_EN0273	22-Jul-21	20-Jan-23	18
Water Lab	Conductivity	Conductivity meter	BKK_EN0065	19-Nov-21	20-May-23	18
Water Lab	BOD (5 days at 20°C)	DO Meter	BKK_EN0205	19-Jan-21	20-Jul-22	18
Water Lab	BOD (5 days at 20°C)	Incubator	BKK_EN0005	4-Oct-21	4-Apr-23	18
Water Lab	Temperature	pH Meter	BKK_LG0031	23-Dec-21	23-Dec-22	12
Water Lab	Calcium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	12
Water Lab	Magnesium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Magnesium	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	12
Water Lab	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Chromium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	12
Water Lab	Chromium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Chromium	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Copper	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	12
Water Lab	Copper	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Copper	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Zinc	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	12
Water Lab	Zinc	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Zinc	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	SAR	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	12
Water Lab	SAR	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	SAR	Chamber (Cold Room)	BKK_EN0167	18-May-21	16-Nov-22	18
Water Lab	Mercury	DUO-CVAFS / CVAAS	BKK_EL0023	6-Jun-22	5-Jun-23	12
Water Lab	Fecal Coliform	Autoclave	BKK_ML0043	1-Dec-21	1-Jun-23	18



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Fecal Coliform	Incubator	BKK_ML0010	21-Jan-22	22-Jul-23	18
Water Lab	Fecal Coliform	Hot Air Oven	BKK_ML0013	7-Jun-21	6-Dec-22	18
Water Lab	Fecal Coliform	Water Bath	BKK_ML0056	20-May-22	20-May-23	12



Lot No. 2244531-1

ANALYZER CALIBRATION DATA

Client : Gulf NRV2 Co., Ltd. Location : HRSG 21
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.40
Low-Level Gas	8.05	8.00	8.00	0.00
Span Gas	16.06	16.10	15.90	0.80

NO_x ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.40	0.20
Low-Level Gas	50.32	50.00	50.00	0.00
Span Gas	158.20	158.20	157.60	0.30

SO₂ ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	50.27	49.90	49.90	0.00
Span Gas	161.60	161.60	161.20	0.20

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



Lot No. 2244531-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf NRV2 Co., Ltd. Location : HRSG 21
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.10	0.40	0.10	0.40	0.00
Upscale Gas	16.10	15.90	0.80	15.90	0.80	0.00

NO_x ANALYZER

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

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.30	0.15	0.40	0.20	0.05
Upscale Gas	158.20	157.70	0.25	157.60	0.30	0.05

SO₂ ANALYZER

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

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	161.60	161.20	0.20	161.20	0.20	0.00

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	1
Date	26 May 22	Location	HRSG 21
Start Time	10:15	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	10:35
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:15	14.65	4.03	23.74	0.08	-	
10:16	14.64	4.06	25.40	0.07	-	
10:17	14.64	4.01	26.04	0.08	-	
10:18	14.64	4.03	25.99	0.07	-	
10:19	14.64	4.04	25.94	0.09	-	
10:20	14.64	4.05	25.94	0.08	-	
10:21	14.65	4.04	25.94	0.08	-	
10:22	14.66	4.06	25.30	0.11	-	
10:23	14.67	4.05	24.45	0.10	-	
10:24	14.67	4.02	23.14	0.09	-	
10:25	14.67	4.04	22.96	0.12	-	
10:26	14.73	4.00	22.38	0.12	-	
10:27	14.73	4.03	21.59	0.11	-	
10:28	14.72	4.01	21.15	0.11	-	
10:29	14.73	4.03	21.14	0.11	-	
10:30	14.73	4.00	21.06	0.11	-	
10:31	14.71	4.01	21.28	0.10	-	
10:32	14.71	4.01	21.82	0.13	-	
10:33	14.71	4.03	22.13	0.11	-	
10:34	14.71	4.03	22.15	0.12	-	
10:35	14.68	4.04	22.96	0.10	-	
Average	14.68	4.03	23.45	0.10	-	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	2
Date	26 May 22	Location	HRSG 21
Start Time	10:36	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	10:56
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:36	14.66	4.06	24.55	0.13	-	
10:37	14.65	4.07	25.21	0.13	-	
10:38	14.65	4.08	25.59	0.10	-	
10:39	14.64	4.09	25.75	0.13	-	
10:40	14.63	4.07	25.79	0.11	-	
10:41	14.63	4.09	25.76	0.11	-	
10:42	14.66	4.05	25.65	0.11	-	
10:43	14.66	4.07	25.53	0.12	-	
10:44	14.66	4.05	25.46	0.13	-	
10:45	14.68	4.06	25.14	0.14	-	
10:46	14.75	3.96	23.63	0.15	-	
10:47	14.71	4.06	21.91	0.12	-	
10:48	14.67	4.01	22.33	0.13	-	
10:49	14.65	4.07	24.47	0.09	-	
10:50	14.65	4.06	25.52	0.12	-	
10:51	14.66	4.05	25.68	0.13	-	
10:52	14.65	4.07	25.62	0.10	-	
10:53	14.65	4.06	25.46	0.13	-	
10:54	14.65	4.05	25.40	0.09	-	
10:55	14.66	4.06	25.40	0.13	-	
10:56	14.66	4.07	25.54	0.12	-	
Average	14.66	4.06	25.02	0.12	-	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	3
Date	26 May 22	Location	HRSG 21
Start Time	10:57	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	11:17
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:57	14.65	4.07	25.58	0.12	-	
10:58	14.66	4.05	25.58	0.12	-	
10:59	14.66	4.00	25.52	0.11	-	
11:00	14.66	4.04	25.53	0.11	-	
11:01	14.66	4.04	25.57	0.13	-	
11:02	14.66	4.05	25.60	0.12	-	
11:03	14.66	4.04	25.62	0.15	-	
11:04	14.65	4.04	25.61	0.16	-	
11:05	14.64	4.05	25.56	0.13	-	
11:06	14.65	4.06	25.59	0.17	-	
11:07	14.66	4.03	25.71	0.15	-	
11:08	14.70	3.97	24.56	0.13	-	
11:09	14.71	4.02	23.41	0.14	-	
11:10	14.73	3.99	21.92	0.15	-	
11:11	14.75	4.00	20.93	0.14	-	
11:12	14.71	4.02	20.92	0.13	-	
11:13	14.71	4.03	21.48	0.15	-	
11:14	14.70	4.01	22.19	0.14	-	
11:15	14.66	4.07	23.17	0.13	-	
11:16	14.65	4.07	24.84	0.15	-	
11:17	14.64	4.06	25.71	0.16	-	
Average	14.67	4.04	24.31	0.14	-	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



Lot No. 2244532-1

ANALYZER CALIBRATION DATA

Client : Gulf NRV2 Co., Ltd. Location : HRSG 22
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.40
Low-Level Gas	8.05	8.00	8.00	0.00
Span Gas	16.06	16.10	15.90	0.80

NO_x ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.40	0.20
Low-Level Gas	50.32	50.00	50.00	0.00
Span Gas	158.20	158.20	157.60	0.30

SO₂ ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	50.27	49.90	49.90	0.00
Span Gas	161.60	161.60	161.20	0.20

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



Lot No. 2244532-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf NRV2 Co., Ltd. Location : HRSG 22
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.10	0.40	0.10	0.40	0.00
Upscale Gas	16.10	15.90	0.80	15.90	0.80	0.00

NO_x ANALYZER

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

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.30	0.15	0.40	0.20	0.05
Upscale Gas	158.20	157.70	0.25	157.60	0.30	0.05

SO₂ ANALYZER

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

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	161.60	161.20	0.20	161.20	0.20	0.00

Calibrated by

(Mr. Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	1
Date	26 May 22	Location	HRSG 22
Start Time	12:05	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	12:25
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:05	14.60	4.10	21.08	0.15	-	
12:06	14.54	4.14	20.95	0.14	-	
12:07	14.50	4.15	21.09	0.13	-	
12:08	14.49	4.17	22.01	0.12	-	
12:09	14.48	4.16	22.44	0.16	-	
12:10	14.47	4.14	22.43	0.13	-	
12:11	14.45	4.18	22.34	0.14	-	
12:12	14.43	4.16	22.41	0.15	-	
12:13	14.42	4.16	22.45	0.12	-	
12:14	14.43	4.15	22.47	0.14	-	
12:15	14.45	4.12	22.44	0.14	-	
12:16	14.45	4.19	22.46	0.15	-	
12:17	14.42	4.21	22.87	0.13	-	
12:18	14.41	4.19	23.43	0.16	-	
12:19	14.43	4.14	23.86	0.15	-	
12:20	14.46	4.12	23.52	0.14	-	
12:21	14.43	4.16	22.89	0.17	-	
12:22	14.42	4.11	22.42	0.17	-	
12:23	14.54	4.12	20.46	0.17	-	
12:24	14.57	4.08	18.31	0.18	-	
12:25	14.59	4.07	16.97	0.18	-	
Average	14.48	4.15	21.87	0.15	#DIV/0!	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	2
Date	26 May 22	Location	HRSG 22
Start Time	12:26	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	12:46
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:26	14.62	4.08	16.02	0.18	-	
12:27	14.62	4.09	15.24	0.18	-	
12:28	14.57	4.09	16.54	0.16	-	
12:29	14.51	4.11	18.31	0.16	-	
12:30	14.47	4.22	20.69	0.18	-	
12:31	14.48	4.13	21.95	0.15	-	
12:32	14.51	4.09	21.58	0.18	-	
12:33	14.55	4.12	20.10	0.19	-	
12:34	14.55	4.11	18.77	0.18	-	
12:35	14.55	4.12	18.47	0.18	-	
12:36	14.55	4.07	18.62	0.19	-	
12:37	14.54	4.08	18.49	0.18	-	
12:38	14.54	4.14	18.12	0.19	-	
12:39	14.56	4.09	18.00	0.18	-	
12:40	14.54	4.07	18.39	0.18	-	
12:41	14.55	4.10	18.71	0.19	-	
12:42	14.56	4.13	18.38	0.18	-	
12:43	14.53	4.13	18.54	0.16	-	
12:44	14.51	4.17	19.57	0.16	-	
12:45	14.50	4.15	20.79	0.17	-	
12:46	14.47	4.14	21.74	0.16	-	
Average	14.54	4.12	18.91	0.18	#DIV/0!	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	3
Date	26 May 22	Location	HRSG 22
Start Time	12:47	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	13:07
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:47	14.48	4.13	22.27	0.16	-	
12:48	14.50	4.10	21.94	0.17	-	
12:49	14.51	4.17	21.19	0.17	-	
12:50	14.53	4.14	20.67	0.21	-	
12:51	14.57	4.05	19.06	0.21	-	
12:52	14.60	4.07	17.75	0.21	-	
12:53	14.62	4.05	16.20	0.19	-	
12:54	14.62	4.09	15.25	0.21	-	
12:55	14.62	4.04	15.00	0.20	-	
12:56	14.61	4.09	15.14	0.21	-	
12:57	14.61	4.11	15.41	0.21	-	
12:58	14.60	4.03	15.62	0.21	-	
12:59	14.61	4.09	15.96	0.20	-	
13:00	14.64	4.02	15.23	0.21	-	
13:01	14.66	4.04	13.89	0.21	-	
13:02	14.67	4.06	13.02	0.20	-	
13:03	14.65	4.04	12.30	0.22	-	
13:04	14.62	4.05	12.74	0.22	-	
13:05	14.61	4.10	13.92	0.19	-	
13:06	14.59	4.08	15.08	0.20	-	
13:07	14.60	4.08	15.42	0.21	-	
Average	14.59	4.08	16.34	0.20	#DIV/0!	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

Lot No. 2259185-1**ANALYZER CALIBRATION DATA**

Client : Gulf NRV2 Co., Ltd. Location : HRSG 21
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.40
Low-Level Gas	8.05	8.00	8.00	0.00
Span Gas	16.06	16.10	15.90	0.80

CO ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.05
Low-Level Gas	49.99	50.00	49.90	0.05
Span Gas	157.50	157.50	157.30	0.10

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group

Lot No. 2259185-1**SYSTEM CALIBRATION BIAS AND DRIFT DATA**

Client : Gulf NRV2 Co., Ltd. Location : HRSG 21
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.10	0.40	0.10	0.40	0.00
Upscale Gas	16.10	15.90	0.80	15.90	0.80	0.00

CO ANALYZER

Cylinder Conc. (ppm) : 157.50 Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.10	0.05	0.05
Upscale Gas	157.50	157.40	0.05	157.30	0.10	0.05

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	1
Date	26 May 22	Location	HRSG 21
Start Time	10:15	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	10:35
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:15	14.65	4.03	-	-	4.34	
10:16	14.64	4.06	-	-	4.45	
10:17	14.64	4.01	-	-	4.42	
10:18	14.64	4.03	-	-	4.32	
10:19	14.64	4.04	-	-	4.36	
10:20	14.64	4.05	-	-	4.38	
10:21	14.65	4.04	-	-	4.41	
10:22	14.66	4.06	-	-	4.34	
10:23	14.67	4.05	-	-	4.40	
10:24	14.67	4.02	-	-	4.36	
10:25	14.67	4.04	-	-	4.35	
10:26	14.73	4.00	-	-	4.35	
10:27	14.73	4.03	-	-	4.31	
10:28	14.72	4.01	-	-	4.35	
10:29	14.73	4.03	-	-	4.33	
10:30	14.73	4.00	-	-	4.37	
10:31	14.71	4.01	-	-	4.37	
10:32	14.71	4.01	-	-	4.39	
10:33	14.71	4.03	-	-	4.32	
10:34	14.71	4.03	-	-	4.42	
10:35	14.68	4.04	-	-	4.33	
Average	14.68	4.03	-	-	4.37	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	2
Date	26 May 22	Location	HRSG 21
Start Time	10:36	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	10:56
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:36	14.66	4.06	-	-	4.36	
10:37	14.65	4.07	-	-	4.32	
10:38	14.65	4.08	-	-	4.34	
10:39	14.64	4.09	-	-	4.34	
10:40	14.63	4.07	-	-	4.34	
10:41	14.63	4.09	-	-	4.33	
10:42	14.66	4.05	-	-	4.35	
10:43	14.66	4.07	-	-	4.35	
10:44	14.66	4.05	-	-	4.37	
10:45	14.68	4.06	-	-	4.31	
10:46	14.75	3.96	-	-	4.21	
10:47	14.71	4.06	-	-	4.21	
10:48	14.67	4.01	-	-	4.34	
10:49	14.65	4.07	-	-	4.36	
10:50	14.65	4.06	-	-	4.37	
10:51	14.66	4.05	-	-	4.40	
10:52	14.65	4.07	-	-	4.29	
10:53	14.65	4.06	-	-	4.34	
10:54	14.65	4.05	-	-	4.30	
10:55	14.66	4.06	-	-	4.29	
10:56	14.66	4.07	-	-	4.37	
Average	14.66	4.06	-	-	4.33	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	3
Date	26 May 22	Location	HRSG 21
Start Time	10:57	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	11:17
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:57	14.65	4.07	-	-	4.30	
10:58	14.66	4.05	-	-	4.36	
10:59	14.66	4.00	-	-	4.37	
11:00	14.66	4.04	-	-	4.39	
11:01	14.66	4.04	-	-	4.36	
11:02	14.66	4.05	-	-	4.36	
11:03	14.66	4.04	-	-	4.37	
11:04	14.65	4.04	-	-	4.32	
11:05	14.64	4.05	-	-	4.32	
11:06	14.65	4.06	-	-	4.32	
11:07	14.66	4.03	-	-	4.33	
11:08	14.70	3.97	-	-	4.31	
11:09	14.71	4.02	-	-	4.29	
11:10	14.73	3.99	-	-	4.28	
11:11	14.75	4.00	-	-	4.33	
11:12	14.71	4.02	-	-	4.31	
11:13	14.71	4.03	-	-	4.31	
11:14	14.70	4.01	-	-	4.32	
11:15	14.66	4.07	-	-	4.32	
11:16	14.65	4.07	-	-	4.32	
11:17	14.64	4.06	-	-	4.31	
Average	14.67	4.04	-	-	4.33	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



Lot No. 2259186-1

ANALYZER CALIBRATION DATA

Client : Gulf NRV2 Co., Ltd. Location : HRSG 22
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.40
Low-Level Gas	8.05	8.00	8.00	0.00
Span Gas	16.06	16.10	15.90	0.80

CO ANALYZER

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.05
Low-Level Gas	49.99	50.00	49.90	0.05
Span Gas	157.50	157.50	157.30	0.10

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group

Lot No. 2259186-1**SYSTEM CALIBRATION BIAS AND DRIFT DATA**

Client : Gulf NRV2 Co., Ltd. Location : HRS22
Date : 26 May 22 Test Operator : Navaphut S.

O₂ ANALYZER

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

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.10	0.40	0.10	0.40	0.00
Upscale Gas	16.10	15.90	0.80	15.90	0.80	0.00

CO ANALYZER

Cylinder Conc. (ppm) : 157.50 Span (ppm) : 200

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.00	0.00	0.10	0.05	0.05
Upscale Gas	157.50	157.40	0.05	157.30	0.10	0.05

Calibrated by

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

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

ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	1
Date	26 May 22	Location	HRSG 22
Start Time	12:05	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	12:25
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:05	14.60	4.10	-	-	2.57	
12:06	14.54	4.14	-	-	2.58	
12:07	14.50	4.15	-	-	2.54	
12:08	14.49	4.17	-	-	2.50	
12:09	14.48	4.16	-	-	2.51	
12:10	14.47	4.14	-	-	2.40	
12:11	14.45	4.18	-	-	2.51	
12:12	14.43	4.16	-	-	2.64	
12:13	14.42	4.16	-	-	2.55	
12:14	14.43	4.15	-	-	2.57	
12:15	14.45	4.12	-	-	2.61	
12:16	14.45	4.19	-	-	2.61	
12:17	14.42	4.21	-	-	2.85	
12:18	14.41	4.19	-	-	2.89	
12:19	14.43	4.14	-	-	2.61	
12:20	14.46	4.12	-	-	2.54	
12:21	14.43	4.16	-	-	2.49	
12:22	14.42	4.11	-	-	2.61	
12:23	14.54	4.12	-	-	2.80	
12:24	14.57	4.08	-	-	2.79	
12:25	14.59	4.07	-	-	2.88	
Average	14.48	4.15	-	-	2.62	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	2
Date	26 May 22	Location	HRSG 22
Start Time	12:26	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	12:46
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:26	14.62	4.08	-	-	3.01	
12:27	14.62	4.09	-	-	3.09	
12:28	14.57	4.09	-	-	3.03	
12:29	14.51	4.11	-	-	2.70	
12:30	14.47	4.22	-	-	2.57	
12:31	14.48	4.13	-	-	2.57	
12:32	14.51	4.09	-	-	2.65	
12:33	14.55	4.12	-	-	2.76	
12:34	14.55	4.11	-	-	2.77	
12:35	14.55	4.12	-	-	2.72	
12:36	14.55	4.07	-	-	2.65	
12:37	14.54	4.08	-	-	2.74	
12:38	14.54	4.14	-	-	2.76	
12:39	14.56	4.09	-	-	2.69	
12:40	14.54	4.07	-	-	2.67	
12:41	14.55	4.10	-	-	2.68	
12:42	14.56	4.13	-	-	2.71	
12:43	14.53	4.13	-	-	2.61	
12:44	14.51	4.17	-	-	2.62	
12:45	14.50	4.15	-	-	2.54	
12:46	14.47	4.14	-	-	2.56	
Average	14.54	4.12	-	-	2.72	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)



EMISSION TEST RESULT

Client	Gulf NRV2 Co., Ltd.	Run #	3
Date	26 May 22	Location	HRSG 22
Start Time	12:47	Test Operator	Navaphut S.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	13:07
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EM	Serial No.	774
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
12:47	14.48	4.13	-	-	2.51	
12:48	14.50	4.10	-	-	2.59	
12:49	14.51	4.17	-	-	2.61	
12:50	14.53	4.14	-	-	2.60	
12:51	14.57	4.05	-	-	2.71	
12:52	14.60	4.07	-	-	2.75	
12:53	14.62	4.05	-	-	2.79	
12:54	14.62	4.09	-	-	2.86	
12:55	14.62	4.04	-	-	2.95	
12:56	14.61	4.09	-	-	2.86	
12:57	14.61	4.11	-	-	2.91	
12:58	14.60	4.03	-	-	2.86	
12:59	14.61	4.09	-	-	2.90	
13:00	14.64	4.02	-	-	3.01	
13:01	14.66	4.04	-	-	3.13	
13:02	14.67	4.06	-	-	3.14	
13:03	14.65	4.04	-	-	3.15	
13:04	14.62	4.05	-	-	3.06	
13:05	14.61	4.10	-	-	3.00	
13:06	14.59	4.08	-	-	2.89	
13:07	14.60	4.08	-	-	2.86	
Average	14.59	4.08	-	-	2.86	

Navaphut S.

(Mr.Navaphut Sriviriya)

Environmental Field Scientist (2)

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A0617	Reference Number:	160-401977168-1
Cylinder Number:	EB0140265	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Dec 22, 2020

Expiration Date: Dec 22, 2028

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	160.0 PPM	158.2 PPM	G1	+/- 0.7% NIST Traceable	12/14/2020, 12/22/2020
CARBON MONOXIDE	160.0 PPM	157.5 PPM	G1	+/- 0.5% NIST Traceable	12/14/2020
NITRIC OXIDE	160.0 PPM	158.1 PPM	G1	+/- 0.7% NIST Traceable	12/14/2020, 12/22/2020
SULFUR DIOXIDE	160.0 PPM	161.6 PPM	G1	+/- 1.0% NIST Traceable	12/14/2020, 12/22/2020
NITROGEN	Balance				

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

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 CO	FTIR	Nov 30, 2020
Nicolet 6700 APW1100391 NO	FTIR	Dec 02, 2020
Nicolet 6700 APW1100391 NO2	FTIR	Dec 02, 2020
Nicolet 6700 APW1100391 SO2	FTIR	Dec 10, 2020

Triad Data Available Upon Request

NOTES:

Gross Weight: 27.7 Kg

Net Weight: 4.7 Kg



Michael A. Fisher
Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

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

Expiration Date: Mar 26, 2028

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	50.00 PPM	50.32 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
CARBON MONOXIDE	50.00 PPM	49.99 PPM	G1	+/- 0.5% NIST Traceable	03/19/2020
NITRIC OXIDE	50.00 PPM	50.32 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
SULFUR DIOXIDE	50.00 PPM	50.27 PPM	G1	+/- 0.8% NIST Traceable	03/19/2020, 03/26/2020
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
NTRM	13010405	KAL003984	97.60 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	13010405	KAL003984	97.60 PPM NOx/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

ANALYTICAL EQUIPMENT

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

Triad Data Available Upon Request

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



Michael A. Miller
Approved for Release

CERTIFICATE OF ANALYSIS

Customer Detail:

ALS Laboratory Group (Thailand)

Production Order Number: 90145553

Material Number: 478100-J-44

Certification Date: 07-Dec-2017

Expiry Date: 07-Dec-2025

Cylinder Description:

STEEL 47 L

The measurement of this reference material is traceable to SI through the reference standard which is traceable to Swiss National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/531 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k=2$, providing a level of confidence of approximately 95%.

Certificate Number:

3983/17

Analyst:

Ariissara T.

ARISSARA THONGNURL

Cylinder Number:

40233

Nominal Cylinder Content:

6.520 M³

Approve:



SUKANYA KAMUTHARAT

Nominal Pressure:

145.0 Bar

Valve Outlet:

CGA 590 BRASS

To Re-Order Please Quote:

478100-J-44

Comment:

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

CERTIFICATE OF ANALYSIS

Analytical Result

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

Reference Standard used in Assay

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

Analytical Instruments used in Assay

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

Method of Analysis

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

Cylinder Number **40233**
Production Order Number **90145553**

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

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

Expiration Date: Nov 11, 2028

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

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

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

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Oct 26, 2020

Triad Data Available Upon Request

NOTES:

Gross Weight: 27.8 Kg

Net Weight: 4.7 Kg



Chaim

Approved for Release



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 4 Jan 22
Next Cal. Date : 4 Jul 22

Barometric Pressure (mm.Hg) : 758
Relative Humidity (%) : 49.0
Temperature : 31.0

Console Control Meter Data

Calibration No. : C-010422-BKK_FS0496
Dry Gas Meter No. : BKK_FS0496
Serial No. : 1412087
Model No. : XC-572-V
Reference Dry Gas Meter ID.: BKK_FS0629
Serial No. : 1607009
Correction Factor (Yr) : 1.0060
Next Calibration Date : 8 Oct 22

ΔH (mm.H ₂ O)	Θ Minutes	Reference Dry Gas Meter Calibration				Console Control : Drygas Meter						Dry Gas Meter Correction Factor (Y)	Orifice Calibration Factor $\Delta H@$	
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Im (°C)			
		Final	Initial	Total		Final	Initial	Total						
15	11.16	150.00	0.00	150.00	32.0	246601.0	246455.0	146.00	33.0	33.0	33.0	1.0354	38.3285	
25	8.73	150.00	0.00	150.00	32.0	246445.0	246300.0	145.00	33.0	33.0	33.0	1.0416	39.0904	
50	6.30	150.00	0.00	150.00	32.0	246286.6	246140.0	146.60	33.0	33.0	33.0	1.0277	40.7149	
100	4.41	150.00	0.00	150.00	32.0	246134.0	245987.0	147.00	33.0	33.0	33.0	1.0200	39.9006	
150	3.60	150.00	0.00	150.00	32.0	245606.0	245461.0	145.00	33.0	33.0	33.0	1.0291	39.8839	
												Avg.	1.0308	39.5837

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

$\Delta H@$: Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH₂O ; tolerance for individual values ± 5.08 from average .

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

Calibrated by:

Chawalit

(Mr. Chawalit Wongchan)
Field Scientist(2)

Approved by:

Mr. Samart Roo-ngan

(Mr.Samart Roo-ngan)
Specialist (1)



Stopwatch Calibration Test Report

Calibration Date : 4 Jan 22 Next Cal. Date : 4 Jul 22
Barometric Pressure (mmHg) : 758 Temperature (°C) : 31.0
Relative Humidity (%) : 49.0

Reference Stopwatch Data

Stopwatch ID No. : E18061
Model : F808
Serial No. : -
Calibration Date : 8 Sep 20
Certificate No. : E-2009018

Console Control Meter Data

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

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:10	5:00	10	0.00017
2	5:00:11	5:00	11	0.00018
3	5:00:12	5:00	12	0.00020
4	5:00:11	5:00	11	0.00018
5	5:00:10	5:00	10	0.00017
6	5:00:10	5:00	10	0.00017
7	5:00:08	5:00	8	0.00013
8	5:00:10	5:00	10	0.00017
9	5:00:12	5:00	12	0.00020
10	5:00:11	5:00	11	0.00018
			Average	0.00018
			SD	0.00002

Calibrate by :

Mr. Chawalit Wongchan

Field Scientist (2)

Approved by :

Mr. Samart Roo-ngan

Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	4 Jan 22	Ambient Temperature (°C) :	31
Calibration sheet No. :	C-040122-BKK_FS0497	Relative Humidity (%) :	49

Digital Temperature ID	BKK_FS0497	Reference Temperature ID :	BKK_FS0609
Serial No. :	1412087	Serial No. :	7688004
Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	4 Jul 22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	25	0	
	50	50	0	
	100	100	0	
	150	150	0	
	200	199	-1	
	250	249	-1	
	300	299	-1	
	500	499	-1	
	1000	999	-1	
	1200	1199	-1	
Probe	100	100	0	
	125	125	0	
	150	150	0	
Oven	100	100	0	
	125	125	0	
	150	151	1	
Filter	100	100	0	
	125	125	0	
	150	150	0	
Exit	0	1	1	
	10	11	1	
	20	21	1	
Meter	0	1	1	
	25	26	1	
	50	51	1	
AUX	0	0	0	
	25	25	0	
	50	50	0	

Calibrated by : _____

Chawalit
(Mr. Chawalit Wongchan)
Field Scientist (2)

Approved by : _____

Samart
(Mr. Samart Roo-ngan)
Specialist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0500

Calibration Date : 4 Jan 22

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

Standard Pitot ID : BKK_FS0441

Calibration Sheet No. : C-040122-BKK_FS0500

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
\bar{C}_p				0.842	0.842

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

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

$$\text{Average deviation}(A \text{ or } B) = \frac{\sum_1^3 [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by : Chawalit

(Mr. Chawalit Wongchan)
Field Scientist (2)

Approved by : [Signature]

(Mr. Samart Roo-ngan)
Field Specialist (1)



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0501

Calibration Date : 4 Jan 22

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

Standard Pitot ID : BKK_FS0441

Calibration Sheet No. : C-040122-BKK_FS0501

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
				\bar{C}_p	0.842

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

$$| \bar{C}_p(A) - \bar{C}_p(B) | \text{ must } BE \leq 0.01$$

$$\text{Average deviation}(A \text{ or } B) = \frac{\sum_1^3 [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by :

Chawalit

(Mr. Chawalit Wongchan)
Field Scientist (2)

Approved by :

Samart

(Mr. Samart Roo-ngan)
Field Specialist (1)



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	4 Jan 22	Nozzle Set ID. :	BKK_FS0502
Calibration Sheet No. :	C-040122-228-2-32-07	Vernier Caliper ID. :	BKK_FS0626

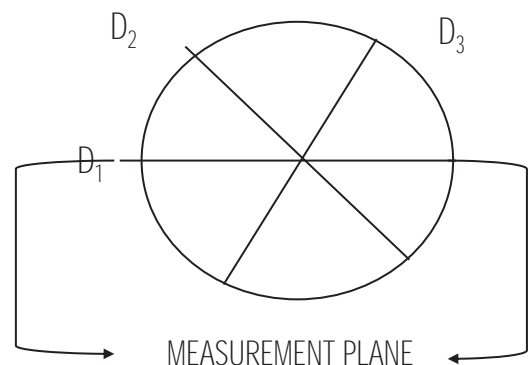
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270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

Where :

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

ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.

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



Calibrated by : Chawalit

(Mr. Chawalit Wongchan)
Field Scientist (2)

Approved by : [Signature]

Mr. Samart Roo-ngan
Field Specialist (1)



Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/21161

Certificate No.:	PTC/07/21161	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	38304165
Model:	SECURA224-1S	ID No:	BKK_EN0309
Type of Balance:	Single interval		



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

Environment Condition: Temperature 23.8 °C ± 0.4 °C
Humidity 58.1 %RH ± 0.7 %RH
Air density 1.18 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40, Phatthanakarn Rd.,
Khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.



The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: December 16, 2021

Calibration Date: December 16, 2021

Issued Date: December 20, 2021

Calibration By: Mr. Keattisak Kerdto



PENTA CALIBRATION CO., LTD.

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Mr. Keattisak Kerdto)

Laboratory Manager

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/21161

Certificate No.: PTC/07/21161

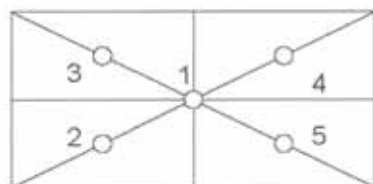
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Internal Calibration

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	0.0000	-0.0001	-0.0001
Maximum deviation:			0.0001	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
200	0.00004

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00013	2.37
0.01	0.01000	0.0100	0.0000	0.00028	2.00
0.1	0.10000	0.1000	0.0000	0.00015	2.12
1	1.00000	1.0000	0.0000	0.00014	2.18
2	2.00000	2.0000	0.0000	0.00014	2.20
5	5.00001	5.0000	0.0000	0.00014	2.20
10	10.00000	10.0000	0.0000	0.00014	2.20
20	20.00003	20.0000	0.0000	0.00014	2.18
50	50.00004	50.0000	0.0000	0.00015	2.11
100	100.00004	100.0000	0.0000	0.00018	2.05
200	200.00011	200.0000	0.0001	0.00025	2.00

Note: Weight of adjust - (g)

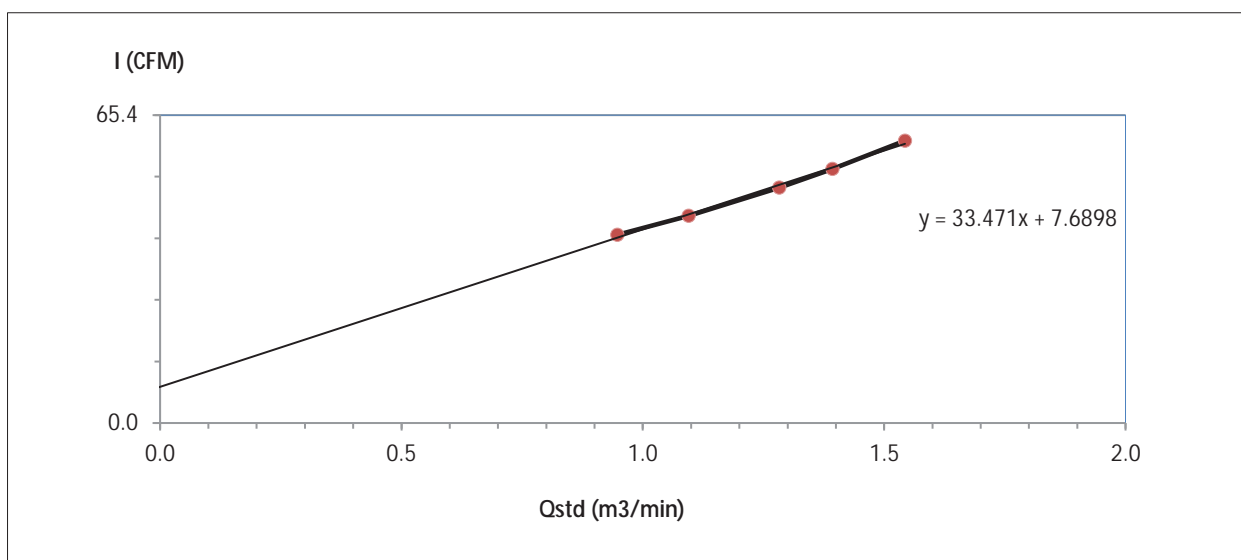
The End of Certificate



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NRV2 Co.,Ltd.	Barometric Pressure (mm Hg) :	743
Calibrate Location :	โรงเรียนบ้านหนองดาง	Temperature (°C) :	33
Calibrate Date :	23-May-22	High Volume ID :	NKH_FS0050
CalibrationSheet No.:	C-230522-NKH_FS0050	High Volume Model :	TE-5170D
Calibrator ID:	NKH_FS0044	High Volume S/N :	5853
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64919
Calibrator S/N :	3681	Calibrator Intercept :	-0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.9475	40	Slope : 33.4705 Intercept : 7.6898 Correlation Coefficient : 0.9973
2	3.0	1.0947	44	
3	4.2	1.2825	50	
4	5.0	1.3929	54	
5	6.2	1.5431	60	



Calibrated by

Sangtawan N.

(Mr.Sangtawan Natasat)
Field Scientist(1)

Approved by :

N. Pong

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

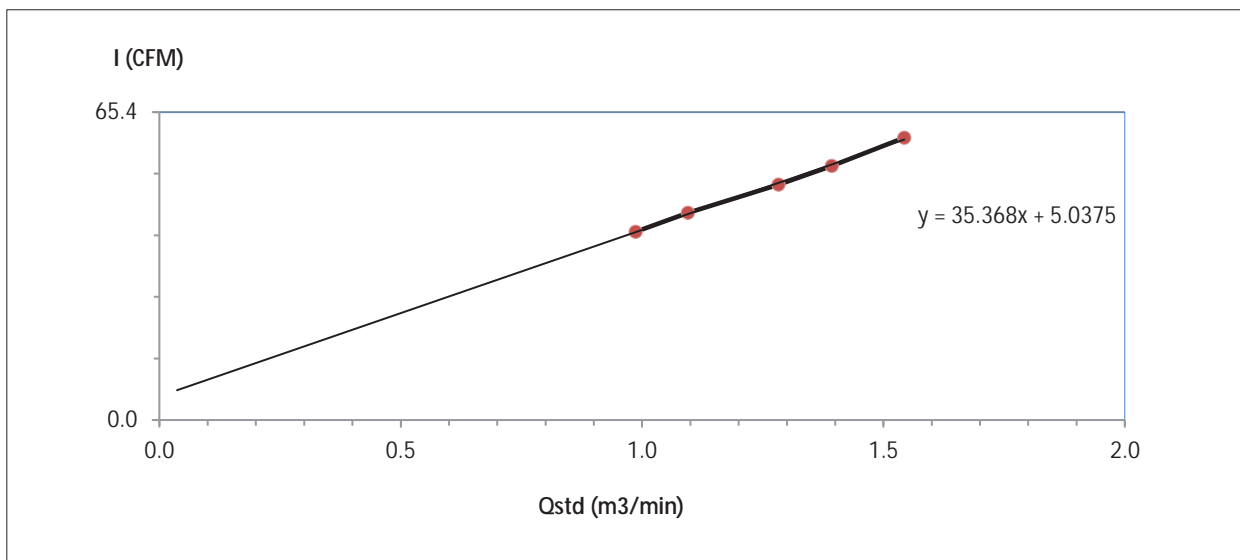


High Volume Air Sampler Calibration Worksheet

Project Site : GulfNRV2 Co.,Ltd.
Calibrate Location : โรงเรียนบ้านมาบมะค่า
Calibrate Date : 23-May-22
Calibration Sheet No.: C-230522-NKH_FS0051
Calibrator ID: NKH_FS0044
Calibrator Model : TE-5028A
Calibrator S/N : 3681

Barometric Pressure (mm Hg) : 743
Temperature (°C) : 33
High Volume ID : NKH_FS0051
High Volume Model : TE-5170D
High Volume S/N : 5854
Calibrator Slope : 1.64919
Calibrator Intercept : -0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.9865	40	Slope : 35.3682 Intercept : 5.0375 Correlation Coefficient : 0.9991
2	3.0	1.0947	44	
3	4.2	1.2825	50	
4	5.0	1.3929	54	
5	6.2	1.5431	60	



Calibrated by Sangtawan N.
(Mr.Sangtawan Natasat)
Field Scientist(1)

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

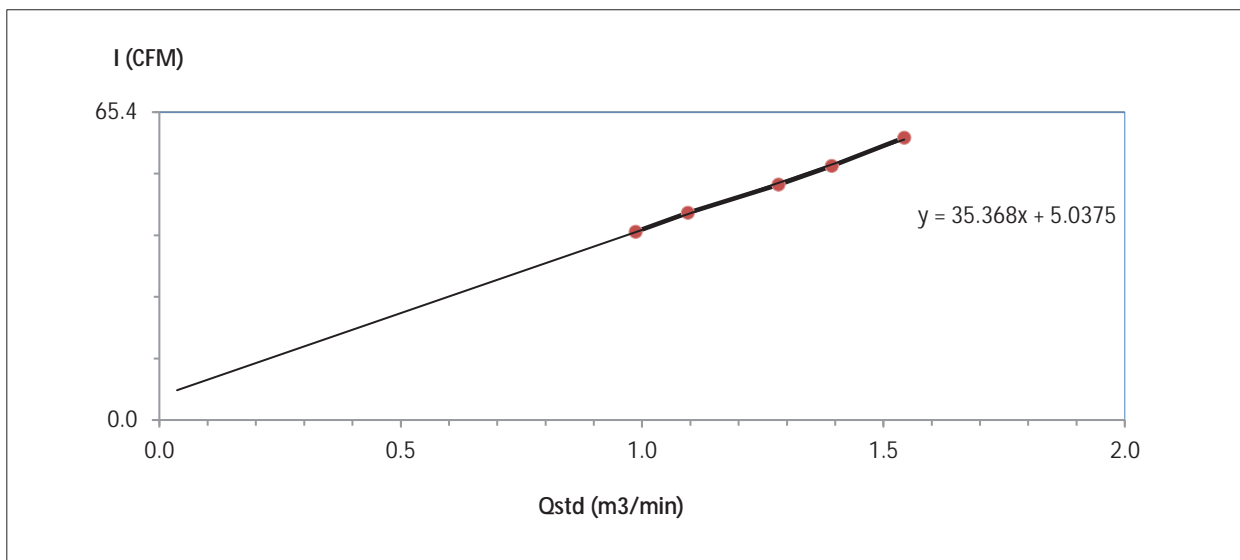


High Volume Air Sampler Calibration Worksheet

Project Site : GulfNRV2 Co.,Ltd.
Calibrate Location : โรงพยาบาลส่งเสริมสุขภาพตำบลหนองปลิง
Calibrate Date : 23-May-22
Calibration Sheet No.: C-230522-NKH_FS0049
Calibrator ID: NKH_FS0044
Calibrator Model : TE-5028A
Calibrator S/N : 3681

Barometric Pressure (mm Hg) : 743
Temperature (°C) : 33
High Volume ID : NKH_FS0049
High Volume Model : TE-5170D
High Volume S/N : 5852
Calibrator Slope : 1.64919
Calibrator Intercept : -0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.9865	40	Slope : 35.3682 Intercept : 5.0375 Correlation Coefficient : 0.9991
2	3.0	1.0947	44	
3	4.2	1.2825	50	
4	5.0	1.3929	54	
5	6.2	1.5431	60	



Calibrated by Sangtawan N.
(Mr.Sangtawan Natasat)
Field Scientist(1)

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

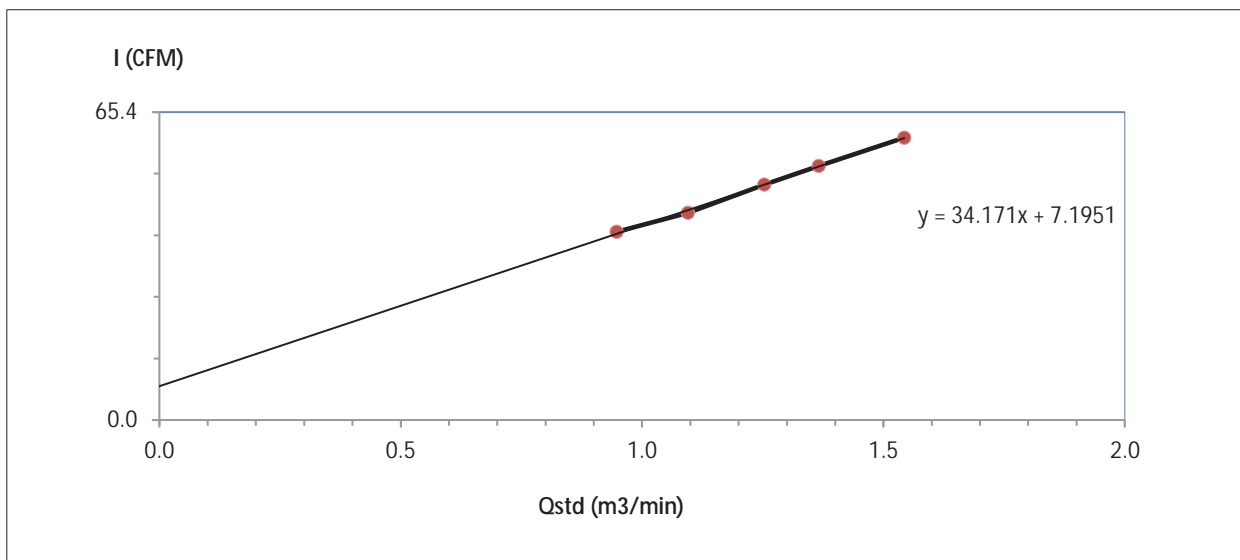


High Volume Air Sampler Calibration Worksheet

Project Site : GulfNRV2 Co.,Ltd.
Calibrate Location : วัดใหม่หนองบอน
Calibrate Date : 23-May-22
Calibration Sheet No.: C-230522-NKH_FS0052
Calibrator ID: NKH_FS0044
Calibrator Model : TE-5028A
Calibrator S/N : 3681

Barometric Pressure (mm Hg) : 743
Temperature (°C) : 33
High Volume ID : NKH_FS0052
High Volume Model : TE-5170D
High Volume S/N : 5855
Calibrator Slope : 1.64919
Calibrator Intercept : -0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.9475	40	Slope : 34.1709 Intercept : 7.1951 Correlation Coefficient : 0.9989
2	3.0	1.0947	44	
3	4.0	1.2533	50	
4	4.8	1.3662	54	
5	6.2	1.5431	60	



Calibrated by Sangtawan N.
(Mr.Sangtawan Natasat)
Field Scientist(1)

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



Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.:	PTC/07/22072	Page:	1 of 3
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	METTLER TOLEDO	Serial No:	1123091884
Model:	XP105	ID No:	BKK_EN0004
Type of Balance:	Multi interval		



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

Environment Condition: Temperature 21.0 °C ± 0.4 °C
Humidity 62.8 %RH ± 3.7 %RH
Air density 1.20 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.



The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO., LTD.

(Mr.Kriangsak Kalasri)
Reviewed by

Approved By :

(Mr. Keattisak Kerdto)
Laboratory Manager

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

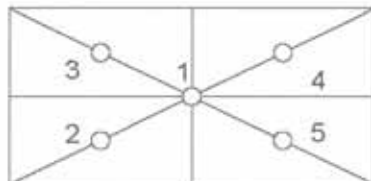
Page: 2 of 3

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 30 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	0.0000	0.0000	0.0000
Maximum deviation:			0.0000	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
100	0.00005

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
40	40.00005	40.0000	0.0000	0.00016	2.11
50	50.00001	50.0000	0.0000	0.00015	2.13
60	60.00003	60.0000	0.0000	0.00016	2.08
70	70.00003	70.0000	0.0000	0.00017	2.07
80	80.00005	80.0001	-0.0001	0.00019	2.04
90	90.00006	90.0001	0.0000	0.00020	2.03
100	100.00002	99.9999	0.0001	0.00018	2.06

Note: Weight of adjust - (g)



Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

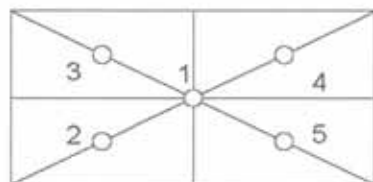
Page: 3 of 3

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 30 (g)

Position (g)				
1	2	3	4	5
0.00000	-0.00001	-0.00002	0.00000	0.00000
Maximum deviation:			0.00002	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.00001 (g)

Nominal test value (g)	Standard Deviation
20	0.000005

Error of indication : from nominal value., Readability 0.00001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.000000	0.00000	0.00000	0.000016	2.52
0.1	0.100000	0.10000	0.00000	0.000019	2.00
0.5	0.499999	0.50000	0.00000	0.000019	2.00
2	2.000010	1.99999	0.00002	0.000024	2.00
5	5.000005	5.00001	0.00000	0.000027	2.00
10	10.000015	10.00001	0.00000	0.000031	2.00
20	20.000019	20.00001	0.00001	0.000042	2.00
30	30.000034	30.00006	-0.00003	0.000069	2.00

Note: Weight of adjust - (g)

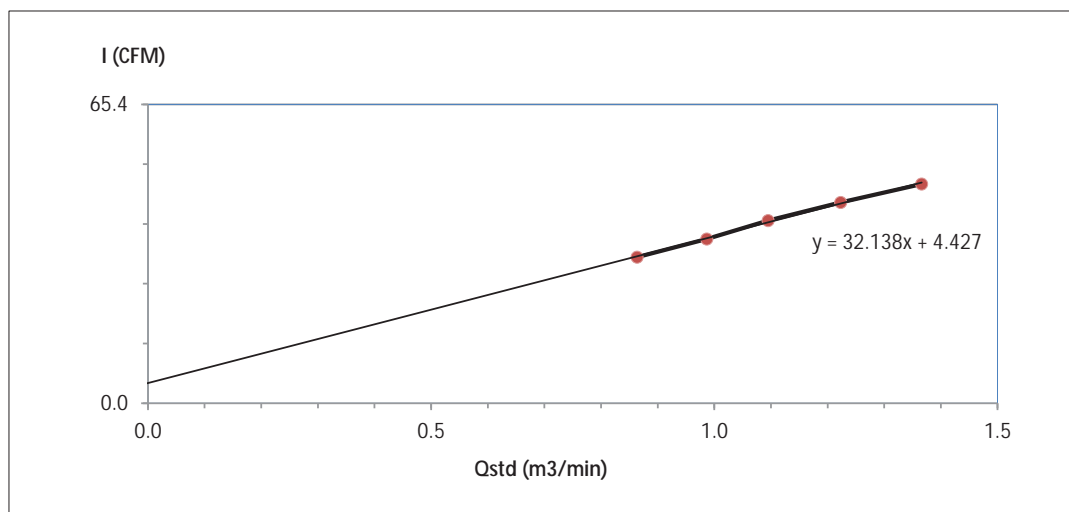
The End of Certificate



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NRV2 Co.,Ltd.	Barometric Pressure (mm Hg) :	743
Calibrate Location :	โรงเรียนบ้านหนองตาก	Temperature (°C) :	33
Calibrate Date :	23-May-22	High Volume ID :	NKH_FS0046
CalibrationSheet No.:	C-230522-NKH_FS0046	High Volume Model :	TE-5009X
Calibrator ID:	NKH_FS0044	High Volume S/N :	5847
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64919
Calibrator S/N :	3681	Calibrator Intercept :	-0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.8637	32	Slope : 32.1377 Intercept : 4.4270 Correlation Coefficient : 0.9988
2	2.4	0.9865	36	
3	3.0	1.0947	40	
4	3.8	1.2233	44	
5	4.8	1.3662	48	



Calibrated by Sangtawan N.
 (Mr.Sangtawan Natasat)
 Field Scientist(1)

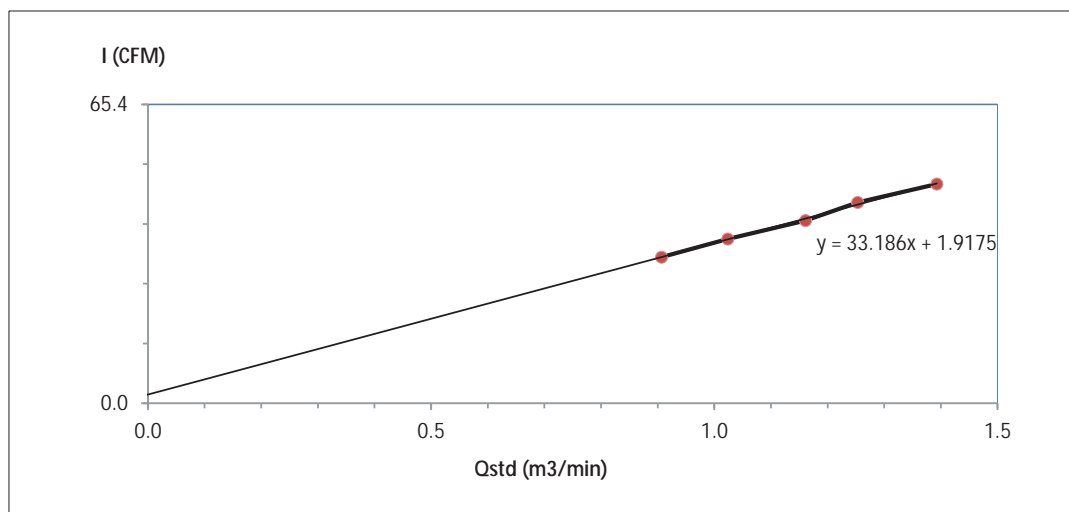
Approved by : [Signature]
 (Mr. Noppong Juntarupan)
 Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NRV2 Co.,Ltd.	Barometric Pressure (mm Hg) :	743
Calibrate Location :	โรงเรียนบ้านมาบมะค่า	Temperature (°C) :	33
Calibrate Date :	23-May-22	High Volume ID :	NKH_FS0047
Calibration Sheet No.:	C-230522-NKH_FS0047	High Volume Model :	TE-5009X
Calibrator ID:	NKH_FS0044	High Volume S/N :	5848
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64919
Calibrator S/N :	3681	Calibrator Intercept :	-0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9067	32	Slope : 33.1862 Intercept : 1.9175 Correlation Coefficient : 0.9985
2	2.6	1.0240	36	
3	3.4	1.1609	40	
4	4.0	1.2533	44	
5	5.0	1.3929	48	



Calibrated by Sangtawan N.
(Mr.Sangtawan Natasat)
Field Scientist(1)

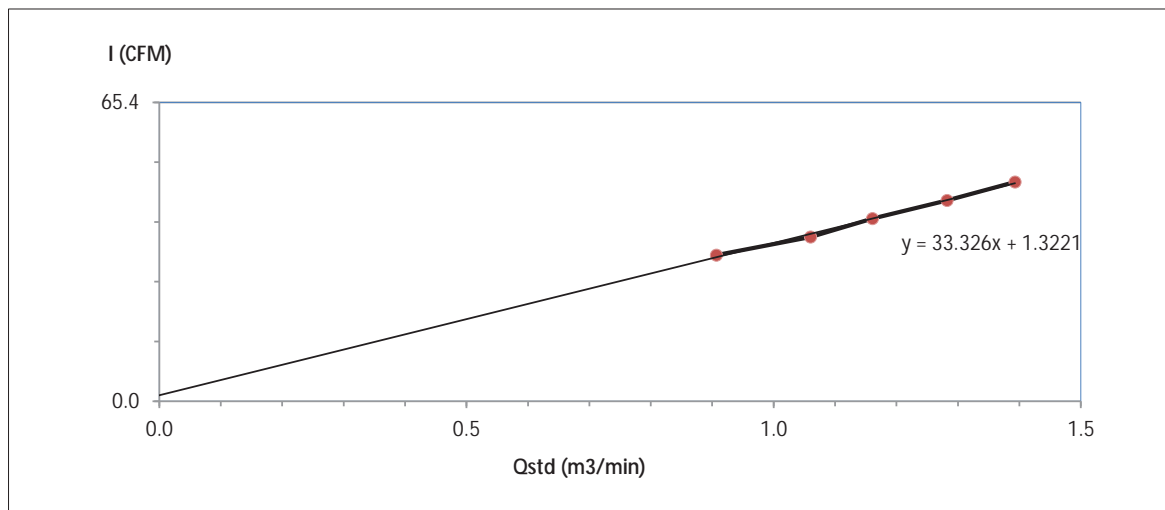
Approved by : N. Pongjuntarup
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NRV2 Co.,Ltd.	Barometric Pressure (mm Hg) :	743
Calibrate Location :	โรงพยาบาลส่งเสริมสุขภาพส่วนตำบลหนองปลิง	Temperature (°C) :	33
Calibrate Date :	23-May-22	High Volume ID :	NKH_FS0048
CalibrationSheet No.:	C-230522-NKH_FS0048	High Volume Model :	TE-5009X
Calibrator ID:	NKH_FS0044	High Volume S/N :	5849
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64919
Calibrator S/N :	3681	Calibrator Intercept :	-0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9067	32	Slope : 33.3261 Intercept : 1.3221 Correlation Coefficient : 0.9978
2	2.8	1.0600	36	
3	3.4	1.1609	40	
4	4.2	1.2825	44	
5	5.0	1.3929	48	



Calibrated by Sangtawan N.

(Mr.Sangtawan Natasat)
Field Scientist(1)

Approved by : N. Pong

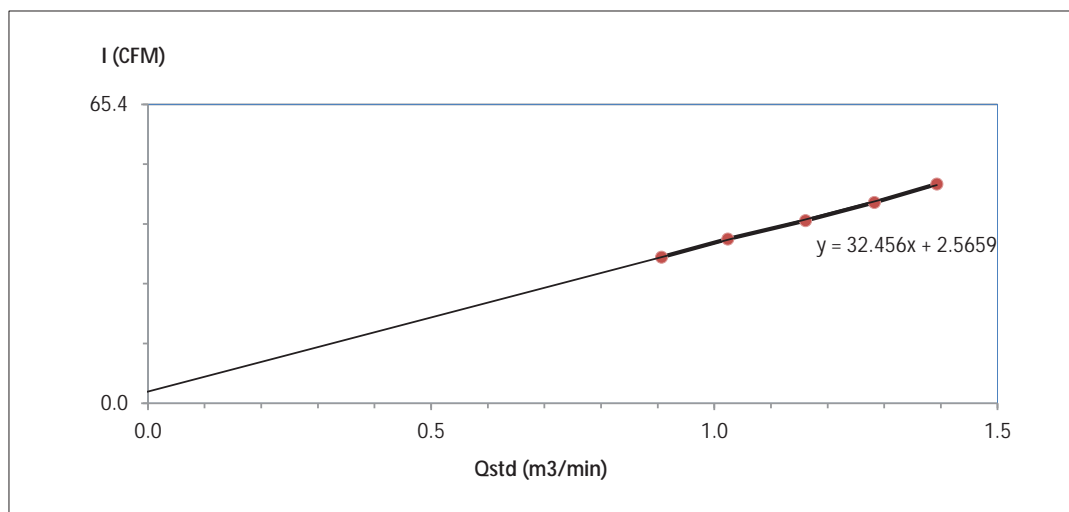
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NRV2 Co.,Ltd.	Barometric Pressure (mm Hg) :	743
Calibrate Location :	วัดใหม่หนองบอน	Temperature (°C) :	33
Calibrate Date :	23-May-22	High Volume ID :	NKH_FS0045
CalibrationSheet No.:	C-230522-NKH_FS0045	High Volume Model :	TE-5009X
Calibrator ID:	NKH_FS0044	High Volume S/N :	5846
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64919
Calibrator S/N :	3681	Calibrator Intercept :	-0.06996

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9067	32	Slope : 32.4559 Intercept : 2.5659 Correlation Coefficient : 0.9994
2	2.6	1.0240	36	
3	3.4	1.1609	40	
4	4.2	1.2825	44	
5	5.0	1.3929	48	



Calibrated by Sangtawan N.
 (Mr.Sangtawan Natasat)
 Field Scientist(1)

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

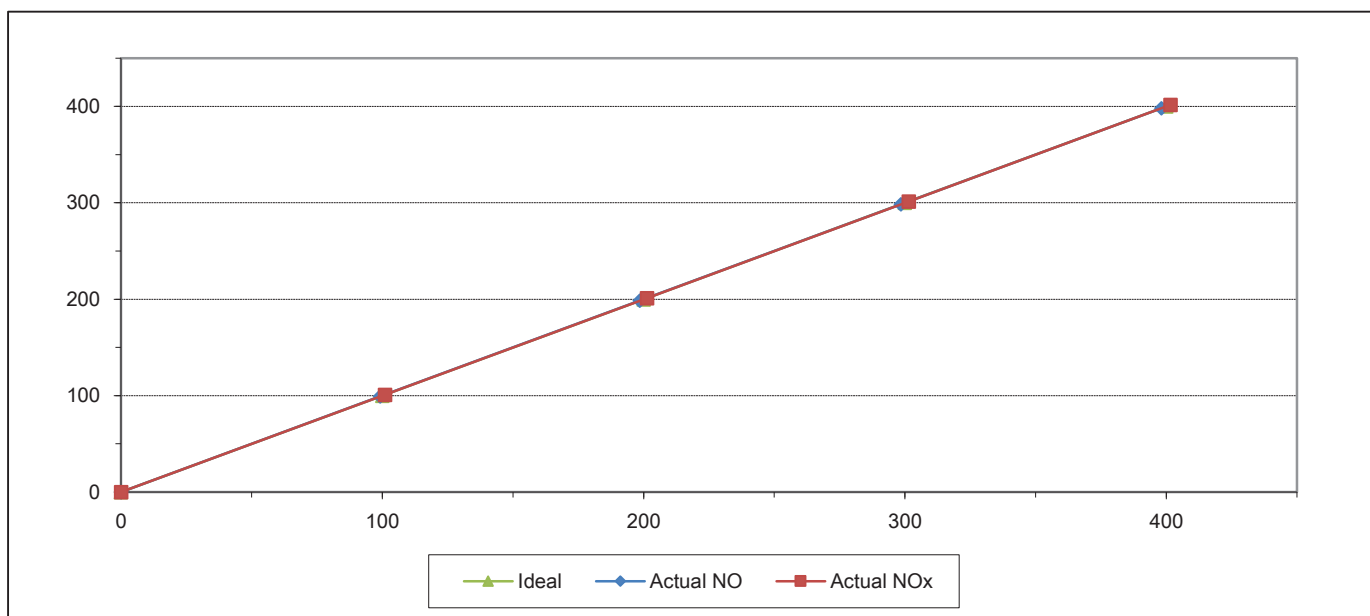


MULTIPOINT CALIBRATION REPORT

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

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID NKH_FS0080
Model 700
Cylinder No. LL36633
Certified By Airgas Inc.
Expired Date 18-Mar-22

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	101.00	1.00	1.00
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.50	-1.50	-0.50	301.50	1.50	0.50
4	400.00	398.20	-1.80	-0.45	401.60	1.60	0.40
AVERAGE (%)				-0.48			0.53



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

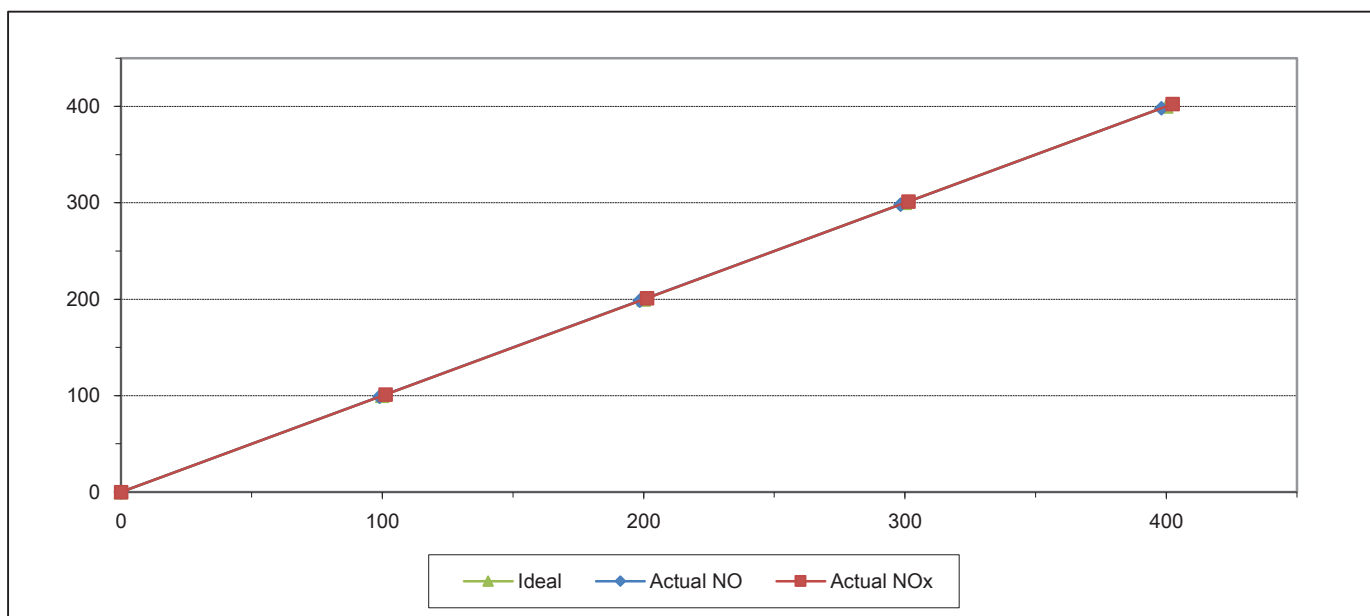


MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22
Manufacturer HORIBA
Serial No. GE3G2AB
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 51.33
Cylinder Pressure (psi) 1200
Certified Date 18-Mar-14

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID NKH_FS0084
Model 700
Cylinder No. LL36633
Certified By Airgas Inc.
Expired Date 18-Mar-22

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.30	1.30	1.30
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.40	-1.60	-0.53	301.40	1.40	0.47
4	400.00	398.20	-1.80	-0.45	402.50	2.50	0.63
AVERAGE (%)				-0.53			0.63



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

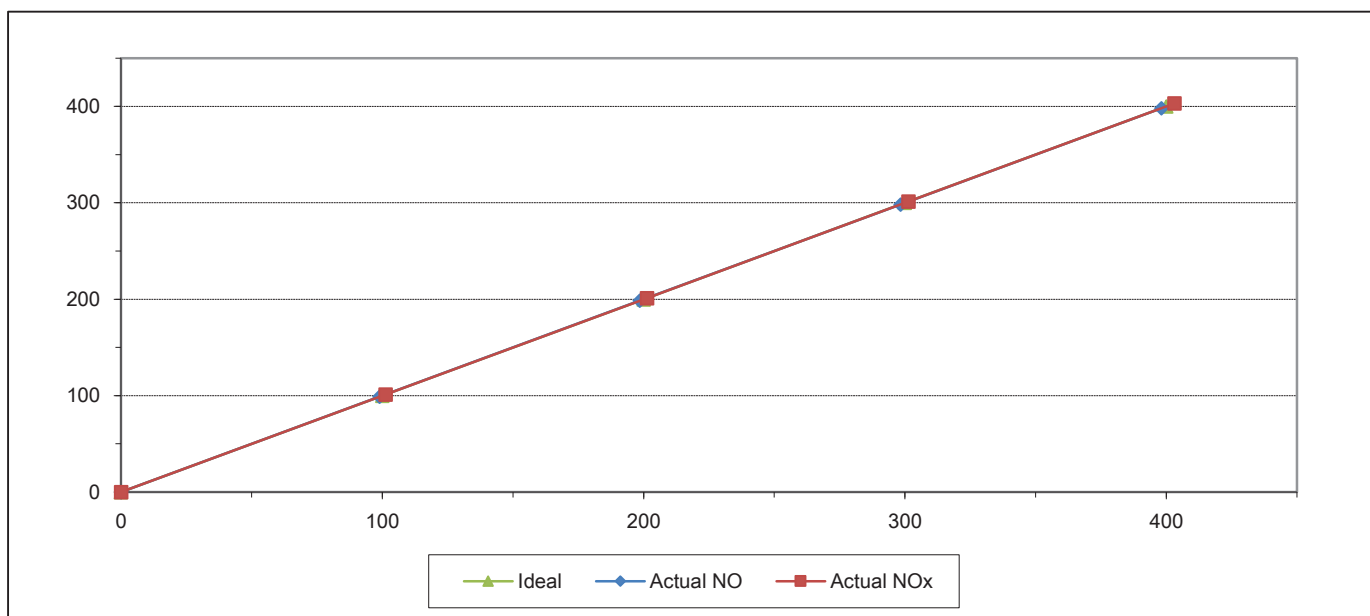


MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22
Manufacturer HORIBA
Serial No. MB63MPX3
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 51.33
Cylinder Pressure (psi) 1200
Certified Date 18-Mar-14

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID NKH_FS0082
Model 700
Cylinder No. LL36633
Certified By Airgas Inc.
Expired Date 18-Mar-22

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.30	1.30	1.30
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.40	-1.60	-0.53	301.40	1.40	0.47
4	400.00	398.20	-1.80	-0.45	403.20	3.20	0.80
AVERAGE (%)				-0.53			0.66



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

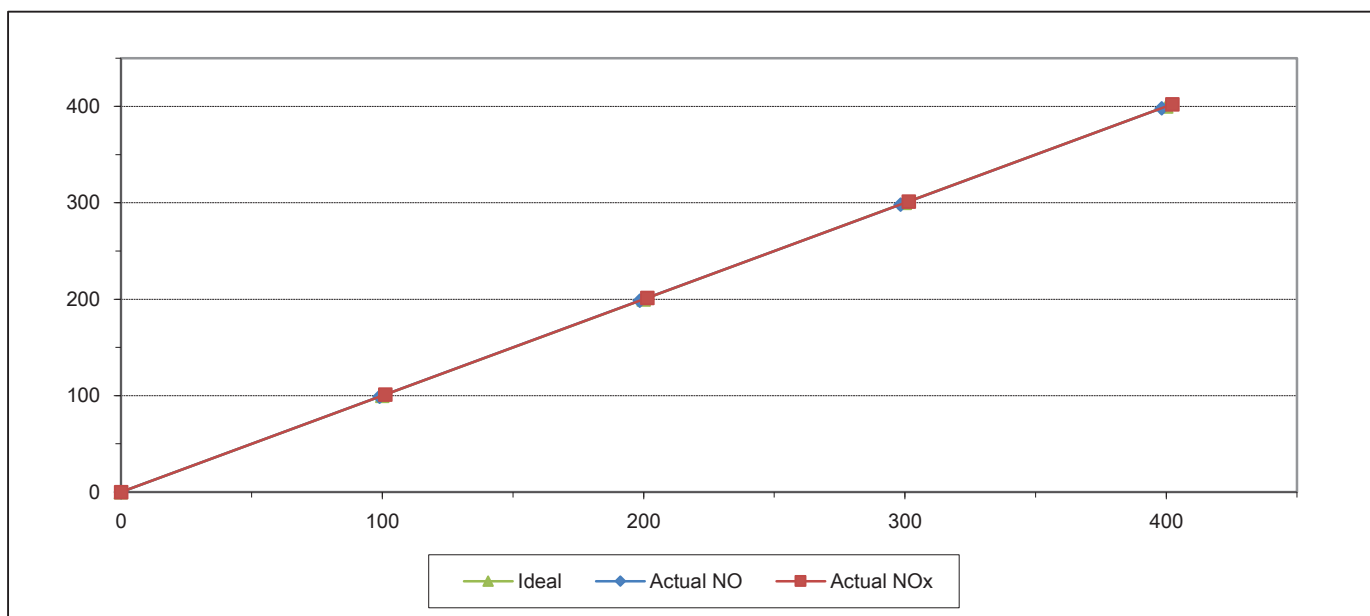


MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-22
Manufacturer HORIBA
Serial No. R2T8H8XTY
Calibrator Manufacturer Teledyne API
Serial No. 947
Std. Gas Concentration (PPM) 51.33
Cylinder Pressure (psi) 1200
Certified Date 18-Mar-14

Equipment Name NOx Analyzer
Model APNA-370
Equipment ID NKH_FS0078
Model 700
Cylinder No. LL36633
Certified By Airgas Inc.
Expired Date 18-Mar-22

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.20	1.20	1.20
2	200.00	198.50	-1.50	-0.75	201.50	1.50	0.75
3	300.00	298.40	-1.60	-0.53	301.50	1.50	0.50
4	400.00	398.30	-1.70	-0.42	402.30	2.30	0.58
AVERAGE (%)				-0.52			0.63



Calibrated By

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

Approved By

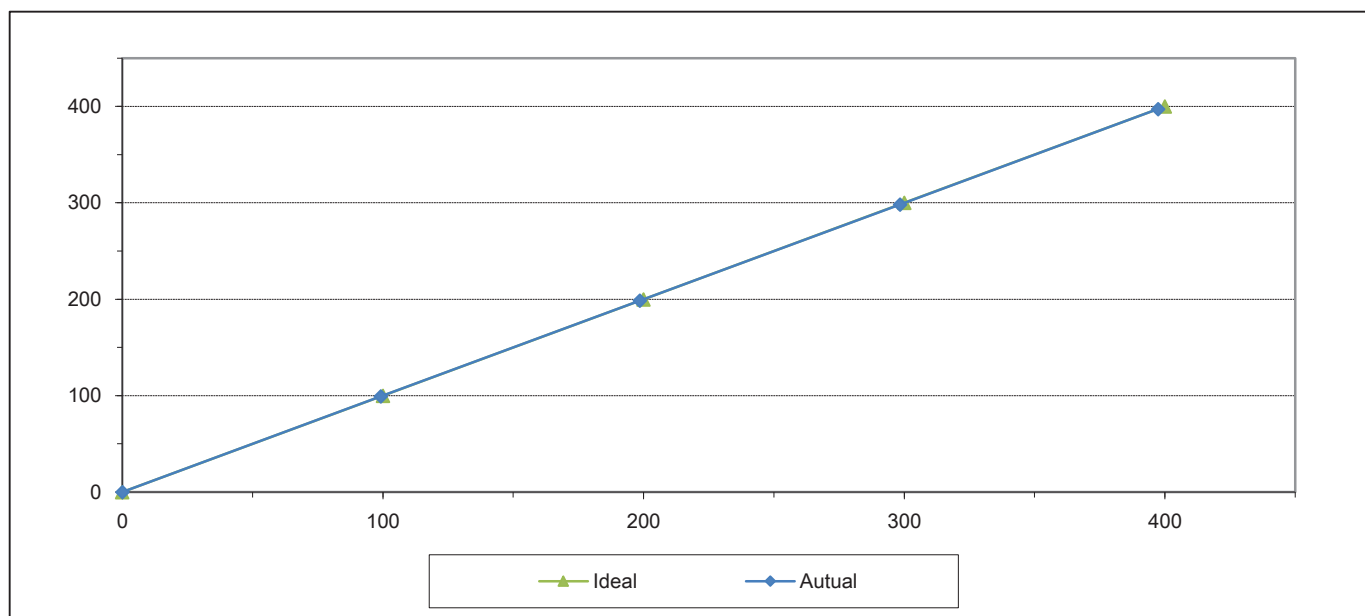
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	JVU4R449	Equipment ID	NKH_FS0081
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80
2	200.00	198.60	-1.40	-0.70
3	300.00	298.40	-1.60	-0.53
4	400.00	397.40	-2.60	-0.65
AVERAGE (%)				-0.52



Calibrated By

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

Approved By

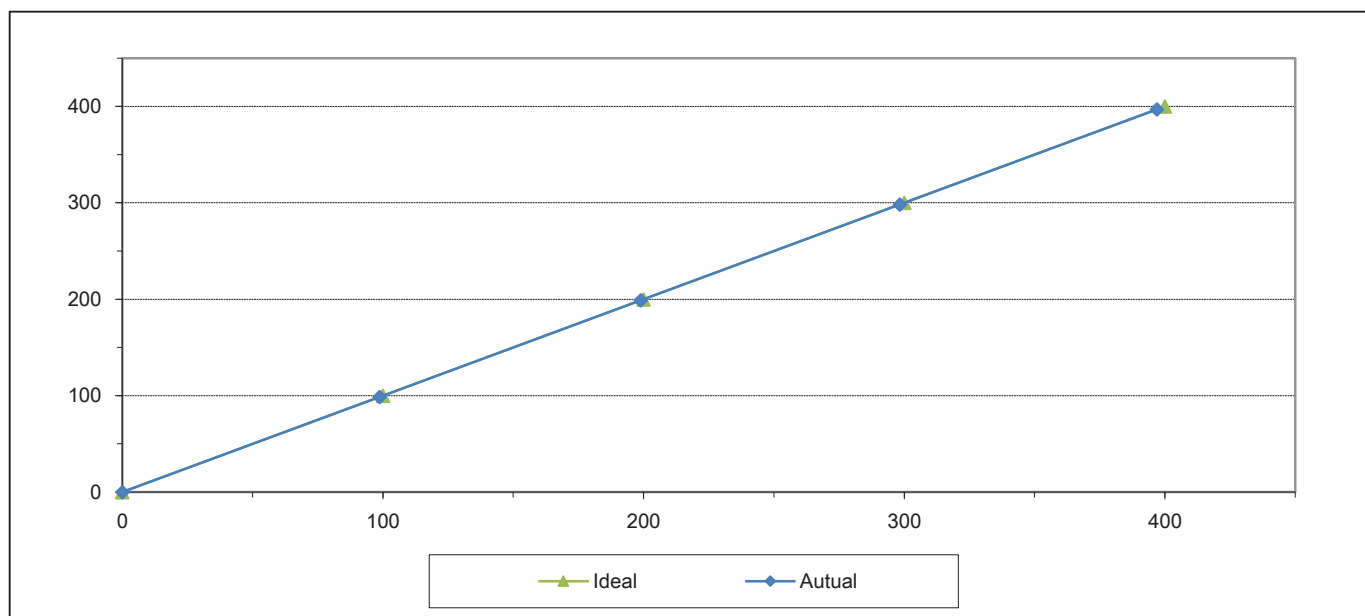
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	YKKOE3MP	Equipment ID	NKH_FS0085
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20
2	200.00	198.90	-1.10	-0.55
3	300.00	298.30	-1.70	-0.57
4	400.00	397.00	-3.00	-0.75
AVERAGE (%)				-0.59



Calibrated By

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

Approved By

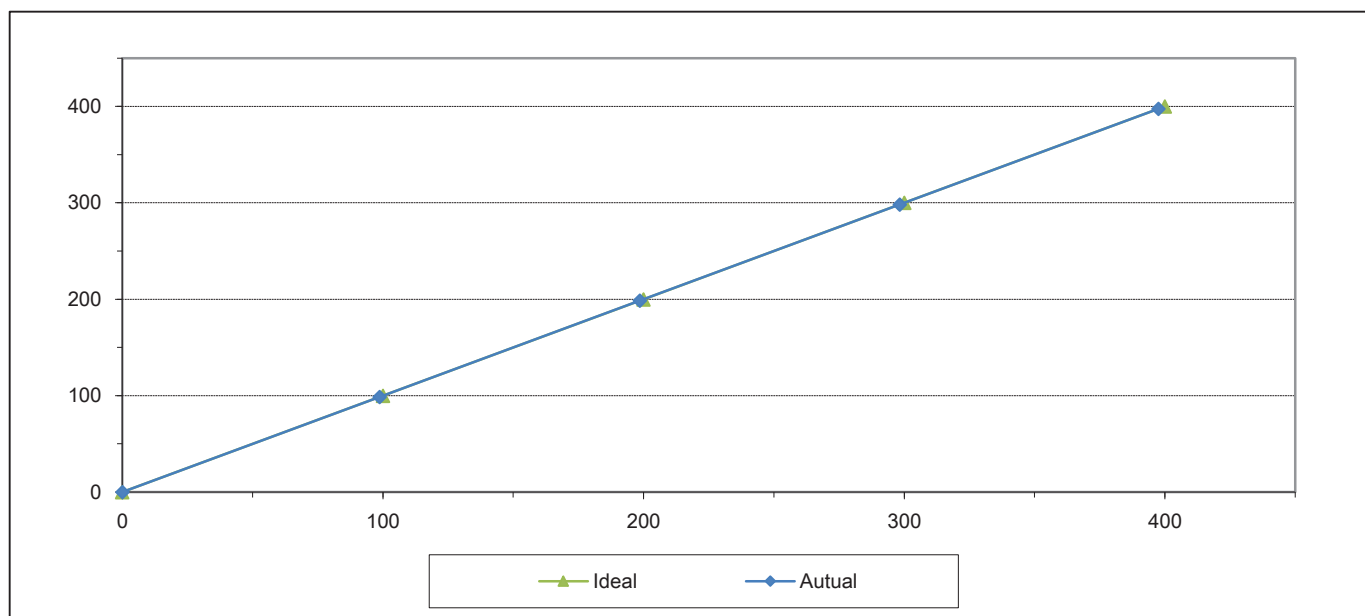
(Mr.Sarayuth Jittranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	SMWOLFJB	Equipment ID	NKH_FS0083
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20
2	200.00	198.60	-1.40	-0.70
3	300.00	298.30	-1.70	-0.57
4	400.00	397.50	-2.50	-0.63
AVERAGE (%)				-0.60



Calibrated By

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

Approved By

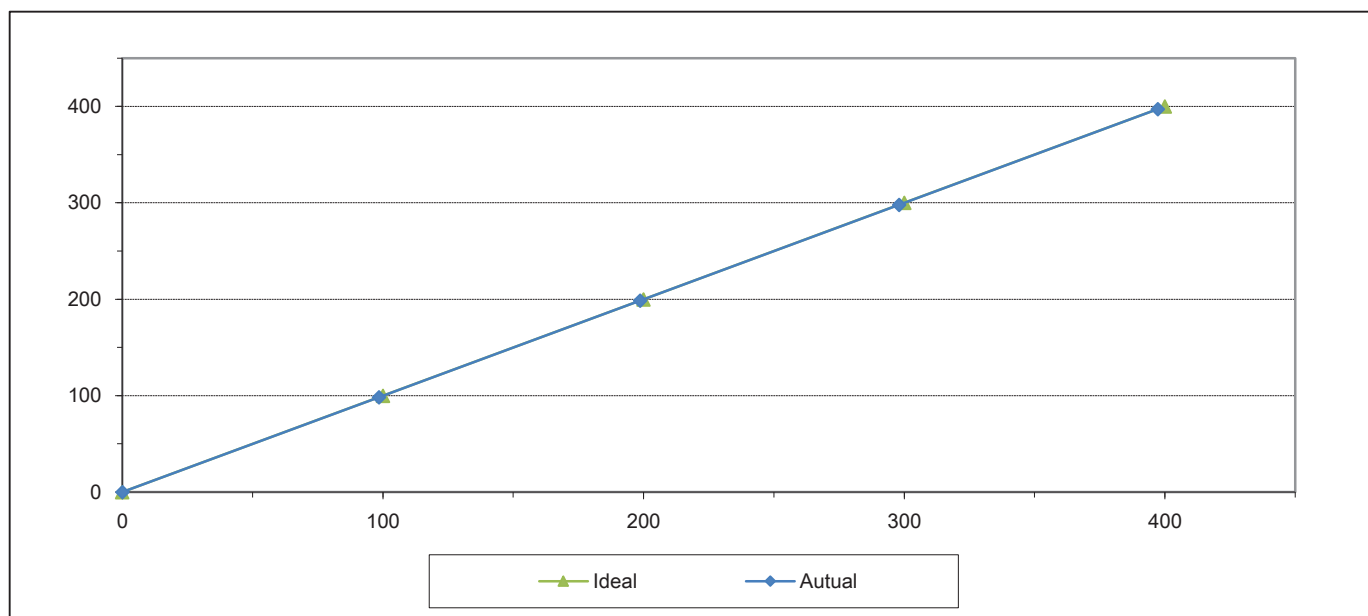
(Mr.Sarayuth Jittrantont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	C6GMRU6P	Equipment ID	NKH_FS0079
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	50.87	Cylinder No.	LL36633
Cylinder Pressure (psi)	1200	Certified By	Airgas Inc.
Certified Date	18-Mar-14	Expired Date	18-Mar-22

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.50	-1.50	-1.50
2	200.00	198.70	-1.30	-0.65
3	300.00	298.00	-2.00	-0.67
4	400.00	397.30	-2.70	-0.67
AVERAGE (%)				-0.68



Calibrated By

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

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-10072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 110-WS-25DL-N.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5488.
: Cup anemometer: WSD-008.

ID No : Data logger: NKH_FS0054.
: Cup anemometer: -.

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.1 ±0.8 °C
: Air pressure 1008.7 ±0.4 hPa
: Relative air humidity 60.1 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
: IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
: MCASNET Anemometer Calibration Procedure - Version 2: 2009;

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

Measurement Date : Jul 20, 2021.

Issued Date : Jul 21, 2021.

REVIEW BY *Harikorn P.*
APPROVED BY *[Signature]*
NEXT CAL. DATE 18/1/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orethai Wiwatwittaya



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-10072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V _{STD} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.049	1.9	-0.1	2.5
4.087	4.1	0.0	1.2
5.99	6.0	0.0	1.1
8.00	8.0	0.0	1.1
10.00	10.1	0.1	0.82
12.00	12.3	0.3	0.55
13.99	14.4	0.4	0.65
15.99	16.4	0.4	0.41
15.00	15.3	0.3	0.57
13.00	13.3	0.3	0.66
11.02	11.3	0.3	0.61
9.02	9.2	0.2	0.73
6.98	7.0	0.0	1.0
5.135	5.1	0.0	0.98
2.961	3.0	0.0	1.9
1.042	0.9	-0.1	5.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 - 1100 hPa
7	Wind tunnel	ESSOM	MP3300	-	-	0 - 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-10072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Wind direction sensor: WS-02F.

Serial Number : Data logger: A5488.
: Wind direction sensor: WSD-008.

ID No : Data logger: NKH_FS0054.
: Wind direction sensor: -.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23\pm3)^{\circ}\text{C}$. and relative humidity of $(40\pm10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045.
Certificate No.: KWS63/0044.

Measurement Date : Jul 20, 2021.

Issued Date : Jul 21, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-10072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	317	2	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	317	2	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CL-054-64

Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx

Model : 110-WS-25DL-N

Serial No. : A5488

ID No. : NKH_FS0054

Customer

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

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

Received date : 15 Jul 2021

Calibration date : 22 Jul 2021

Issue date : 22 Jul 2021

Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022

2. Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

☒ Mr. Sorawit Thachalad

☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R3140637

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.054	20.0	-0.1	0.081
60	24.885	24.9	0.0	0.081
60	29.863	29.9	0.0	0.081
60	34.851	34.8	-0.1	0.081
60	39.841	39.8	0.0	0.081

UUC* : Unit Under Calibration

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

*** End of Certificate ***



CALIBRATION REPORT

Calibration No. : RH-05072021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5488.
: Relative humidity sensor: R3140637.

ID No : Data logger: NKH_FS0054
: Relative humidity sensor: -.

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : Jul 20, 2021

Issued Date : Jul 21, 2021

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC(reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.5	0.0
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.8	-0.1
KCl : Potassium Chloride	84.34	83.9	-0.4

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen,
Technical Support
and Calibration Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-02062021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 110-WS-25DL-N
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5490.
: Cup anemometer: WSD-009

ID No : Data logger: NKH_FS0055.
: Cup anemometer: -

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

Test Conditions	: Wind tunnel cross test section area	900	cm ²
	: Anemometer frontal area	100	cm ²
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]

Test Conditions	: Air temperature	22.7	±0.8 °C
	: Air pressure	1007.4	±0.4 hPa
	: Relative air humidity	45.8	±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASNET Anemometer Calibration Procedure – Version 2: 2009;

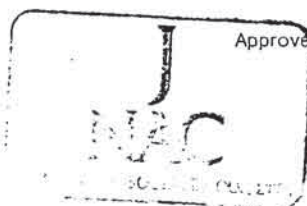
Traceability : This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jun 10, 2021.

Issued Date : Jun 10, 2021.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Orathai (unw)
Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-02062021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V _{STD} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.063	1.9	-0.2	2.9
4.080	4.0	-0.1	1.6
5.99	6.0	0.0	1.06
7.99	8.0	0.0	0.85
10.01	10.2	0.2	0.83
11.99	12.1	0.1	0.53
14.02	14.3	0.3	0.43
16.02	16.4	0.4	0.52
15.03	15.4	0.4	0.45
13.00	13.2	0.2	0.61
11.00	11.2	0.2	0.61
8.99	9.1	0.1	0.77
6.99	7.0	0.0	1.02
5.168	5.1	-0.1	0.90
2.998	3.0	0.0	1.8
1.032	0.8	-0.2	7.1

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration

CERTIFICATE OF CALIBRATION

Certificate No.: WD-02062021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Wind direction sensor: WS-02F.

Serial Number : Data logger: A5490.
: Wind direction sensor: WSD-009.

ID No : Data logger: NKH_FS0055.
: Cup anemometer: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23\pm3)^{\circ}\text{C}$, and relative humidity of $(40\pm10)\%$.

Measurement Method:

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

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

Traceability:

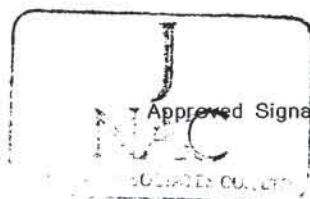
The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Jun 10, 2021.

Issued Date : Jun 10, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Orathai Wiwatwittaya
Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-02062021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	39	-6	3.0
3		90	90	85	-5	3.0
4		135	135	131	-4	3.0
5		180	180	178	-2	3.0
6		225	225	227	2	3.0
7		270	270	274	4	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	39	-6	3.0
11		90	90	85	-5	3.0
12		135	135	131	-4	3.0
13		180	180	178	-2	3.0
14		225	225	227	2	3.0
15		270	270	274	4	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Certificate No. : CL-043-64

Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx

Model : 110-WS-25DL-N

Serial No. : A5490

ID No. : NKH_FS0055

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 : 04 June 2021

Calibration date : 11 June 2021

Issue date : 11 June 2021

Reference Used During Calibration

1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022

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

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0071-
20

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

Orathai (Linh)
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Certificate No. : CL-043-64

Page 2 of 2

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R3440767

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion</u> <u>Depth</u> (mm)	<u>Standard</u> <u>Reading</u> (°C)	<u>UUC</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
60	20.050	19.8	-0.2	0.19
60	24.877	24.5	-0.4	0.25
60	29.860	29.6	-0.3	0.32
60	34.840	34.4	-0.4	0.19
60	39.822	39.3	-0.5	0.47

UUC* : Unit Under Calibration

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

*** End of Certificate ***

CALIBRATION REPORT

Calibration No. : RH-01062021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5490.
: Relative humidity sensor: R3440767.

ID No : Data logger: NKH_FS0055.
: Relative humidity sensor: -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with display, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : Jun 10, 2021

Issued Date : Jun 11, 2021

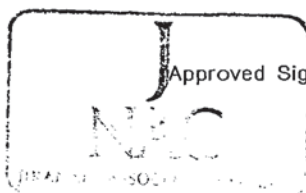
Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC _(Reading)	Error
CH_3COOK : Potassium Acetate	22.51	24.6	2.1
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	54.2	1.3
KCl : Potassium Chloride	84.34	85.2	0.9

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory.....

Orathai (w.w.)

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

CERTIFICATE OF CALIBRATION

Certificate No. : CL-022-64

Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx

Model : 110-WS-25DL-N

Serial No. : A5546

ID No. :-

Customer

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

Received date : 22 Feb 2021

Calibration date : 24 Feb 2021

Issue date : 03 Mar 2021

Reference Used During Calibration

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

Calibration Condition

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

REVIEW BY *W. Pookrak*

APPROVED BY *[Signature]*

NEXT CAL. DATE *25/8/22*

Calibration Procedure

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

Traceability

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

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Mr. Bongkoch Malithong



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Certificate No. : CL-022-64
Page 2 of 2

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R3440766

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.053	19.9	-0.2	0.080
60	24.887	24.5	-0.4	0.080
60	29.872	29.5	-0.4	0.080
60	34.860	34.3	-0.6	0.080
60	39.846	39.3	-0.5	0.080

UUC* : Unit Under Calibration

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

*** End of Certificate ***



CALIBRATION REPORT

Calibration No.: RH-01032021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
Relative humidity sensor: HMP60.

Serial Number : Data logger: A5546.
Relative humidity sensor: R3440766.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^\circ\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with display, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK ; Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$; Magnesium Nitrate, KCl ; Potassium Chloride to determine the errors.

Measurement Date : Feb 24, 2021
Issued Date : Mar 03, 2021

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC _{Reading}	Error
CH_3COOK ; Potassium Acetate	22.51	22.8	0.3
$\text{Mg}(\text{NO}_3)_2$; Magnesium Nitrate	52.89	51.1	-1.8
KCl ; Potassium Chloride	84.34	83.2	-1.1

Performed by

- ☐ Mr. Sorawit Thechaiaed
☒ Mr. Bongkoth Meuthong



Approved Signatory:



Mr. Parinya Buoncharoen,
Technical Support
and Calibration Manager

CERTIFICATE OF CALIBRATION

Certificate No: WS-02032021

Page 1 of 2 pages

Measurement Item	: Cup anemometer with data logger.		
Manufacturer	: Data logger: Novallinx. : Cup anemometer: Novallinx.		
Model/Type	: Data logger: Vanloger 110-WS-25DLN. : Cup anemometer: WS-02F		
Serial Number	: Data logger: A5546. : Cup anemometer: WSD-007.		
Customer	: ALS laboratory group (Thailand) co., ltd. : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.		
Test Conditions	: Wind tunnel cross test section area	900	cm ²
	: Anemometer frontal area	100	cm ²
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]
Test Conditions	: Air temperature	23.5	±0.8 °C
	: Air pressure	1013.9	±0.4 hPa
	: Relative air humidity	53.5	±3.5 %RH
Calibration Procedure	Calibration was carried out base on: IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines. MEASNET Anemometer Calibration Procedure – Version 2: 2009;		
Traceability	This calibration documents the traceable to national standard, which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).		
Measurement Date	: Feb 23, 2021.		
Issued Date	: Mar 03, 2021.		

Calibrated by

- ☐ Mr. Sorawit Thachasid
☒ Mr. Bongkorn Matichong



Approved Signatory:

Mr. Pankya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No. : WS-02032021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V _{std} Reading m/s	V _{user} Reading m/s	Error (m/s)	Uncertainty (%)
2.038	1.8	-0.2	2.7
4.059	4.0	-0.1	1.3
5.99	6.1	0.1	0.96
7.99	8.2	0.2	1.1
9.97	10.3	0.3	0.53
12.01	12.4	0.4	0.63
13.99	14.8	0.8	0.67
15.96	16.8	0.8	0.48
14.98	15.6	0.6	0.55
13.00	13.6	0.6	0.58
10.96	11.4	0.4	0.62
8.98	9.3	0.3	0.64
6.98	7.1	0.1	0.83
5.059	5.0	0.1	1.0
2.990	3.0	0.0	1.7
1.072	0.7	-0.4	7.0

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flow static	TCS TO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zongli	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036M-20	0 – 5 m/s
4	Temperature	Zongli	QSR-TMP	March 3, 2020	H2202003301001	30 – 70°C
5	Relative humidity	Zongli	QSR-TMP	March 3, 2020	H2202003301001	0 – 100 %RH
6	Atmospheric pressure	Zongli	QSR-TMP	March 3, 2020	H2202003301001	500 – 1100 hPa
7	Wind tunnel	CSSCM	MP3300			0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-02032021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: I1D-WS-25DL-N.
Wind direction sensor: WS-02F.

Serial Number : Data logger: A5546.
Wind direction sensor: WSD-007.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045.
Certificate No.: KWS63/0044.

Measurement Date : March 02, 2021.

Issued Date : March 03, 2021.

Performed by

- ☒ Mr. Sorawit Thachsiad
☐ Mr. Bongkoch Malithong



Approved Signatory: _____



Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-02032021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	182	2	3.0
6		225	225	228	3	3.0
7		270	270	275	5	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	182	2	3.0
14		225	225	228	3	3.0
15		270	270	275	5	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-09072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 110-WS-25DL-N.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5486.
: Cup anemometer: WSD-009.

ID No : Data logger: NKH_FS0053.
: Cup anemometer: -.

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.2 ±0.8 °C
: Air pressure 1006.8 ±0.4 hPa
: Relative air humidity 46.5 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
: IEC 61400-12-1 6D.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
: MGSNET Anemometer Calibration Procedure - Version 2: 2009;

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

Measurement Date : Jul 20, 2021.

Issued Date : Jul 21, 2021.

REVIEW BY *Warakorn P.*

APPROVED BY *[Signature]*

EXT CAL. DATE 18/1/23

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-09072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V _{std} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.085	2.0	-0.1	2.4
4.127	4.0	-0.1	1.2
5.98	6.0	0.0	0.94
8.00	8.1	0.1	0.71
9.97	10.1	0.1	0.58
12.01	12.2	0.2	0.49
13.97	14.3	0.3	0.47
15.98	16.5	0.5	0.42
15.00	15.5	0.5	0.45
12.99	13.3	0.3	0.51
11.00	11.1	0.1	0.48
8.97	9.0	0.0	0.81
7.01	7.0	0.0	1.1
5.123	5.0	-0.1	1.0
3.017	3.0	0.0	1.6
1.044	0.9	-0.1	5.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 - 1100 hPa
7	Wind tunnel	ESSOM	MP3300	-	-	0 - 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-09072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Wind direction sensor: WS-02P.

Serial Number : Data logger: A5486.
: Wind direction sensor: WSD-009.

ID No : Data logger: NKH_FS0053.
: Wind direction sensor: -.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Jul 20, 2021.
Issued Date : Jul 21, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: _____

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-09072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	88	-2	3.0
4		135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	225	0	3.0
7		270	270	272	2	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	88	-2	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	225	0	3.0
15		270	270	272	2	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CL-053-64
Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx

Model : 110-WS-25DL-N

Serial No. : A5486

ID No. : NKH_FS0053

Customer

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

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

Received date : 15 Jul 2021

Calibration date : 22 Jul 2021

Issue date : 22 Jul 2021

Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022

2. Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

☒ Mr. Sorawit Thachalad

☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : R3140638

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.052	20.0	-0.1	0.081
60	24.887	24.8	-0.1	0.081
60	29.868	29.8	-0.1	0.081
60	34.849	34.8	0.0	0.081
60	39.834	39.8	0.0	0.081

UUC* : Unit Under Calibration

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

✱ End of Certificate ✱



CALIBRATION REPORT

Calibration No. : RH-Q4072021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

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

Model/Type : Data logger: 110-WS-25DL-N.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5486.
: Relative humidity sensor: R3140638.

ID No : Data logger: NKH_FS0053.
: Relative humidity sensor: -.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl: Potassium Chloride to determine the errors.

Measurement Date : Jul 20, 2021
Issued Date : Jul 21, 2021

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC(Reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.1	-0.4
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.6	-0.3
KCl: Potassium Chloride	84.34	84.8	0.5

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

CALIBRATION REPORT

Calibration No. : BP-02072021

Page 1 of 2 Pages

Measurement Item : Barometric pressure with data logger.

Manufacturer : Data logger: Novalynx.
: Barometric pressure: Novalynx.

Model/Type : Data logger: 110-WS-25DL-N
: Barometric pressure: 110-WS-25BP.

Serial Number : Data logger: A5486
: Barometric pressure: A5486

ID NO : -

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25\pm3)^{\circ}\text{C}$, and relative humidity of $(50\pm15)\%$.

Measurement Method:

The Barometric pressure sensor, Unit Under Calibration (UUC) was calibrated in the pressure conditioning chamber. The standard pressure (P_{STD}) at 990 - 1016 hPa was generated by digital pressure generator. The pressure reading of UUC (P_{UUC}) were compared to the pressure reading of standard to determine the error.

Traceability:

This calibration documents the traceability to national standard which realize the unit of measurements according to the national system of units (SI) through Druck Limited via Certificate No: PS1206, Certificate No: PS1237.

Measurement Date : Jul 21, 2021
Issued Date : Jul 21, 2021

Performed by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Calibration report number

Calibration No: BP-02072021

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Calibration Point (hPa)	P _(STD) reading (hPa)	P _(JUC) reading (hPa)	Error (hPa)
990	990.010	991.012	1.002
995	995.009	995.989	0.980
1000	1000.007	1001.245	1.238
1005	1005.003	1006.687	1.684
1010	1010.006	1011.572	1.566
1015	1015.004	1016.884	1.880

End of calibration report



SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC21015

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34478385
ID No.: NKH_FS0019

Condition As Found : GOOD

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

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

Received Date : 18 AUGUST 2021
Calibration Date : 20 AUGUST 2021
Date of Issue : 25 AUGUST 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	30/8/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACC21015
Job No. : VC64AC0061
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-21	10-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACC21015

Job No. : VC64AC0061

Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.08	0.08	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1002.3	0.2	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.32	0.10	3.0

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

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

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21050

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00709777 / 187363 / 01328
ID No.: - (NPL 65002)

Condition As Found : GOOD

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

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

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	7/6/22

Received Date : 07 JUNE 2021
Calibration Date : 07-08 JUNE 2021
Date of Issue : 09 JUNE 2021

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21050
Job No. : VC64AC0044
Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	± 1.5
1000	0.1	0.0	0.0	± 1.0
8000	1.1	1.2	1.2	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

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	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21050

Job No. : VC64AC0044

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21049

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00709776 / 187362 / 01327
ID No.: -

Condition As Found : GOOD

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

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

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	7/16/22

Received Date : 07 JUNE 2021
Calibration Date : 07-08 JUNE 2021
Date of Issue : 09 JUNE 2021

Calibrated by : Nathakorn Pisutpaisan

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21049

Job No. : VC64AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21049
Job No. : VC64AC0044
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21049
Job No. : VC64AC0044
Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.4
Flat	23.2

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.3	1.4	1.4	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21049

Job No. : VC64AC0044

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21049
Job No. : VC64AC0044
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21049
Job No. : VC64AC0044
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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21049

Job No. : VC64AC0044

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	89.7	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21073

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472124 / 169437 / 72458
ID No.: NKH_FS0008

Condition As Found : GOOD

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

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

Received Date : 13 JULY 2021
Calibration Date : 14-16 JULY 2021
Date of Issue : 20 JULY 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	14/7/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.9

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

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.1
Flat	25.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-0.9	-1.0	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	25.0	0.0	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21073
Job No. : VC64AC0053
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21073

Job No. : VC64AC0053

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	89.5	-0.2	±1.5

12. High level stability

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

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

End of Calibration Certificate

Certificate No.: 0180SV21
Operation No.: CP2021040016

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)

Serial No.: 00371914 (Meter), 169110 (Microphone), 72255 (Preamplifier)

ID No.: NKH_FS0001

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

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

Received Date: 20 April 2021

Calibrated Date: 26 - 29 April 2021

Issued Date: 30 April 2021

Calibrated by: Ms. Juntaporn Kunhakom

REVIEW BY	<i>Warakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	26/4/22

Approved by:



สถาบันไฟฟ้าและอิเล็กทรอนิกส์
ELECTRICAL AND ELECTRONICS INSTITUTE

(Mr. Sittichai Swaksuriyawong)
Group Manager

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: 0180SV21

Calibration Report

Equipment: Sound Level Meter
Manufacturer: RION
Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)
Serial No.: 00371914 (Meter), 169110 (Microphone), 72255 (Preamplifier)
ID No.: NKH_FS0001
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1013-20	12 May 2021
2) Sine generator	1051	1501442	0151RF20	21 September 2021
3) Arbitrary Function Generator	AFG2021	C010063	0099RF20	17 June 2021
4) Programmable Attenuator	PA5	2755	EF-0034-20	10 November 2021
5) 6.5 Digit precision multimeter	8846A	9609027	0498EL20	10 August 2021
6) 6.5 Digit precision multimeter	8846A	9610014	0669EL20	27 October 2021
7) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P200051 0305TE20	31 May 2021 28 June 2021
8) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P200052 0306TE20	1 June 2021 28 June 2021

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

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

- Reference standards instrument for Acoustic function
 - National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
 - National Institute of Metrology (Thailand)
 - Electrical and Electronics Institute; ONSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.0

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34615278.

Certificate No.: 0180SV21

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
14.9

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	9.9
C-weighting	16.5
Z-weighting	22.4

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

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

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.4	0.6	0.4	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-1.2	-1.3	-1.2	±5.0

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	-0.1	-0.1	-0.1	±2.0
125	-0.1	-0.2	0.0	±1.5
250	0.0	-0.1	-0.1	±1.5
500	0.0	-0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	-0.2	0.0	0.0	±2.0
4000	0.0	0.0	-0.1	±3.0
8000	0.1	0.1	0.0	±5.0

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

Certificate No.: 0180SV21

Calibration Report

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.3

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.1
99.0	99.0	0.0	±1.1
104.0	104.0	0.0	±1.1
109.0	109.0	0.0	±1.1
114.0	114.0	0.0	±1.1
119.0	119.0	0.0	±1.1
124.0	124.0	0.0	±1.1
129.0	129.0	0.0	±1.1
130.0	130.0	0.0	±1.1
131.0	131.0	0.0	±1.1
132.0	132.0	0.0	±1.1
133.0	133.0	0.0	±1.1
134.0	134.0	0.0	±1.1
135.0	135.0	0.0	±1.1
136.0	136.0	0.0	±1.1
137.0	137.0	0.0	±1.1

7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1

Certificate No.: 0180SV21

Calibration Report

7.2 Level Linearity on the reference level range, Lower (Cont.)

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
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
29.0	29.0	0.0	±1.1
24.0	24.0	0.0	±1.1

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	126.0	0.0	±1.0
	2	108.9	-0.1	+1.0 ; -2.5
	0.25	99.8	-0.2	+1.5 ; -5.0
Slow	200	119.5	-0.1	±1.0
	2	99.9	-0.1	+1.0 ; -5.0
LAE	200	120.0	0.0	±1.0
	2	100.0	0.0	+1.0 ; -2.5
	0.25	90.8	-0.2	+1.5 ; -5.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	125.4	125.1	-0.3	±3.0
Positive half cycle	124.4	124.1	-0.3	±2.0
Negative half cycle	124.4	124.1	-0.3	±2.0

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.5	139.4	-0.1	±1.5

Certificate No.: 0180SV21

Calibration Report

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	129.0	129.0	0.0	±0.3

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 2.

-- End of Report --

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL21088

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173614 / 172176 / 74026
ID No.: NKH_FS0027

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 : 18 AUGUST 2021
Calibration Date : 20-24 AUGUST 2021
Date of Issue : 25 AUGUST 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	20/8/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21088
Job No. : VC64AC0061
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KA1	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21088
Job No. : VC64AC0061
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21088
Job No. : VC64AC0061
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.2

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.0
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21088
Job No. : VC64AC0061
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21088

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Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	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

Continuation of Calibration Certificate

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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.1	-0.3	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.3	-0.1	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

Continuation of Calibration Certificate

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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	89.7	0.2	±1.5

12. High level stability

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

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

End of Calibration Certificate

Certificate No.: 0184SV21
Operation No.: CP2021040020

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)

Serial No.: 00371923 (Meter), 169100 (Microphone), 72245 (Preamplifier)

ID No.: NKH_FS0005

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

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

Received Date: 20 April 2021

Calibrated Date: 27 - 29 April 2021

Issued Date: 30 April 2021

Calibrated by: Ms. Juntaporn Kunhakom

REVIEW BY	<i>Warakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	27/4/22

Approved by:



สถาบันไฟฟ้าและอิเล็กทรอนิกส์
ELECTRICAL AND ELECTRONICS INSTITUTE

(Mr. Sittichai Swaksuriyawong)
Group Manager

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: 0184SV21

Calibration Report

Equipment: Sound Level Meter
Manufacturer: RION
Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)
Serial No.: 00371923 (Meter), 169100 (Microphone), 72245 (Preamplifier)
ID No.: NKH_FS0005
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1013-20	12 May 2021
2) Sine generator	1051	1501442	0151RF20	21 September 2021
3) Arbitrary Function Generator	AFG2021	C010063	0099RF20	17 June 2021
4) Programmable Attenuator	PA5	2755	EF-0034-20	10 November 2021
5) 6.5 Digit precision multimeter	8846A	9609027	0498EL20	10 August 2021
6) 6.5 Digit precision multimeter	8846A	9610014	0669EL20	27 October 2021
7) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P200051 0305TE20	31 May 2021 28 June 2021
8) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P200052 0306TE20	1 June 2021 28 June 2021

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; ONSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.0

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34615278.

Certificate No.: 0184SV21

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
14.8

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	10.4
C-weighting	17.1
Z-weighting	22.8

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

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

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.6	0.8	0.5	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-1.9	-1.9	-2.0	±5.0

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	-0.2	0.0	-0.1	±2.0
125	0.0	-0.1	0.0	±1.5
250	-0.1	-0.1	0.0	±1.5
500	0.0	-0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	-0.1	±3.0
8000	0.1	0.1	0.0	±5.0

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

Certificate No.: 0184SV21

Calibration Report

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.3

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.1
99.0	99.0	0.0	±1.1
104.0	104.0	0.0	±1.1
109.0	109.0	0.0	±1.1
114.0	114.0	0.0	±1.1
119.0	119.0	0.0	±1.1
124.0	124.0	0.0	±1.1
129.0	129.0	0.0	±1.1
130.0	130.0	0.0	±1.1
131.0	131.0	0.0	±1.1
132.0	132.0	0.0	±1.1
133.0	133.0	0.0	±1.1
134.0	134.0	0.0	±1.1
135.0	135.0	0.0	±1.1
136.0	136.0	0.0	±1.1
137.0	137.0	0.0	±1.1

7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1

Certificate No.: 0184SV21

Calibration Report

7.2 Level Linearity on the reference level range, Lower (Cont.)

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
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
29.0	29.0	0.0	±1.1
24.0	24.0	0.0	±1.1

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	126.0	0.0	±1.0
	2	109.0	0.0	+1.0 ; -2.5
	0.25	99.9	-0.1	+1.5 ; -5.0
Slow	200	119.6	0.0	±1.0
	2	100.0	0.0	+1.0 ; -5.0
LAE	200	120.0	0.0	±1.0
	2	100.0	0.0	+1.0 ; -2.5
	0.25	90.9	-0.1	+1.5 ; -5.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	125.4	125.3	-0.1	±3.0
Positive half cycle	124.4	124.0	-0.4	±2.0
Negative half cycle	124.4	124.0	-0.4	±2.0

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.4	139.4	0.0	±1.5

Certificate No.: 0184SV21

Calibration Report

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	129.0	129.0	0.0	±0.3

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 2.

- - End of Report - -

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21051

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00709778 / 187364 / 01329
ID No.: -

Condition As Found : GOOD

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

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

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>Thanakul P.</i>
NEXT CAL. DATE	7/6/22

Received Date : 07 JUNE 2021
Calibration Date : 07-08 JUNE 2021
Date of Issue : 09 JUNE 2021

Calibrated by : Nathakorn Pisutpaisan

Approved by :

Thanakul P.
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21051

Job No. : VC64AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21051
Job No. : VC64AC0044
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21051

Job No. : VC64AC0044

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.5
Flat	22.2

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	0.3	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.4	-0.2	-0.3	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21051

Job No. : VC64AC0044

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

Continuation of Calibration Certificate

Cert. No. : ACL21051
Job No. : VC64AC0044
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	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21051

Job No. : VC64AC0044

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL21051

Job No. : VC64AC0044

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

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

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL21048

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00709775 / 187361 / 01326
ID No.: - 187361-60

Condition As Found : GOOD

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

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

Received Date : 07 JUNE 2021
Calibration Date : 07-08 JUNE 2021
Date of Issue : 09 JUNE 2021

REVIEW BY	Nathakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	7/6/22

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21048
Job No. : VC64AC0044
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.0
Flat	22.8

3. Acoustical signal tests of frequency weightings

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21048

Job No. : VC64AC0044

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21072

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472123 / 142962 / 22541
ID No.: NKH_FS0007

Condition As Found : GOOD

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

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

Received Date : 13 JULY 2021
Calibration Date : 14-16 JULY 2021
Date of Issue : 20 JULY 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	14 / 7 / 22

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL21072

Job No. : VC64AC0053

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21072

Job No. : VC64AC0053

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21072

Job No. : VC64AC0053

Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.2
Flat	24.0

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	0.1	0.2	0.3	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.1	0.0	0.0	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21072

Job No. : VC64AC0053

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21072
Job No. : VC64AC0053
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21072
Job No. : VC64AC0053
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.0	-0.4	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21072

Job No. : VC64AC0053

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

Cert. No. : ACL21071

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472122 / 169435 / 72456
ID No.: NKH_FS0006

Condition As Found : GOOD

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

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

Received Date : 13 JULY 2021
Calibration Date : 14-16 JULY 2021
Date of Issue : 20 JULY 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	14/7/22

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21071
Job No. : VC64AC0053
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21071
Job No. : VC64AC0053
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21071

Job No. : VC64AC0053

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.5
Flat	23.2

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	0.1	0.1	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.5	0.6	0.5	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21071

Job No. : VC64AC0053

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21071

Job No. : VC64AC0053

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21071
Job No. : VC64AC0053
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	-
One	136.4	135.7	-0.7	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21071

Job No. : VC64AC0053

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22104

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00371917 / 169101 / 72247
ID No.: NKH_FS0004

Condition As Found : GOOD

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

Location : -

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

Received Date : 22 APRIL 2022
Calibration Date : 03-06 MAY 2022
Date of Issue : 09 MAY 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	3/9/23

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22104

Job No. : VC65AC0051

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL22104
Job No. : VC65AC0051
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL22104

Job No. : VC65AC0051

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.9
Flat	23.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	0.4	0.5	0.5	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22104
Job No. : VC65AC0051
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL22104

Job No. : VC65AC0051

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.0	0.0	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22104
Job No. : VC65AC0051
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL22104
Job No. : VC65AC0051
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL21087

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173613 / 172175 / 74025
ID No.: NKH_FS0026

Condition As Found : GOOD

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

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

Received Date : 18 AUGUST 2021
Calibration Date : 20-24 AUGUST 2021
Date of Issue : 25 AUGUST 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	20/8/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21087
Job No. : VC64AC0061
Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.5

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.0
Flat	23.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.1	0.1	± 1.0
8000	0.6	0.7	0.7	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.1	-0.3	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21087

Job No. : VC64AC0061

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	89.8	0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21052

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01000335 / 189260 / 01998
ID No.: - NKKL-ES0003

Condition As Found : GOOD

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

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

Received Date : 07 JUNE 2021
Calibration Date : 07-08 JUNE 2021
Date of Issue : 09 JUNE 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	7/6/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : ACL21052

Job No. : VC64AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

Continuation of Calibration Certificate

Cert. No. : ACL21052

Job No. : VC64AC0044

Pages : 3 of 8

Summary of Measurement Result :

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

Continuation of Calibration Certificate

Cert. No. : ACL21052

Job No. : VC64AC0044

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.1
Flat	22.7

3. Acoustical signal tests of frequency weightings

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

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

Continuation of Calibration Certificate

Cert. No. : ACL21052

Job No. : VC64AC0044

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

Continuation of Calibration Certificate

Cert. No. : ACL21052
Job No. : VC64AC0044
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	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21052
Job No. : VC64AC0044
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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.4	-1.0	±3.0

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

Continuation of Calibration Certificate

Cert. No. : ACL21052

Job No. : VC64AC0044

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	89.5	0.0	±1.5

12. High level stability

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

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

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

CERTIFICATE OF CALIBRATION

Certificate No. : CL-059-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 17011741
ID No: NKH_FS0024

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 : 21 JUL 2021
Calibration date : 27 JUL 2021
Issue date : 27 JUL 2021

REVIEW BY

Horakorn P.

Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
2. Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

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

APPROVED BY

[Signature]

NEXT CAL. DATE

27/7/22

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17015109.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.054	20.0	-0.1	0.10
30	25.053	25.0	-0.1	0.099
30	30.046	30.0	0.0	0.099
30	35.037	35.0	0.0	0.099
30	40.028	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 17009119.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.054	20.0	-0.1	0.099
70	24.888	24.9	0.0	0.099
70	29.834	29.8	0.0	0.099
70	34.778	34.7	-0.1	0.099
70	39.731	39.6	-0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17015120.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.1	0.0	0.099
110	25.047	25.1	0.1	0.099
110	30.044	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.028	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-060-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 17011740
ID No: NKH_FS0025

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 : 21 JUL 2021
Calibration date : 27 JUL 2021
Issue date : 27 JUL 2021

Reference Used During Calibration

- 1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
- 2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

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

REVIEW BY

APPROVED BY

NEXT CAL. DATE

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number : TT-0036-21, Certificate number : ER-0032-21

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17015107.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.059	20.1	0.0	0.099
30	25.050	25.1	0.1	0.099
30	30.042	30.1	0.1	0.099
30	35.033	35.1	0.1	0.099
30	40.026	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 17009120.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.056	20.1	0.0	0.099
70	24.877	24.9	0.0	0.099
70	29.828	29.7	-0.1	0.099
70	34.781	34.6	-0.2	0.099
70	39.730	39.5	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17013819.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.058	20.1	0.0	0.099
110	25.050	25.0	0.0	0.099
110	30.041	30.0	0.0	0.099
110	35.034	35.0	0.0	0.099
110	40.028	40.0	0.0	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-057-64

Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 18006592
ID No: NKH_FS0031

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 : 21 JUL 2021

Calibration date : 26 JUL 2021

Issue date : 26 JUL 2021

Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
2. Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

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

REVIEW BY

Narakorn T.

APPROVED BY

H. G.

NEXT CAL. DATE

26/7/22

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:

P. Booncharoen
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager



Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18007973.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.054	20.0	-0.1	0.099
30	25.051	25.0	-0.1	0.099
30	30.049	30.0	0.0	0.099
30	35.038	35.0	0.0	0.099
30	40.031	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18003397.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.056	20.1	0.0	0.099
70	24.893	24.9	0.0	0.099
70	29.841	29.7	-0.1	0.099
70	34.782	34.6	-0.2	0.099
70	39.736	39.5	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18009531.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.1	0.0	0.099
110	25.054	25.1	0.0	0.099
110	30.043	30.1	0.1	0.099
110	35.036	35.1	0.1	0.099
110	40.033	40.1	0.1	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-061-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 18006593
ID No: NKH_FS0032

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 : 21 JUL 2021
Calibration date : 29 JUL 2021
Issue date : 29 JUL 2021

Reference Used During Calibration

1. Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
2. Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(55 \pm 15) \%$

REVIEW BY

Parinya P.

APPROVED BY

[Signature]

NEXT CAL. DATE

29/7/22

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number : TT-0036-21, Certificate number : ER-0032-21

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18005276.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.054	20.0	-0.1	0.099
30	25.043	25.0	0.0	0.099
30	30.035	30.0	0.0	0.099
30	35.032	35.0	0.0	0.099
30	40.026	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18007689.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.052	20.2	0.1	0.099
70	24.878	24.9	0.0	0.099
70	29.823	29.7	-0.1	0.099
70	34.770	34.6	-0.2	0.099
70	39.719	39.4	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18009543.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.0	-0.1	0.099
110	25.043	25.0	0.0	0.099
110	30.035	30.0	0.0	0.099
110	35.032	35.0	0.0	0.099
110	40.026	40.0	0.0	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-055-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 18006594
ID No: NKH_FS0033

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 : 21 JUL 2021
Calibration date : 22 JUL 2021
Issue date : 22 JUL 2021

Reference Used During Calibration

1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

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

REVIEW BY

Parinya J.

APPROVED BY

[Signature]

NEXT CAL. DATE

22/7/22

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18007969.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.039	20.0	0.0	0.099
30	25.044	25.0	0.0	0.099
30	30.033	30.0	0.0	0.099
30	35.030	34.9	-0.1	0.14
30	40.021	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18007692.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.036	20.1	0.1	0.099
70	24.872	24.8	-0.1	0.099
70	29.818	29.6	-0.2	0.099
70	34.773	34.4	-0.4	0.099
70	39.728	39.2	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18009542.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.039	20.0	0.0	0.099
110	25.044	25.0	0.0	0.099
110	30.033	30.0	0.0	0.099
110	35.030	35.0	0.0	0.099
110	40.021	40.0	0.0	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

Certificate No. : CL-056-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 17001605
ID No: NKH_FS0021

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 : 21 JUL 2021
Calibration date : 22 JUL 2021
Issue date : 22 JUL 2021

Reference Used During Calibration
1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

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

REVIEW BY *Maxkam P.*
APPROVED BY *[Signature]*
NEXT CAL. DATE *22/7/22*

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number : TT-0036-21, Certificate number : ER-0032-21

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17015104.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.051	20.1	0.0	0.099
30	25.038	25.1	0.1	0.099
30	30.026	30.0	0.0	0.099
30	35.013	35.0	0.0	0.099
30	40.011	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 17009122.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.049	20.0	0.0	0.099
70	25.040	24.8	-0.2	0.099
70	29.829	29.8	0.0	0.099
70	34.778	34.6	-0.2	0.099
70	39.735	39.5	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17015121.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.051	20.1	0.0	0.099
110	25.038	25.1	0.1	0.099
110	30.026	30.1	0.1	0.099
110	35.013	35.1	0.1	0.099
110	40.011	40.1	0.1	0.099

UUC* : Unit Under Calibration

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



CERTIFICATE OF CALIBRATION

Certificate No. : CL-058-64
Page 1 of 2

Equipment Name : Heat Stress Monitor with Sensor
Manufacturer. : DeltaOHM
Model: HD32.2
Serial No: 17006333
ID No: NKH_FS0022

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 : 21 JUL 2021
Calibration date : 26 JUL 2021
Issue date : 26 JUL 2021

Reference Used During Calibration

- 1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
- 2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

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

REVIEW BY	<i>Naralam J.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	26/7/22

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number : TT-0036-21, Certificate number : ER-0032-21

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17015105.
Dimension : Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.056	20.1	0.0	0.099
30	25.047	25.1	0.1	0.099
30	30.038	30.0	0.0	0.099
30	35.032	35.0	0.0	0.099
30	40.029	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 17009284.
Dimension : Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.054	20.1	0.0	0.099
70	24.884	24.9	0.0	0.099
70	29.836	29.7	-0.1	0.099
70	34.783	34.6	-0.2	0.099
70	39.736	39.5	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17015115.
Dimension : Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.2	0.1	0.099
110	25.048	25.2	0.2	0.099
110	30.038	30.2	0.2	0.099
110	35.034	35.2	0.2	0.099
110	40.029	40.2	0.2	0.099

UUC* : Unit Under Calibration

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

* End of Certificate *





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



Certificate of Calibration

Certificate No. : 22PH3

Page : 1 of 2

Equipment : Lux Meter

Manufacturer: PEAKMETER

Model : PM6612L

Serial No.: H12A-K20123

ID No.: - NKH 130026

Condition As-Received: New Item

Received Date: 05 January 2022

Calibration Date: 07 January 2022

Reference: 2201-0094WSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Photometry & Encorder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2022
2) Luminous intensity standard lamp	OL FEL-U	F-1542	TP-1019-21	20 Feb 2022

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

3.Test Equipment : Programmable Voltage/Current Source (Model : OL83A, S/N : 16221394).

4.Test Equipment : Illuminance Meter (Model : 51002, S/N : 080129).

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

6.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	<i>Marakon P.</i>
APPROVED BY	<i>Wichan</i>
NEXT CAL DATE	7/1/23

Calibrated by : Nivat Nitas
Issue Date : 10 January 2022

Approved Signatory :

[*g*] Phalinee Prabpaipal

[] Chatchawan Khunpiluek



Cert. No.: 22PH3

Page.: 2 of 2

Result of calibration:-

(*) Without adjustment () After adjustment

Function : Illuminance Measurement

Range : Autorange

<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
(lx)	(lx)	(lx)	(± lx)
0	0.00	0.00	0.060
15	15.01	0.00	0.20
100	99.8	-0.2	1.3
500	498	-2	6.5
1000	998	-2	13
2000	1996	-4	26
3000	2960	-40	39
4000	3940	-60	52
5000	4920	-80	65

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

Light source factor setting : $L0 = 1.000$

UUC* = Unit Under Calibration.

-o0o-

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH452
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact S220
Serial No. :	B520948426
ID No. :	BKK_EN0072
Condition As-Received:	Used Item
Received Date :	24 March 2021
Calibration Date :	26 March 2021
Reference :	2103-1008DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM) - CP-CH8 by comparison with standard thermometer

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

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

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

Issue Date :

31 March 2021

The Uncertainties are for a confidence probability of approximately 95%

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

A 0026590



Cert.No.: 21CH452

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	1385032	130RC022	20E4213	24 Nov 2021
2) Ref. Standard Thermometer	4982054	110RC044	20I1233	15 Oct 2021

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	706694	06 Sep 2022
pH 6.985	CPA chem	722285	19 Dec 2021
pH 10.012	CPA chem	722287	19 Dec 2021

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

Calibration Results

Function : mV Measurement

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

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

Malu.



Cert.No.: 21CH452

Page.: 3 of 3

Calibration Results**Function : pH Measurement**

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

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

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM
- Serial No. : 9265091

Dimension of probe;

- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

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

Remark : - UUC* = Unit Under Calibration

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

-o0o-

Malu.



บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยอุดมสุข 14 แขวงบางนา เขตบางนา กรุงเทพฯ 10260 โทรศัพท์: (02) 747-7009 โทรสาร: (02) 747-7008
4 Soi Udomsuk 14, Bangna, Bangkok 10260 Tel. (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2021

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม						10/10/21 CK						10/10/21 CK

Periodical maintenance check list for Konelab

	6M	12M	Note!
1.Diluent-wash tubing change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3.Syringe check/change		<input checked="" type="checkbox"/>	
4.Dispensing check/ change		<input checked="" type="checkbox"/>	
5.Waste tubing change when necessary		<input checked="" type="checkbox"/>	
6.Lamp check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)		<input checked="" type="checkbox"/>	
8.ISE needles check/change		<input checked="" type="checkbox"/>	
9.Pump tubing check/ chance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10.Broken/worn out part check /change		<input checked="" type="checkbox"/>	
11.Peristaltic pump check /cleaning/ lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
12.Heating check		<input checked="" type="checkbox"/>	
13.Cooling check		<input checked="" type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
16.Dispenser movement check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
18.Dispensing tubing tightness check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
22.Instrument cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
25.UPS Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Place: ALS Lab Instrument: Aquakem 950
Date/Time: 28-06-21 Serial no: 22781
Service done by: [Signature] Install date:
Signature of customer: [Signature] Date/Time: 28/6/21



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CG1446

Page.: 1 of 2

Certificate of Calibration

Equipment :	Burette
Capacity :	50 mL
Serial No. :	-
ID. No. :	BKK_EN0171
Manufacturer :	Witeg
Made in :	Germany
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd. Khwaeng Phatthanakan, Khet Suan Luang Bangkok 10250 Thailand
Ambient Temperature :	(20 ± 2.5) °C
Relative Humidity :	(50 ± 10) %
Barometric Pressure :	755 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Sa-ngeunkam Wongsas



Approved by :

Malee

Approved Signatory

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

Issue Date :

31 March 2021

The Uncertainties are for a confidence probability of approximately 95%

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

A 0026589



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

Cert.No.: 21CG1446

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID. No.</u>	<u>Certificate No.</u>	<u>Traceability</u>	<u>Due date</u>
1) Balance	XP205	B134206712	140RC007	21MM181	NIMT	02 Mar 2022
2) Thermo-Hygrograph	TH 803	09153022	140EC004	20H1434	NIST,NIMT	19 June 2021
3) Thermometer		1594592	140EC010	20I1191	NIMT	08 Oct 2021

This certification is traceable to SI Unit

2. The certificate is valid only to the item calibrated on date and place of calibration.
3. True value is converted to true volume at the standard temperature of 20 °C

Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty (\pm mL)	k Factor
50	50.0041	0.011	2.00

Remark mL = cm³

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

-o0o-

Malu



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. T211009

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK_EN0167

ID No. : T2463A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Laboratory

Date of Receipt : 6 May 2021

Calibrated By : Watcharapon Songthong (Technician)

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

Date of Issue : 20 MAY 2021

REVIEW BY	<u>Sinlue P.</u>
APPROVED BY	<u>LL AL</u>
NEXT CAL. DATE	<u>16/11/22</u>

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T211009

Page 2 of 4

Calibration Report

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

Condition of this results of calibration :

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

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

- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	8 January 2022
TC	TYPE T	TN171-TN180	T210009	8 January 2022
DATA LOGGER	34970A	T149	T210009	8 January 2022

- This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

- Condition of calibrated item : good

Equipment Description :

Time Constant 1 Hour - Minute At 3 °C
 Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

- Adjustment :

(X) without adjustment

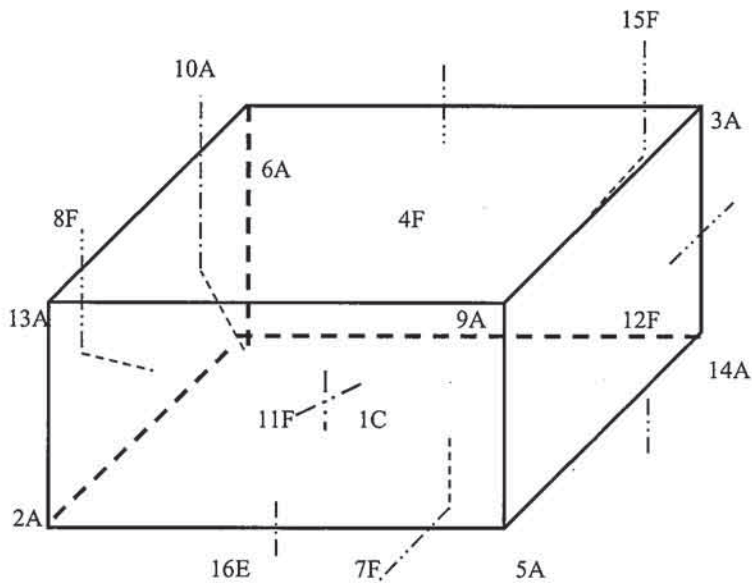
() after adjustment

Approved By. 

Certificate No. T211009

Page 3 of 4

Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C = TN161	12F = TN172
2A = TN162	13A = TN173
3A = TN163	14A = TN174
4F = TN164	15F = TN175
5A = TN165	16E = TN176
6A = TN166	
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	
11F = TN171	

Approved By. 

Certificate No. T211009

Page 4 of 4

Calibration Report

Measurement Results

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

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

* The Acuoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6, e-mail: service.thailand@sartorius.com

**SARTORIUS**

Certificate

of Calibration

REVIEW BY	Siriluk P.
APPROVED BY	KL AL
NEXT CAL DATE	3/9/22

Model Number : **MSU224S-000-DA**
Description : **Analytical Balance**
Serial Number : **27405555 # BKK_EN0003**
Manufacturer : **Sartorius**

Certificate No. : **21BCI0263**
Issued Date : **Monday, September 06, 2021**
Reference No. : **502052**
Page No. : **1 Of 2**

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

Calibrated Place : **Lab Room**

Calibrated By : **Mr.Chonchai Inthana**
Calibration Date : **Friday, September 03, 2021**

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

Metrological data :

Capacity : **220** g Readability : **0.0001** g

Ambients Conditions:

Temperature : **23.5 °C** ± **5.0 °C**
Humidity : **59.1 % RH** ± **10.0 % RH**
Pressure : **—** ± **—**

Reasons for calibration

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

Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 200g E2,YCS011-522-00	Sartorius	119934 D-K-19398-01-00	10-Sep-2021
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	SPCC	KSPR2111869	31-Aug-2022

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.

ISO17025-RF-22 26/03/2020 R2


Mr.Chonchai Inthana(Technical Manager)

S
T
A
M
P



Certificate

of Calibration

Model Number : **MSU224S-000-DA**Description : **Analytical Balance**Serial Number : **27405555 # BKK_EN0003**Manufacturer : **Sartorius**Certificate No. : **21BCI0263**Issued Date : **Monday, September 06, 2021**Reference No. : **502052**Page No. : **2 of 2**

Calibration Results : Without Adjustment

Repeatability

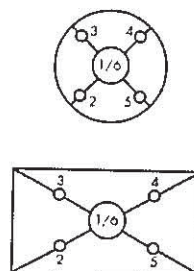
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.

Nominal Value : (Low Load)	20.0000	200.0001
20 g	20.0001	200.0000
Tolerance	20.0000	200.0001
0.0001 g	20.0000	200.0001
	20.0001	200.0001
Nominal Value : (High Load)	20.0000	200.0001
200 g	20.0001	200.0000
Tolerance	20.0000	200.0001
0.0001 g	20.0000	200.0000
	20.0000	200.0001
Standard Deviation	0.00005	0.00005

Eccentricity (Off-center loading error)

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

Nominal value : 50 g
Tolerance 0.0004 g



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

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
1	1.0000	1.0000	0.0000	0.00013
2	2.0000	2.0000	0.0000	0.00013
5	5.0000	5.0000	0.0000	0.00013
10	10.0000	10.0000	0.0000	0.00013
20	20.0000	20.0000	0.0000	0.00013
50	50.0001	50.0002	0.0001	0.00014
100	100.0001	100.0002	0.0001	0.00018
200	200.0001	200.0001	0.0000	0.00029

End of Report.



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th



Certificate No. T220139

Page 1 of 3

Certificate of Calibration

Equipment : Liquid Bath (Water)

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611.0135

Customer Code : BKK_EN0148

ID No. : T6455A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 26 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 08 FEB 2022



The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T220139

Page 2 of 3

Calibration Report

Equipment : Liquid Bath (Water)
Date of Calibration : 31 January 2022
Environment : Temperature : 22.4-23.9 °C
Line Voltage : 221.4-225.4 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert five resistance thermometer detectors into its water bath , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T36 (based on ASTM E715-80 (Reapproved 2001)).

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 OHM	M34 (CH1-CH5)	T210115	2 February 2022
DATA LOGGER	34970A	T47	T210115	2 February 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good


Equipment Description :

Time Constant 1 Hour - Minute At 60 °C

5. Adjustment :

(X) without adjustment

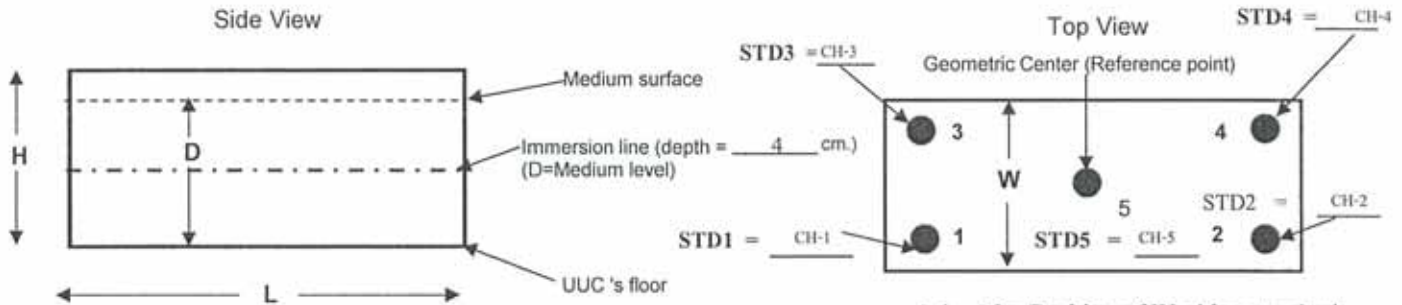
() after adjustment

Approved By. 

Certificate No. T220139

Page 3 of 3

Calibration Report



- D = Medium level : 8 cm.
 - UUC's medium : Water
 - Working standards are located at 2.5 cm. away from each corner and walls.
- Working space dimension : 62 × 41 × 14 (W×L×H)

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-2	CH-3	CH-4	CH-5
60	59.95	60.04	60.12	60.01	59.89
85	85.17	84.89	85.34	84.78	84.93
95	93.46	93.14	93.81	93.05	93.28

Liquid Bath (Water)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average				
61.0	60.9 , 61	61.0	0.10	0.19	0.25	2.00
86.0	85.9 , 86.1	86.0	0.12	0.39	0.32	2.06
95.0	94.8 , 95.1	94.9	0.14	0.51	0.38	2.11

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



REVIEW BY	Autcharawan S.
APPROVED BY	Sarasat M.
NEXT CAL. DATE	12 / Jan / 23
	12 / Jan / 22

Certificate of Calibration

ICS-2100: Anion (ID#659)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co., Ltd.

ICS-2100 S/N: 15010977

AS-HV S/N: 5450A36659

For

ALS Laboratory Group (Thailand) Co., Ltd.



Operator Signature: _____

Date: Jan 12, 2022

(Mr. Thitipong Piromkripuk)

Applications Chemist



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

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

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T220133I01 "Substitute for Calibration Certificate Number T220133" Page 1 of 5

Certificate of Calibration

Equipment : Digestion Unit

Manufacturer : Environmental Express

Model : TKN100

Serial No. : 2017TKNBC142

Customer Code : BKK_EN0223

ID No. : T6773A4

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

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

Customer Location : Wet Chemistry Lab1

Date of Receipt : 26 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 28 FEB 2022

REVIEW BY	Sinluk P.
APPROVED BY	K.L.A.
NEXT CAL. DATE	1/2/23

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T220133101

Page 2 of 5

Calibration Report

Equipment : Digestion Unit
Date of Calibration : 1 February 2022
Environment : Temperature : 23.9 - 26.3 °C
Line Voltage : 221.4 - 225.1 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert four standard thermocouples type S into its chamber , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T10.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	Type S	M20A1-(CH17-CH20)	T210011	14 March 2022
DATA LOGGER	34970A	T149	T210011	14 March 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 1 Minute At 380 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

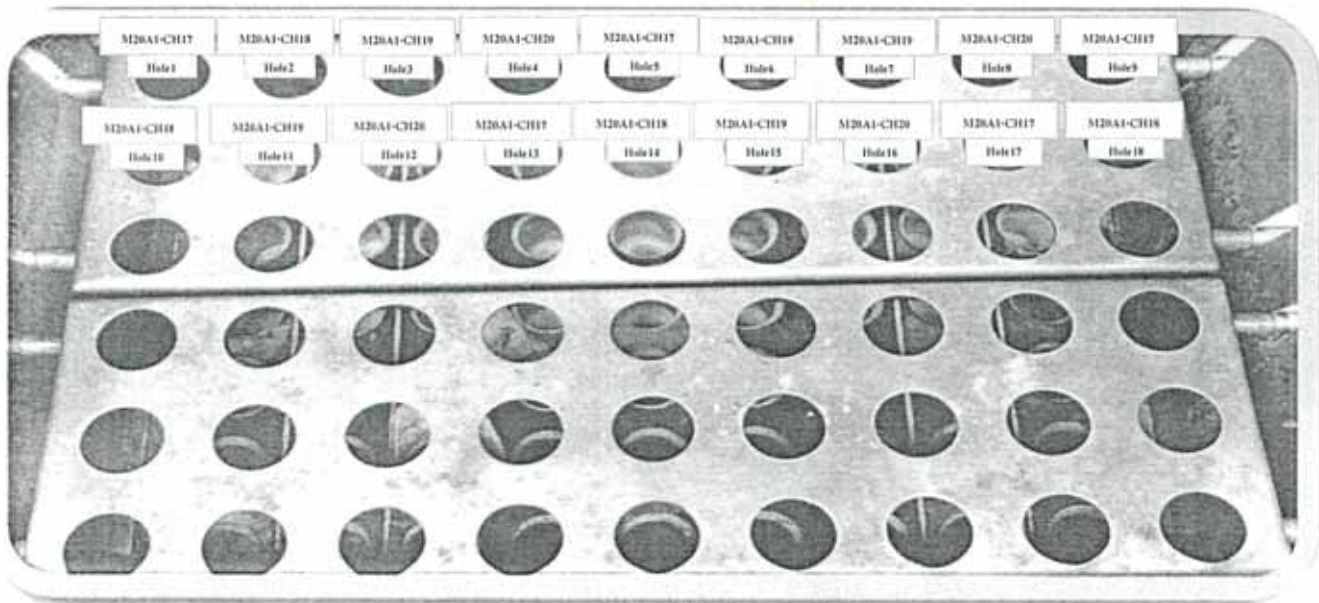
5. Adjustment :

(X) without adjustment

() after adjustment

Approved By. 

Calibration Report



FRONT

Measurement Results

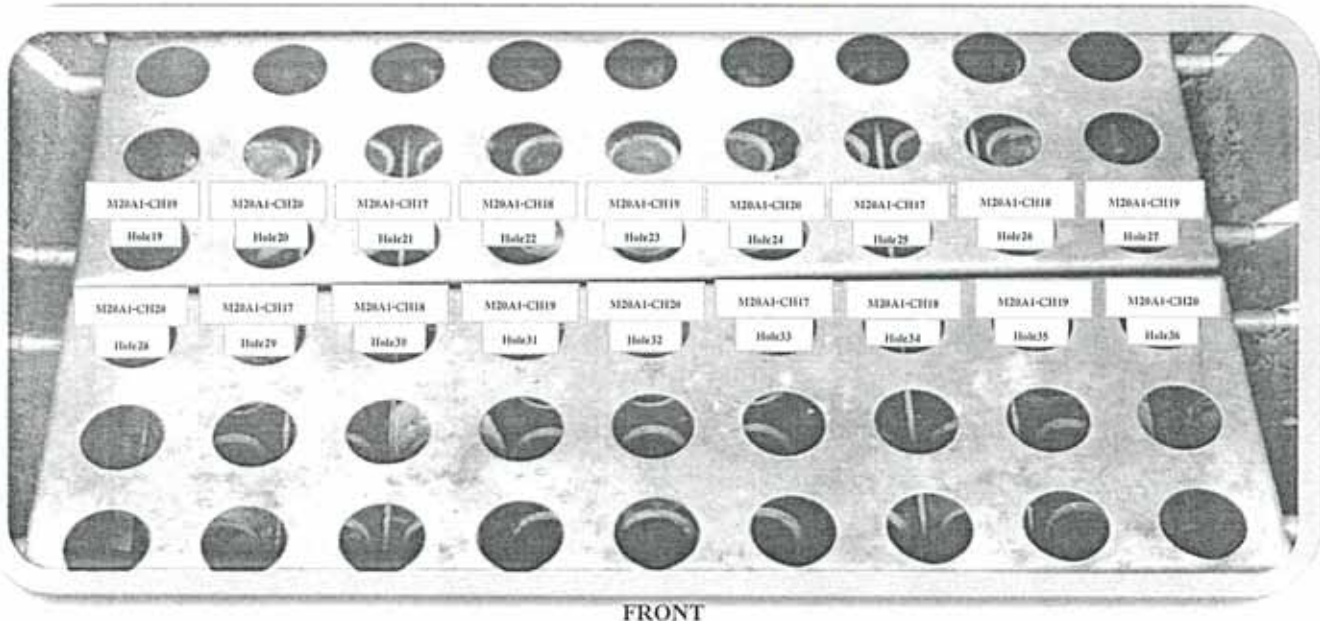
Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole1	Hole2	Hole3	Hole4	Hole5	Hole6	Hole7	Hole8	Hole9
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17
380.0	380.0	379.8 - 380.2	Max °C	376.5	377.1	377.3	382.0	383.8	380.9	376.0	377.0	376.3
			Min °C	376.1	376.7	377.0	381.8	383.5	380.6	375.7	376.7	375.9
			Average °C	376.3	376.9	377.1	381.9	383.6	380.8	375.8	376.9	376.1
			Stability ± °C	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole10	Hole11	Hole12	Hole13	Hole14	Hole15	Hole16	Hole17	Hole18
				M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380.0	380.0	379.8 - 380.2	Max °C	377.3	378.1	382.6	383.2	381.8	380.8	380.4	376.6	378.2
			Min °C	376.9	377.6	382.2	382.7	381.4	380.5	380.1	375.8	377.4
			Average °C	377.1	377.9	382.4	382.9	381.6	380.6	380.3	376.2	377.8
			Stability ± °C	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.4	0.4

Approved By. _____



Calibration Report



FRONT

Measurement Results

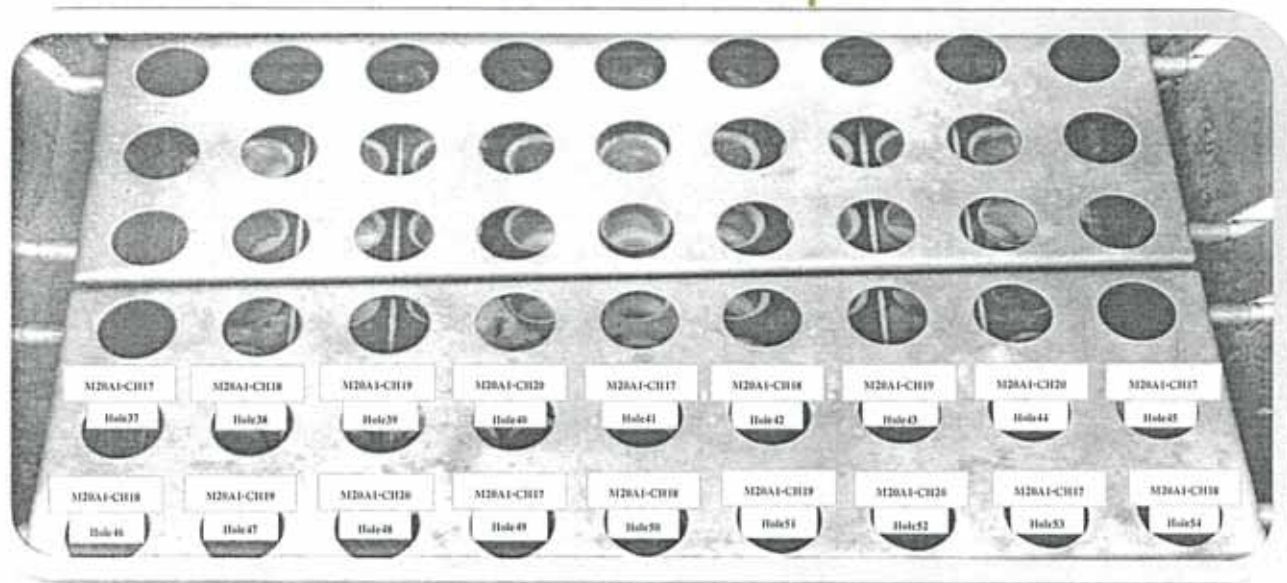
Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole19	Hole20	Hole21	Hole22	Hole23	Hole24	Hole25	Hole26	Hole27
				M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19
380.0	380.0	379.8 - 380.2	Max °C	379.2	383.0	382.8	384.1	383.1	384.1	377.2	377.4	378.4
			Min °C	378.4	382.3	382.2	383.6	382.6	383.7	376.9	377.1	378.0
			Average °C	378.8	382.7	382.5	383.9	382.8	383.9	377.0	377.2	378.2
			Stability ± °C	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole28	Hole29	Hole30	Hole31	Hole32	Hole33	Hole34	Hole35	Hole36
				M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20
380.0	380.0	379.8 - 380.2	Max °C	380.6	381.9	383.9	381.4	382.0	378.3	379.4	380.4	376.2
			Min °C	380.1	381.5	383.5	381.1	381.7	377.9	379.0	379.8	375.8
			Average °C	380.4	381.7	383.7	381.2	381.8	378.1	379.2	380.1	376.0
			Stability ± °C	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.2

Approved By. _____



Calibration Report



FRONT

Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole37	Hole38	Hole39	Hole40	Hole41	Hole42	Hole43	Hole44	Hole45	
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH21	M20A1-CH22	M20A1-CH23	M20A1-CH24	M20A1-CH25	
380.0	380.0	379.8 - 380.2	Max °C	381.1	383.5	384.2	379.8	381.3	381.4	381.3	380.6	380.7	
			Min °C	380.8	383.2	383.9	379.4	380.8	381.0	380.9	380.2	380.4	
			Average °C	381.0	383.4	384.1	379.6	381.1	381.2	381.1	380.4	380.6	
			Stability ± °C	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	
Cal. Point	Setting	Reading	STD.	Position of Standards at Block									
(°C)	(°C)	(°C)	Reading	Hole46	Hole47	Hole48	Hole49	Hole50	Hole51	Hole52	Hole53	Hole54	
				M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH21	M20A1-CH22	M20A1-CH23	M20A1-CH24	M20A1-CH25	M20A1-CH26	
380.0	380.0	379.8 - 380.2	Max °C	377.2	377.8	382.8	378.6	379.5	380.4	383.3	383.0	378.1	
			Min °C	376.8	377.2	382.2	378.3	379.3	380.1	383.1	382.7	377.8	
			Average °C	377.0	377.5	382.5	378.4	379.4	380.2	383.2	382.8	377.9	
			Stability ± °C	0.2	0.3	0.3	0.2	0.1	0.2	0.1	0.2	0.2	

The expanded uncertainty of temperature measurement was ± 1.63 °C

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By.





Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. T211650

Page 1 of 3

Certificate of Calibration

Equipment : Chamber (Oven)

Manufacturer : Memmert

Model : UF 450

Serial No. : B7170531

Customer Code : BKK-EN0273

ID No. : T8042A4

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


104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250

Customer Location : Oven Room

Date of Receipt : 16 July 2021

Calibrated By : Atiphong Rongrat (Technician)

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 23 JUL 2021

REVIEW BY	<u>Sinluk P.</u>
APPROVED BY	<u>KL AL</u>
NEXT CAL. DATE	<u>2011/23</u>

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T211650

Page 2 of 3

Calibration Report

Equipment : Chamber (Oven)
Date of Calibration : 22 July 2021
Environment : Temperature : 25.6-25.7 °C
Line Voltage : 227.5-233.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	13-(CH1-10)	T202056	24 September 2021
DATA LOGGER	34970A	T121	T202056	24 September 2021

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 10 Minute At 104 °C
Fresh Air Damper ☒ Open ☐ Min ☒ Medium ☐ Max
☐ Close
☐ Not Available

5. Adjustment :

(X) without adjustment

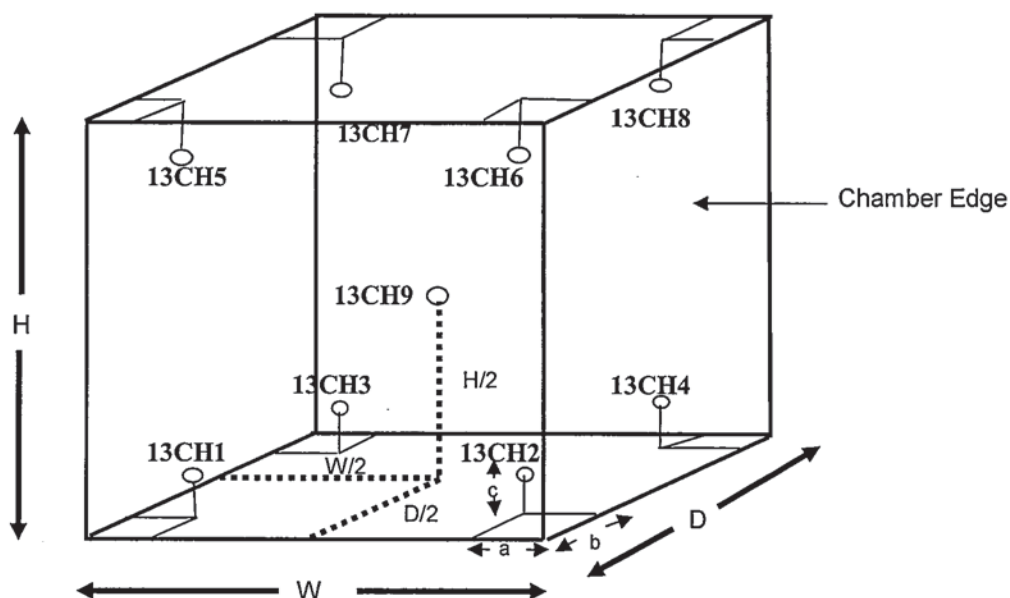
() after adjustment

Approved By. 

Certificate No. T211650

Page 3 of 3

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm. , H(Height)=72 cm. and D(Depth)=60 cm.
 Size of Installed Standard sensor number13CH1to number13CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.
 Size of Installed Standard sensor number13CH9 : W/2=104 cm./2 ,H/2=72 cm./2 and D/2=60 cm./2

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)								
	13CH1	13CH2	13CH3	13CH4	13CH5	13CH6	13CH7	13CH8	13CH9
104	104.34	104.10	103.94	104.63	103.75	104.79	103.41	104.74	103.40
180	180.62	180.63	180.75	180.38	179.47	180.97	178.80	180.63	178.86


Chamber (Oven)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average				
104.0	104 , 104.1	104.0	0.3	1.7	0.59	2.00
180.0	180 , 180.1	180.0	0.2	2.7	0.73	2.00

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CALIBRATION AND TESTING EQUIPMENT SERVICES

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000-24 FAX. 0-2719-9484

Cert.No.: 21CH1589

Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact
Serial No. :	B429832167
ID No. :	BKK_EN0065
Condition As-Received:	Used Item
Received Date :	17 November 2021
Calibration Date :	19 November 2021
Reference :	2111-0586DSC-6
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	$(25 \pm 2.5) ^\circ\text{C}$
Relative Humidity :	$(50 \pm 15) \%$
Calibration Procedure:	In -house method : - CP-CH6 : based on direct measurement by using reference material (RM)

REVIEW BY	<u>Sinlute P.</u>
APPROVED BY	<u>K An</u>
NEXT CAL. DATE	<u>20/05/23</u>

Calibrated by : Walalak Sirithean

Approved by :

Malee Butkruea

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 23 November 2021

The Uncertainties are for a confidence probability of approximately 95%.

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



Cert.No.: 21CH1589

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	211451	15 Apr 2022

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials :-

- Conductivity calibration solution, Thermo Scientific (traceable to NIST)

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
84 $\mu\text{S/cm}$	Thermo Scientific	081/02	23 Feb 2022
1413.0 $\mu\text{S/cm}$	Thermo Scientific	171/02	30 Apr 2024
12.880 mS/cm	Thermo Scientific	230/01	07 June 2023

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

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413 $\mu\text{S/cm}$

Conductivity Electrode Serial No.: 5821270404

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
84 $\mu\text{S/cm}$	85.92 $\mu\text{S/cm}$	85.52 $\mu\text{S/cm}$	4.3 $\mu\text{S/cm}$	2.00
1413 $\mu\text{S/cm}$	1419 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	15 $\mu\text{S/cm}$	2.00
12.88 mS/cm	12.92 mS/cm	12.79 mS/cm	0.14 mS/cm	2.00

Remark - UUC* = Unit Under Calibration

- Adjustment Cell constant = 0.559929 cm^{-1}

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES


534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 21TW6

Page.: 1 of 2

Certificate of Testing

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





Cert.No.: 21TW6

Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 18C100772

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 21TM166

Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5100

Serial No. : 15L103204

ID No. : BKK_EN0205

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

Location : TPA On Site Calibration Laboratory

Received Order : 15 January 2021

Calibrated Date : 21 January 2021

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Kritsada Chaitrong

Approved by :

Approved Signatory

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

Issue Date : 28 January 2021

The Uncertainties are for a confidence probability of approximately 95%

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

A 0023875



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

Cert. No.: 21TM166

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1523	2188080	2011389	20 Nov 2021

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

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

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (±°C)	<u>Coverage Factor</u> <i>k</i>
20.00	60	20.002	19.94	-0.062	0.15	2.00

UUC* : Unit Under Calibration

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

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Mali.



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. T212123

Page 1 of 3

Certificate of Calibration

Equipment : Chamber (Incubator)

Manufacturer : SHEL LAB

Model : 2020-2E

Serial No. : 802899

Customer Code : BKK_EN0005

ID No. : T7499A0

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250


Customer Location : Wet Chemistry Lab2

Date of Receipt : 1 October 2021

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By :  /Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 07 OCT 2021

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	4/4/23

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T212123

Page 2 of 3

Calibration Report

Equipment : Chamber (Incubator)
Date of Calibration : 4-5 October 2021
Environment : Temperature : 23.8-24.9 °C
Line Voltage : 227.5-231.1 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	29-(CH1-10)	T210118	2 February 2022
DATA LOGGER	34970A	T47	T210118	2 February 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 20 Minute At 20 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

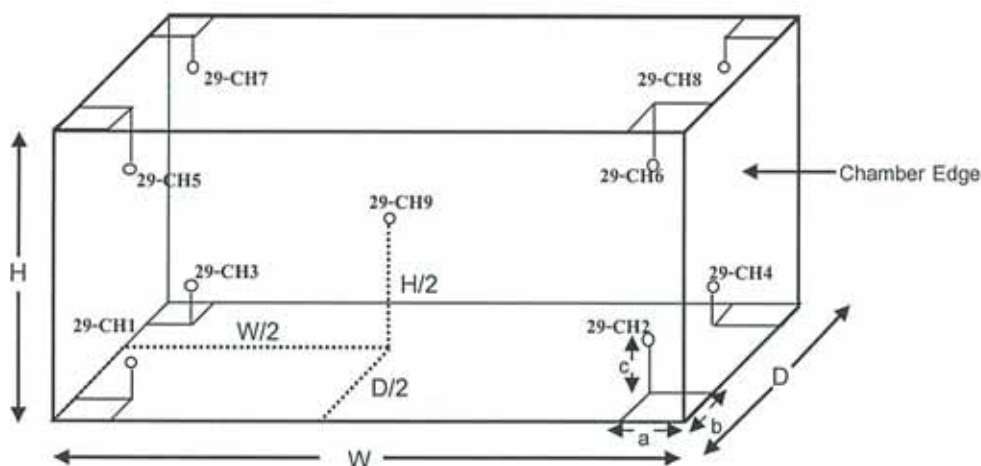
Approved By. _____



Certificate No. T212123

Page 3 of 3

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 70 cm. , H (Height) = 130 cm. and D (Depth) = 55 cm.
 Size of Installed Standard sensor number 29-CH1 to number 29-CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.
 Size of Installed Standard sensor number 29-CH9 : W/2 = 70 cm./2 , H/2 = 130 cm./2 and D/2 = 55cm./2

Measurement Results

Average Standard Reading at each position (°C)									
Calibration Point	29-CH1	29-CH2	29-CH3	29-CH4	29-CH5	29-CH6	29-CH7	29-CH8	29-CH9
20	20.04	20.06	20.19	19.86	19.68	20.08	20.12	19.80	20.07
25	24.99	25.06	25.18	24.89	24.74	25.12	25.16	24.80	25.10

Chamber (Incubator)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
	Min , Max	Average				
20.0	-	20.0	0.05	1.01	0.38	2.00
25.0	-	25.0	0.07	0.96	0.38	2.00

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH1730

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go
Serial No. :	B553912470
ID No. :	BKK_LG0031
Condition As-Received:	Used Item
Received Date :	22 December 2021
Calibration Date :	23 December 2021
Reference :	2112-0571DSC-3
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Malee

Approved Signatory

- ☒ Malee Butkruea
☐ Saithip Meangmai
☐ Warakorn Lerngagtrakul

Issue Date : 24 December 2021

The Uncertainties are for a confidence probability of approximately 95%

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



Cert. No.: 21CH1730

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	43160066	130RC092	21E1223/1	27 Apr 2022

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	761016	02 Aug 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B553912470	4.00	177.48	177	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor <i>k</i>
pH Electrode S/N.: 0191151	4.008	4.01	171	0.0071	2.00
	6.982	6.98	-4	0.0099	2.00
	10.015	10.01	-179	0.0095	2.00

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

-o0o-

Malu.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 21TM2304

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go

Serial No. : B553912470

ID No. : BKK_LG0031

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

Location : TPA On Site Calibration Laboratory

Received Order : 22 December 2021

Calibrated Date : 27 December 2021

Ambient Temperature : (26 \pm 10) °C

Relative Humidity : (50 \pm 30) %

AC Line Voltage : (220 \pm 22) V

Calibrated by : Preecha Hlahib

Approved by :

Approved Signatory

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

Issue Date :

6 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0036304



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2112-0571DSC-2

Cert. No.: 21TM2304

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1502A	A52847	2111144	20 Oct 2022

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with thermocouple Type T, S/N.: 0191151

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
20.0	100	20.009	20.1	0.091	0.30	2.00
25.0	100	24.999	25.1	0.101	0.30	2.00
30.0	100	30.003	30.2	0.197	0.30	2.00
35.0	100	35.004	35.2	0.196	0.30	2.00
40.0	100	40.003	40.2	0.197	0.30	2.00
45.0	100	45.008	45.2	0.192	0.30	2.00
50.0	100	50.004	50.2	0.196	0.30	2.00

UUC* : Unit Under Calibration

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

-o0o-

Maku

Certificate of System Qualification

ES-OQ

System ID: MY16010005
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250
Date: September 13, 2021 5:49:11 PM
EQP Name: AgilentRecommended
EQP Revision: ES.02.50
Overall Qualification Status: Pass

Preparation

Pass

Instrument Tests

Pass

Autosampler Operation

Pass

REVIEW BY	Thitima B.
APPROVED BY	Saowan N.
NEXT CAL. DATE	12 Mar 23

Instrument Details

Purpose

This section describes the as found system configuration.

Details

Spectrometer 1

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

Chiller 1

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

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

Switching Valve Accessory 1

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

Electronic Signature

Purpose

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

Details

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

Regulatory Disclaimer

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

Warranty

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

User Name: phimpapha.jeeraphong
 Hostname: ASBKKWX328

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

QQHW 5100 ICPOES ALS 08Sep21 Transaction log :

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

Page 1 / 2

User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

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

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

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



Agilent CrossLab Compliance Services

Agilent
CrossLab
From Insight to Outcome

EQUIPMENT QUALIFICATION REPORT (EQR)

Agilent CrossLab Compliance

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

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Preparation : 5100 SVDV	7
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Autosampler Operation : Autosampler 1 - SPS4	11
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Test Summary

Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

Details

Test	Status	Runs
Preparation : 5100 SVDV	Pass	1
Instrument Tests : 5100 SVDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details

Service Order No./Request: 6004823273
EQP Name: AgilentRecommended
EQP Revision: ES.02.50
Report Type: Report

Organization Details

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

Local Contact Details

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

Operator Details

Name: Kanyakorn sukpathrajarearn
Job Title: Field Service Engineer

Data Acquisition Details

Acquisition Software Name: ICP Expert
Acquisition Software Revision: 7.5.3.11953

Customer Data System (CDS): Es: ICP Expert

Instrument Details

Purpose

This section describes the as found system configuration.

Details

Spectrometer 1

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

Chiller 1

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

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

Switching Valve Accessory 1

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

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

Preparation

Purpose

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

Configuration Details

Model/Serial No.:

G8010A

MY16010005

Results

Criteria

Observed Result

Expected Result

Status

Does the plasma ignite successfully in the first three attempts?

Yes

Yes

Pass

Was the detector calibration performed and completed successfully?

Yes

Yes

Pass

Was the instrument calibration performed and completed successfully?

Yes

Yes

Pass

Date:

September 13, 2021 5:50:41 PM

System ID:

MY16010005

Test Evidence

Image Details:

Was the detector calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:07:42 AM

Host Name:

ASBKKWX328

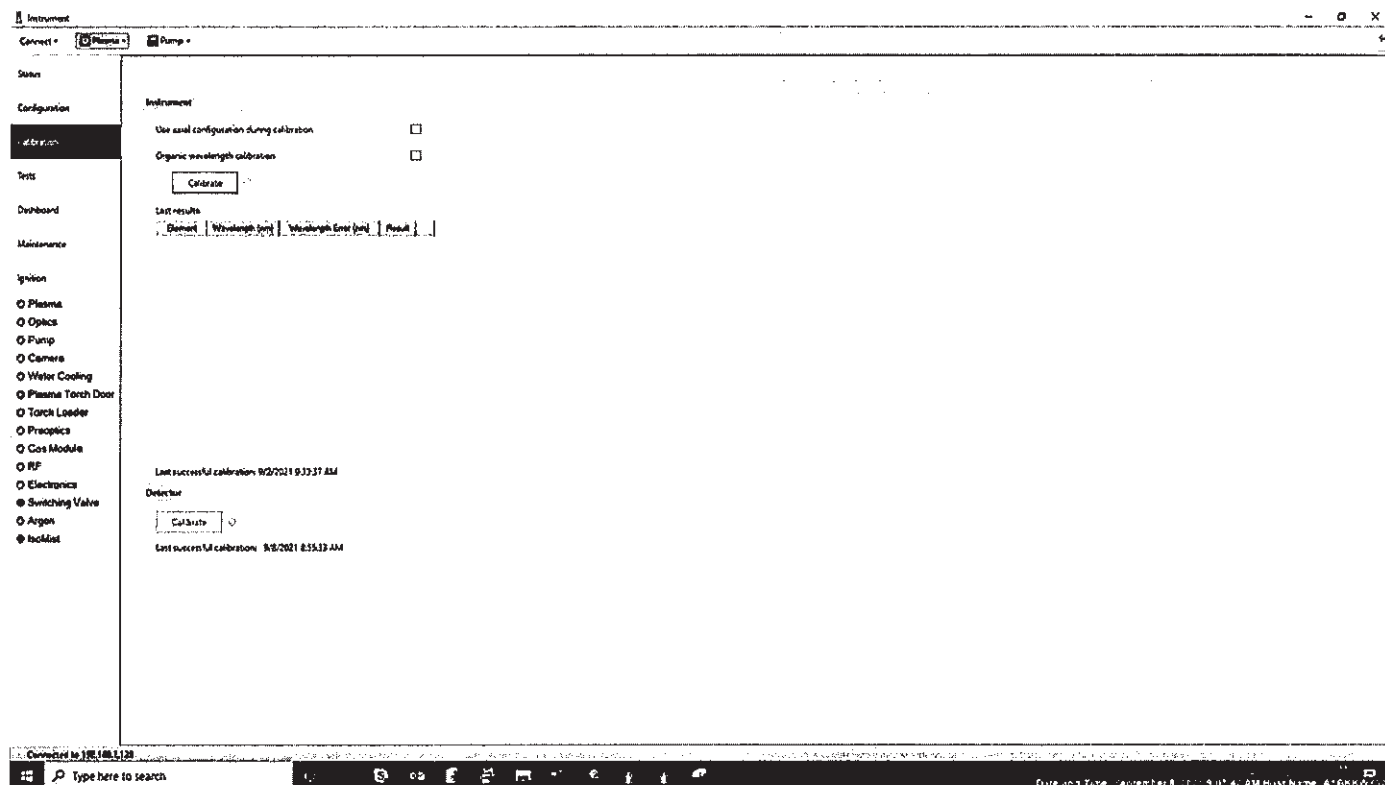


Image Details:

Was the instrument calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:33:30 AM

Host Name:

ASBKKWX328

The screenshot displays the 'Instrument' configuration window. On the left, a sidebar lists various components: Plasma, Optics, Pump, Camera, Water Cooling, Plasma Torch Door, Torch Loader, Pyrolysis, Gas Module, RF, Electronics, Switching Valve, Argon, and Purifier. The 'Plasma' component is selected. The main panel shows the 'Instrument' configuration with a 'Calibrate' button. Below this, a table titled 'Last results' displays calibration data for various elements. The table has four columns: Element, Wavelength (nm), Wavelength Error (nm), and Result. The results show successful calibrations for all elements listed. Below the table, it states 'Last successful calibration: 9/8/2021 9:33:07 AM'. A 'Detector' section with a 'Calibrate' button is also visible. At the bottom, it states 'Last successful calibration: 9/8/2021 8:55:33 AM'.

Element	Wavelength (nm)	Wavelength Error (nm)	Result
Al	187.019	0.008147	✓
H	172.213	0.001644	✓
As	186.94	-0.001437	✓
C	133.017	0.003076	✓
As	193.696	0.002520	✓
Se	196.026	0.004831	✓
Ma	202.032	-0.000364	✓
Zn	202.543	-0.005679	✓
Ma	203.848	0.004704	✓
Mo	254.596	0.002782	✓
Cr	205.36	-0.002789	✓
Zn	213.857	-0.004754	✓
Cd	214.439	-0.006227	✓
Pb	220.353	-0.005075	✓

Overall Test Status

Pass

Runs: 1

Instrument Tests

Purpose

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

Configuration Details

Model/Serial No.:

G8010A

MY16010005

Results

Observed Result

Expected Result

Status

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Yes

Yes

Pass

Air Flow

Yes

Yes

Pass

Water Flow

Yes

Yes

Pass

Gas Flows

Yes

Yes

Pass

RF Generator

Yes

Yes

Pass

Camera

Yes

Yes

Pass

Optics

Yes

Yes

Pass

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes

Yes

Pass

Sensitivity

Yes

Yes

Pass

Precision

Yes

Yes

Pass

Overall Test Status

Pass

Runs: 1

Autosampler Operation

Purpose

This test verifies that the autosampler operates properly.

Configuration Details

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

Results

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

Overall Test Status

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

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

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

General

Document Name:

Certificate of Qualification for ACE



Agilent Technologies

Agilent Compliance Engine Self Qualification

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

Drive Serial #: EAF04572

Platform Revision:

A.03.01

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
UV-Vis Spectrophotometer	13	Conforms
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Software	6	Conforms
Emission Spectroscopy	3	Conforms
Infrared Spectroscopy	7	Conforms

Overall Qualification Status

Conforms

General

Document Name: Certificate of Qualification for ACE

Certificate of Completion

Learner Name: Kanyakorn Sukpathrajarearn**Title Of Course:** AN-CE-SS-II-030-A: ACE 3.X User Update Training**Completion Date:** June 25, 2020**Certified By Company:** Learning at Agilent**All Service and Support training certificates have the following specific limitations.**

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Operator's training certificate and qualifications

Certificate of Completion

Learner Name: Kanyakorn Sukpathrajarern**Title Of Course:** ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training**Completion Date:** November 2, 2017**Certified By Company:** Learning at Agilent**All Service and Support training certificates have the following specific limitations.**

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Materials

Document Name:

Certificate of Analysis Wavelength calibration solution



CERTIFICATE OF ANALYSIS

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

Agilent Part No: 8610030100

Lot No: 0010578941

Product Specifications

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO ₃) ₃	7784-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.001 ± 0.025 mg/L
As	As	7440-38-2	5.001 ± 0.025 mg/L	Mo	(NH ₄) ₂ MoO ₄	13106-76-8	5.007 ± 0.025 mg/L
Ba	Ba(NO ₃) ₂	10022-31-8	5.000 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.004 ± 0.025 mg/L
Cd	Cd	7440-43-9	5.002 ± 0.025 mg/L	Pb	Pb	7439-92-1	4.999 ± 0.025 mg/L
Co	Co	7440-48-4	4.996 ± 0.025 mg/L	Se	Se	7782-49-2	5.004 ± 0.025 mg/L
Cr	Cr(NO ₃) ₃	13548-38-4	5.002 ± 0.025 mg/L	Sr	Sr(NO ₃) ₂	10042-76-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.007 ± 0.025 mg/L	Zn	Zn	7440-66-6	5.002 ± 0.025 mg/L
K	KNO ₃	7757-79-1	50.00 ± 0.25 mg/L				

Matrix: 5% HNO₃

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

Certification & Traceability: This CRM was manufactured under a quality management system that is registered to ISO 9001, ISO 17034 and ISO/IEC 17025. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid (HNO₃) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3113, 3112a, 3114, 3141a, 3132, 3134, 3136, 3128, 3149, 3153a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

Instructions for Use: Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

Date:
System ID:

 September 13, 2021 5:50:41 PM
 MY16010005

Document Name:

Certificate of Analysis Wavelength calibration solution



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

Date of release: 6 April 2020
Date of expiration: 6 October 2021

Sample lot approver:

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

Chuck Goudreau, Certifying Officer

Document Name:

Certificate of Analysis Wavelength calibration solution



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

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with QSP 8-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

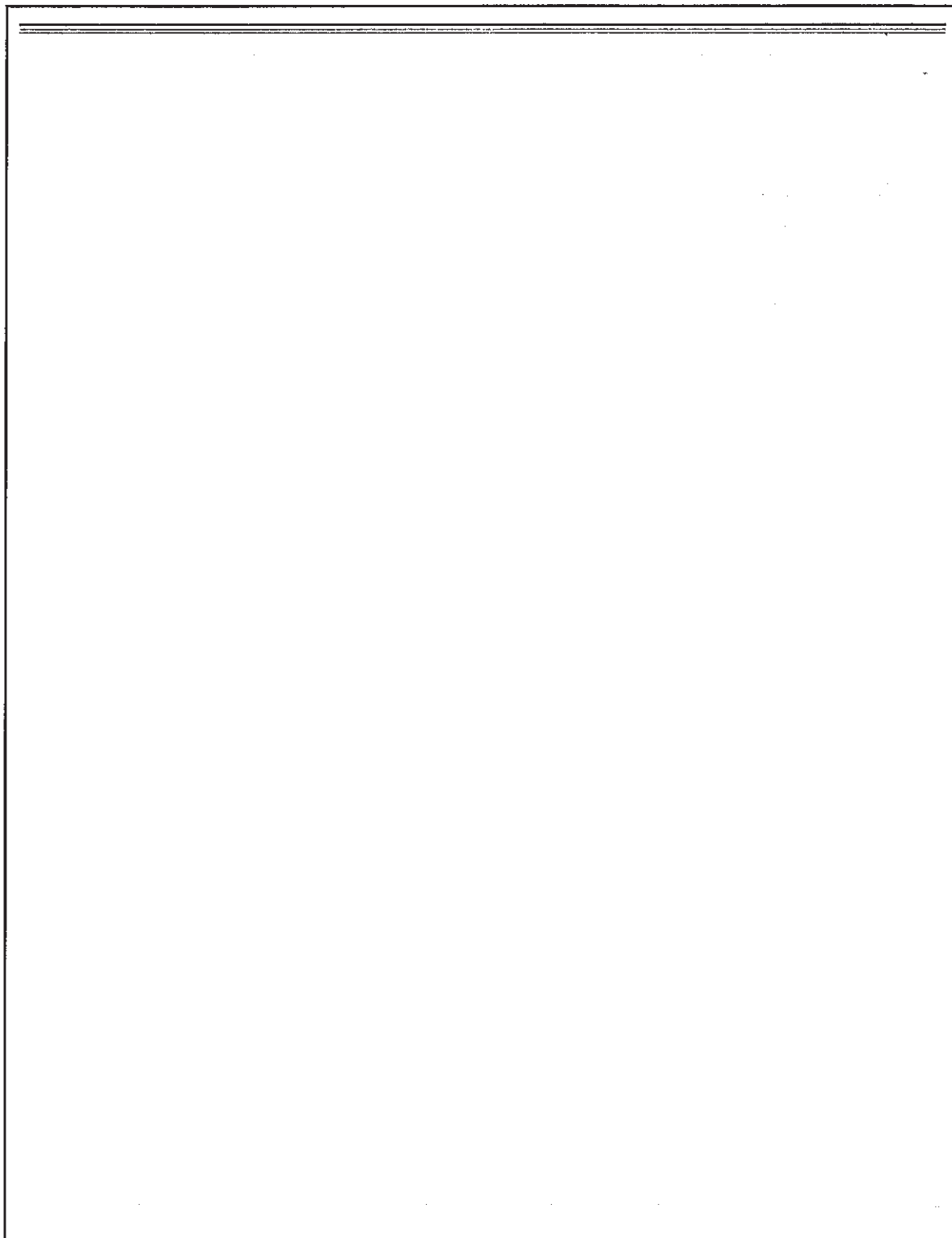
Further Information: Please contact Agilent for further information about this CRM.

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

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 16560231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.02)
 - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)

Document Name:

Certificate of Analysis Wavelength calibration solution



Comments

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

General

Document Name:

Instrument's Test Report

Report Summary

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

Result Summary

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

Subsystem Communications Test**Pass****Optics Test****Pass**

	Radial	Axial	SVDV
Intensity	3082176	3162050	3419288
Wavelength	737.212	737.212	737.212

Page 1 of 5

Date:
System ID:

September 13, 2021 5:50:41 PM
MY16010005

Document Name:

Instrument's Test Report

Resolution Test		Pass
Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.54
As (188.980 nm)	≤ 8.20	6.43
C (193.027 nm)	≤ 11.50	8.89
Mo (202.032 nm)	≤ 8.20	6.50
Cr (206.158 nm)	≤ 13.40	11.05
Zn (213.857 nm)	≤ 8.70	7.27
Pb (220.353 nm)	≤ 9.50	7.52
Co (228.615 nm)	≤ 17.20	12.66
Ba (230.424 nm)	≤ 9.40	7.80
Mn (257.610 nm)	≤ 13.30	9.99
Mn (260.568 nm)	≤ 20.30	16.83
Cr (267.716 nm)	≤ 11.00	8.53
Cu (324.754 nm)	≤ 25.00	19.14
Cu (327.395 nm)	≤ 14.20	11.75
Sr (338.071 nm)	≤ 33.50	26.94
Ba (455.403 nm)	≤ 44.00	33.57
Sr (460.733 nm)	≤ 36.00	22.38
Ba (493.408 nm)	≤ 36.00	25.86
Ba (614.171 nm)	≤ 42.00	28.49
Ar (675.283 nm)	≤ 74.00	60.58
K (766.491 nm)	≤ 80.00	66.42

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Document Name:

Instrument's Test Report

Sensitivity Test**Pass**

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	88.8	960.1	94.9
Se (196.026 nm)	≥ 41.0	SRBR	55.8	709.4	113.8
Zn (213.857 nm)	≥ 1421.0	SRBR	2095.3	29674.4	197.9
Pb (220.353 nm)	≥ 46.0	SRBR	100.6	1392.6	152.2
Mn (257.610 nm)	≥ 3518.0	SRBR	6641.7	127413.8	365.9
Al (396.152 nm)	≥ 3.4	SBR	6.9	24237.9	3081.8
Ba (493.408 nm)	≥ 34.0	SBR	95.1	1015416.2	10563.7
K (766.491 nm)	≥ 1.8	SBR	4.4	82043.9	15321.8

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	292.4	5108.5	273.5
Se (196.026 nm)	≥ 159.0	SRBR	199.9	3903.2	321.0
Zn (206.200 nm)	≥ 243.0	SRBR	793.6	12455.9	237.0
Zn (213.857 nm)	≥ 1743.0	SRBR	4924.5	130652.8	696.4
Cd (214.439 nm)	≥ 4227.0	SRBR	4508.6	87692.4	375.1
Pb (220.353 nm)	≥ 320.0	SRBR	327.3	7653.1	480.3
Mn (257.610 nm)	≥ 10625.0	SRBR	19008.6	632891.9	1104.7
Cr (267.716 nm)	≥ 1048.0	SRBR	4115.3	173999.6	1751.9
Cu (324.754 nm)	≥ 19.0	SBR	46.6	186303.3	3960.0
Al (396.152 nm)	≥ 6.0	SBR	16.7	156852.5	8877.5
Ba (493.408 nm)	≥ 60.0	SBR	168.0	5374075.7	31797.5
K (766.491 nm)	≥ 24.0	SBR	64.8	2536127.0	38564.9

Precision Test**Pass**

Radial

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

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Instrument's Test Report

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

Axial

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

Report Detail

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

SubSystem Status

Mains Power Module - Passed
 Gas Control Module - Passed
 RF Generator - Passed
 pre-optics Module - Passed
 Optics/Camera Control Module - Passed
 Peristaltic Pump - Passed
 Subsystem Communications Test Completed - Passed

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed
 Shutter opened - Passed
 Peak Intensity Radial mode 3082176.14 - Passed
 Shutter closed - Passed
 Peak Intensity(closed shutter) Radial mode 55.00 - Passed
 Shutter opened - Passed
 Optical Argon Ratio: Calculated Value = 2.56, Factory Value = 2.60
 Peak Intensity Axial mode 3162050.49 - Passed

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Instrument's Test Report

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

Instrument Performance- Started

Instrument Performance Completed - Passed

Page 5 of 5

General

Document Name:

Instrument's Test Report

Report Summary

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

Result Summary

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

Subsystem Communications Test

Pass

Air Flow Test

Pass

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

Water Flow Test

Pass

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

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System ID:

MY16010005

Document Name:

Instrument's Test Report

Gas Flows Test **Pass**

Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.71	276.73	2.00	2.00	106.21

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

RF Generator Test **Pass**

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

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

Camera Test **Pass**

Black Level Test	Noise Test	Photo Response Test
Passed	Passed	Passed

Optics Test **Pass**

	Radial	Axial	SVDV
Intensity	2965633	3009947	3265038
Wavelength	737.212	737.212	737.212

Report Detail

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

SubSystem Status

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

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System ID:

MY16010005

Document Name:

Instrument's Test Report

Peristaltic Pump - Passed
Subsystem Communications Test Completed - Passed

Air Flow- Started

Fan Speed(%) Air Flow(relative speed) Status

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

Water Flow- Started

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

Gas Flows- Started

Channel Target Actual Pressure Failure Status

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

RF Generator- Started

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

Camera Test- Started

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

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed

Page 3 of 4

Document Name:

Instrument's Test Report

Plasma ignite Started
Plasma ignite - Passed
Waiting 5 min for plasma warm up
Shutter opened - Passed
Peak Intensity Radial mode 2965632.60 - Passed
Shutter closed - Passed
Peak Intensity(closed shutter) Radial mode 55.46 - Passed
Shutter opened - Passed
Optical Argon Ratio: Calculated Value = 2.53, Factory Value = 2.60
Peak Intensity Axial mode 3009947.39 - Passed
Radial-Axial Intensity Ratio:(Range 0-100) - 1.01 - Passed
Peak Intensity Simultaneous mode 3265038.45 - Passed
Shutter closed - Passed
Optics Test Completed - Passed

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Date:
System ID:

September 13, 2021 5:50:41 PM
MY16010005

Electronic Signature

Purpose

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Details

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

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User Name: phlmpapha.jeeraphong
 Hostname: ASBKWX328

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

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

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

User Name: phimpapha.jeeraphong
 Hostname: ASBKWX328

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

QQHW 5100 ICPOES ALS 08Sep21 Transaction log :

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

User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

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

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

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



Metrological Center


SCI ECO Services Company Limited

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Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220730

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Certificate of Calibration

Equipment	: HEATING BLOCK
Manufacturer	: Environmental Express
Model	: SC 196
Serial No.	: 6974CECW3285
Customer Code	: BKK_EL0054
ID No.	: T5306A3
Customer	: ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	: Acid Digestion Lab
Date of Receipt	: 30 March 2022
Calibrated By	: Watcharapon Sangtong (Technician)
Approved By	:  / Sujjar Naknakred (Site Calibration Manager)
Date of Issue	: <u>12 APR 2022</u>

REVIEW BY	Tattaporn C.
APPROVED BY	Santun.
NEXT CAL. DATE	7/10/23

The uncertainties are for a confidence probability of approximately 95%.

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SCI ECO Services Company Limited

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

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T220730

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Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 7 April 2022
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 25 Minute At 95 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

Approved By.



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

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

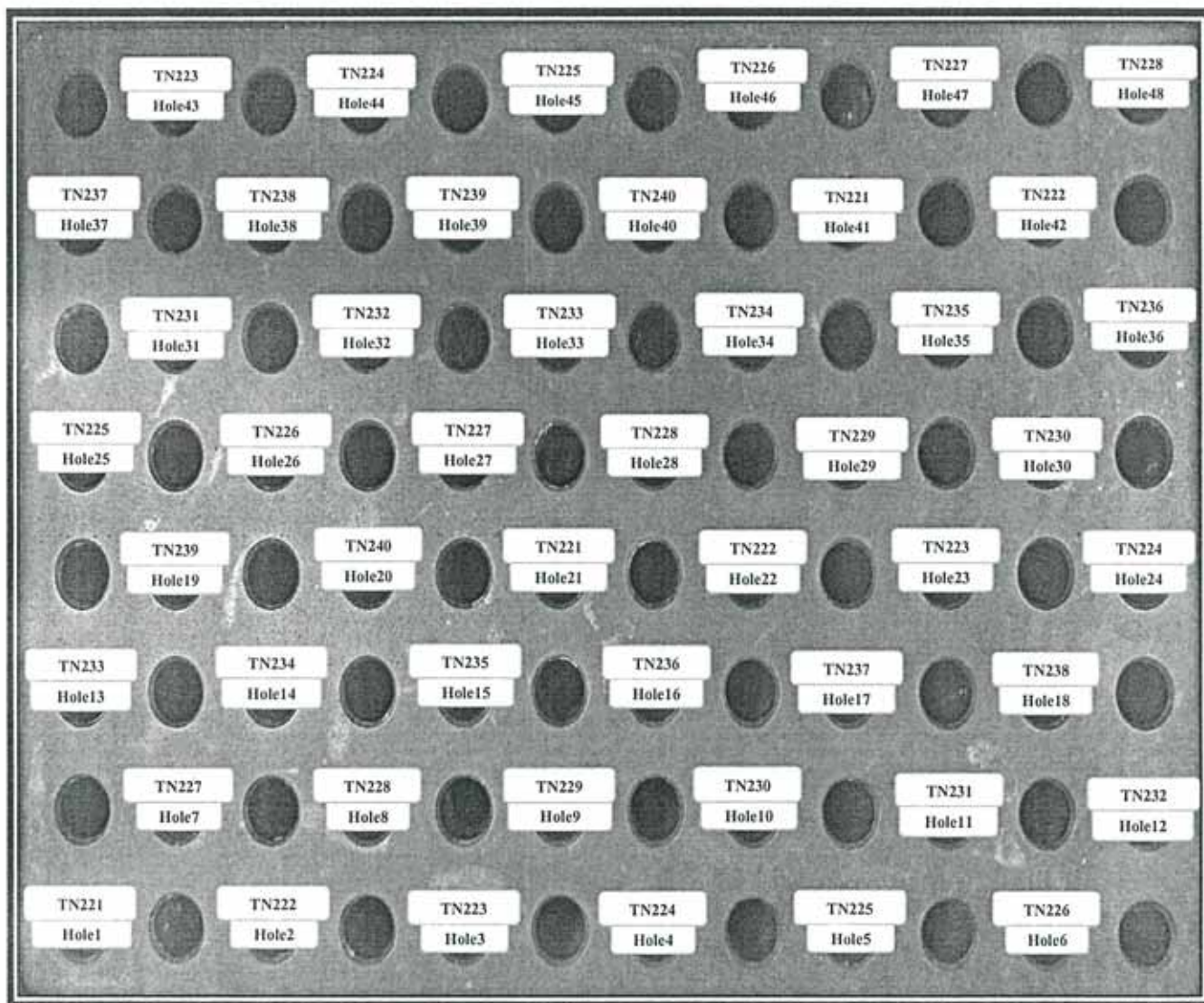
Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th


Certificate No. T220730

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Calibration Report



FRONT CONTROL

Approved By. 

Certificate No. T220730

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	93.60	93.82	94.05	94.20	94.36	94.26
95	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.46	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73	96.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	96.01	96.10	96.02	96.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95	97.09
	Min	96.13	95.84	95.85	95.72	96.64	96.78
	Average	96.30	95.99	96.02	95.89	96.80	96.93
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By. _____



Certificate No. T220730

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (° C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	104.47	104.65	104.79	105.31	105.47	105.46
105	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.68	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.90	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

Approved By. _____



Certificate No. T220730

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Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (\pm °C)	Uncertainty (\pm °C)
	Min , Max	Average		
100.0	100.0 , 100.4	100.1	0.29	0.83
105.0	105.0 , 105.4	105.1	0.20	0.79

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

 Approved By. 



Agilent CrossLab Compliance

Qualification Type: ICPMS-OQ

System ID: JP15471169

EQP Name: AgilentRecommended

EQP Revision: ICPMS.02.50

EQP Publish Date: March 2020

Date: September 30, 2021 4:07:18 PM

Report Type: Report

Org. Name: ALS Laboratory Group (Thailand) Co.,Ltd.

Org. Location: 104 Phattanakarn 40, Suan Luang, Bangkok 10250.

REVIEW BY	<i>Sepakorn M.</i>
APPROVED BY	<i>Sauntan N.</i>
NEXT CAL. DATE	<i>29 March 2023</i>

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Test Summary

Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

Details

Test	Status	Runs
Autosampler Check : SPS4	Pass	1
Integrated Sample Introduction System (ISIS) Check : ISIS3	Pass	1
Autotune : G8403A	Pass	1
Background (No Gas Mode) : G8403A	Pass	1
Background (Gas Modes) : G8403A	Pass	1
20-Minute Stability (No Gas Mode) : G8403A	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details

Service Order No./Request: 6004837154
EQP Name: AgilentRecommended
EQP Revision: ICPMS.02.50
Report Type: Report

Organization Details

Name: ALS Laboratory Group (Thailand) Co.,Ltd.
Location: 104 Phattanakarn 40, Suan Luang, Bangkok 10250.

Local Contact Details

Name: Chatchanai Komarakul.
Job Title: Manager
Qualification Location: Laboratory

Operator Details

Name: Panthep Kurasathain
Job Title: Field Service Emgineer.

Data Acquisition Details

Acquisition Software Name: MassHunter
Acquisition Software Revision: C.01.04

Customer Data System (CDS): IcpMs: MassHunter

Instrument Details

Purpose

This section describes the as found system configuration.

Details

ICP-MS 1

Manufacturer	Agilent Technologies
Name	7900
Model Number	G8403A
Installed Options	#100H: Standard Package with Hydrogen option
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP15471169
Firmware Revision	C.01.04

ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS3
Model Number	G8411A
Type	Peristaltic pump system
Serial Number	JP15510227

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15430722

Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	3U1610713

Calculation Formulas

Purpose

This section includes calculation formulas for all available tests. Depending upon which tests are scheduled, all or some apply to your qualification.

For a description of calculations for ICP-MS tests performed by the MassHunter software, refer to the MassHunter application and documentation.

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ICPMS.02.50	20-Minute Stability (No Gas Mode)
ICPMS.02.50	Autosampler Check
ICPMS.02.50	Autotune
ICPMS.02.50	Background (Gas Modes)
ICPMS.02.50	Background (No Gas Mode)
ICPMS.02.50	Integrated Sample Introduction System (ISIS) Check

Autosampler Check

Purpose

This test demonstrates that the autosampler module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
After the self test, is probe in the home position?	Yes	Yes	Pass
As commanded, is the probe positioned at vial 2?	Yes	Yes	Pass
Setpoint Status:	Pass		Runs: 1

Overall Autosampler Check Test Status

Pass

Integrated Sample Introduction System (ISIS) Check

Purpose

This test demonstrates that the ISIS module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
As commanded, does the pump rotate?	Yes	Yes	Pass
As commanded, do the valves load and inject?	Yes	Yes	Pass

Setpoint Status:

Pass

Runs: 1

Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

Autotune

Purpose

This test uses traceable checkout standards to run a software-executed autotune in all modes. The tune report provides values for peak width, mass axis, sensitivity, oxide species, and doubly-charged species tests.

Setpoint

Results

Peakwidth Mass 7

Agilent Recommended:

	0.719	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Peakwidth Mass 89

Agilent Recommended:

	0.750	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Peakwidth Mass 205

Agilent Recommended:

	0.713	AMU
>=	0.65	
<=	0.80	

Status:

Pass

Mass Axis 7

Agilent Recommended:

	7.05	AMU
>=	6.9	
<=	7.1	

Status:

Pass

Mass Axis 89

Agilent Recommended:

	88.95	AMU
>=	88.9	
<=	89.1	

Status:

Pass

Mass Axis 205

Agilent Recommended:

	205.00	AMU
>=	204.9	
<=	205.1	

Status:

Pass

Mass 7 Sensitivity No Gas

94.28

Mcps/ppm

Agilent Recommended:

>=

25.5

Status:

Pass

Mass 89 Sensitivity No Gas

307.15

Mcps/ppm

Agilent Recommended:

>=

127.5

Status:

Pass

Mass 205 Sensitivity No Gas

203.77

Mcps/ppm

Agilent Recommended:

>=

76.5

Status:

Pass

Mass 59 Sensitivity He

28.38

Mcps/ppm

Agilent Recommended:

>=

23.8

Status:

Pass

Mass 89 Sensitivity H2

129.27

Mcps/ppm

Agilent Recommended:

>=

68

Status:

Pass

Oxide Ratio 156/140

1.047

%

Agilent Recommended:

<=

1.38

Status:

Pass

Doubly Charged Species Ratio 70/140

1.482

%

Agilent Recommended:

<=

2.3

Status:

Pass

Setpoint Status:

Pass

Runs: 1

Overall Autotune Test Status

Pass

Background (No Gas Mode)

Purpose

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run.

Setpoint

Conditions

Masses:	7	AMU
	89	AMU
	205	AMU

Measurements and Results

Masses (AMU):	7	89	205	
Measured Value:	3.200	3.300	9.900	cps
Agilent Recommended:	<= 6.9	<= 4.6	<= 11.5	
Status:	Pass	Pass	Pass	

Setpoint Status:

Pass

Runs: 1

Overall Background (No Gas Mode) Test Status

Pass

Background (Gas Mode)

Purpose

This test examines the background of the ICP-MS in the various gas modes by monitoring ions during a blank run.

Setpoint Gas Mode: Helium

Conditions

Mass: 78 AMU
Integration Time: 1.0 sec
Cycles: 20

Measurements and Results

Mass (AMU): 78
Measured Value: 42.8500 cps
Agilent Recommended: ≤ 115
Status: Pass

Setpoint Status: Pass

Runs: 1

Setpoint Gas Mode: Hydrogen

Conditions

Mass: 78 AMU
Integration Time: 1.0 sec
Cycles: 20

Measurements and Results

Mass (AMU): 78
Measured Value: 2.1500 cps
Agilent Recommended: ≤ 4.6
Status: Pass

Setpoint Status: Pass

Runs: 1

Overall Background (Gas Mode) Test Status

Pass

20-Minute Stability (No Gas Mode)

Purpose

This test monitors the abundance of ions present in the checkout standard over a 20-minute period to verify that the signal is stable. The %RSD of the abundance of given ions is calculated internally by the software and compared to the limit.

Setpoint

Conditions

Mode:	Spectrum	
Masses:	7, 9, 59, 89, 140, 205	
Integration Time:	9.99	sec
Peak Pattern:	3	points/peak
Repetitions:	20	
Sweeps/Replicates:	100	

Measurements and Results

Masses (AMU):	7	89	205	
Stability RSD:	0.96400	0.51495	0.73011	%
Agilent Recommended:	<= 2.3	<= 2.3	<= 2.3	
Status:	Pass	Pass	Pass	

Setpoint Status: Pass Runs: 1

Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
EQR	General	Certificate of System Qualification	18
EQR	General	Operator's training certificate and qualifications	19
EQR	General	Certificate of Qualification for ACE	20
EQR	General	Certificate of Qualification for ACE	21
EQR	General	Tune reports	22
EQR	General	Test Report	25
EQR	General	Test Report	27
EQR	General	Test Report	29

General

Document Name: Certificate of System Qualification



Agilent Technologies

Agilent Compliance Engine Self Qualification

Date: September 14, 2021 4:59:15 PM

Drive Serial #: ACA025C9

Platform Revision:

ACE 3.11

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	8	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	9	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

Overall Qualification Status

Conforms

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

General

Document Name: Operator's training certificate and qualifications



Certificate of Completion

Learner Name:	Panthep Kurasathain
Title Of Course:	AN-CE-ICPMS-2-038-A:Agilent 7900 ICPMS FSE update training
Completion Date:	June 7, 2014
Certified By Company:	Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE



Certificate of Completion

Learner Name: Panthep Kurasathain

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

Completion Date: July 7, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE



Certificate of Completion

Learner Name:	Panthep Kurasathain
Title Of Course:	AN-CE-ICPMS-2-035-B: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-MS Systems
Completion Date:	October 31, 2020
Certified By Company:	Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

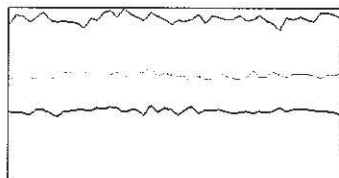
Document Name: Tune reports

Tune Report

Operator Name Supakwan Mak
 Acq/Data Batch C:\Agilent\ICPMH1\UserTune_7900.b
 Acq. Date-Time 2021-09-30 14:44:08
 Report Comment OQ 30 Sep 2021
 Instrument Name G8403A.JP15471169

[No Gas]

Sensitivity



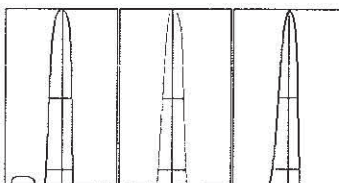
Mass	Range	Count	RSD%	Background
7	10000	9428	2.630	3.200
89	50000	30715	2.825	3.300
205	50000	20377	3.319	9.900

Sampling Period [sec] 0.311
 Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.047 %
 Doubly Charged 70 / 140 1.482 %

Resolution/Axis



Mass	Peak Height	Axis	W-50%	W-10%
7	9474.89	7.05	0.62	0.719
89	30716.43	88.95	0.59	0.750
205	20596.12	205.00	0.52	0.713

Integration Time [sec] 0.1
 Acquisition Time [sec] 22.74
 Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	---	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.1 V	Deflect	13.6 V
Extract 2	-205.0 V	Cell Entrance	-30 V	Plate Bias	-35 V
Omega Bias	-90 V	Cell Exit	-50 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		

1 of 3

2021-09-30 2:44 PM

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

Document Name:

Tune reports

Tune Report

H2 Flow 0.0 mL/min

OctP RF 190 V

QP Parameters

Mass Gain 124

Axis Gain 0.9990

QP Bias -3.0 V

Mass Offset 125

Axis Offset 0.01

Hardware Settings

Torch

Torch H -0.3 mm

Torch V 0.1 mm

EM

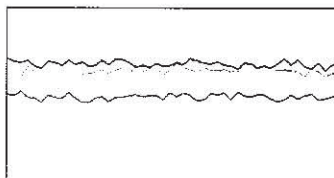
Discriminator 4.0 mV

Analog HV 2247 V

Pulse HV 1318 V

[Hz]

Sensitivity



Mass	Range	Count	RSD%	Background
59	5000	2453	3.423	0.400
89	20000	12927	2.822	0.200
205	20000	13635	2.445	8.701

Sampling Period [sec] 0.31

Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 0.804 %

Doubly Charged 70 / 140 1.020 %

Tune Parameters

Plasma Parameters

Plasma Mode ---

Nebulizer Gas 1.00 L/min

Makeup Gas 0.10 L/min

RF Power 1550 W

Option Gas ---

Auxiliary Gas 0.90 L/min

RF Matching 1.10 V

Nebulizer Pump 0.10 rps

Plasma Gas 15.0 L/min

Sample Depth 9.0 mm

S/C Temp 2 °C

Lens Parameters

Extract 1 0.0 V

Omega Lens 9.0 V

Deflect 6.0 V

Extract 2 -210.0 V

Cell Entrance -30 V

Plate Bias -100 V

Omega Bias -105 V

Cell Exit -90 V

Cell Parameters

Use Gas Yes

3rd Gas Flow ---

Energy Discrimination 3.5 V

He Flow 0.0 mL/min

OctP Bias -22.0 V

H2 Flow 5.0 mL/min

OctP RF 200 V

QP Parameters

Mass Gain 124

Axis Gain 0.9990

QP Bias -18.5 V

Mass Offset 125

Axis Offset 0.01

Hardware Settings

Torch

Torch H -0.3 mm

Torch V 0.1 mm

2 of 3

2021-09-30 2:44 PM

Document Name:

Tune reports

Tune Report

EM

Discriminator

4.0 mV

Analog HV

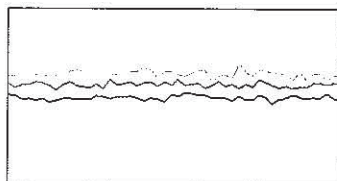
2247 V

Pulse HV

1318 V

[He]

Sensitivity



Mass	Range	Count	RSD%	Background
59	5000	2838	2.592	6.000
89	5000	3149	3.359	5.200
205	20000	9837	2.895	4.201

Sampling Period [sec] 0.31

Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide 156 / 140 0.498 %

Doubly Charged 70 / 140 0.788 %

Tune Parameters

Plasma Parameters

Plasma Mode	---	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.2 V	Deflect	12.4 V
Extract 2	-225.0 V	Cell Entrance	-30 V	Plate Bias	-100 V
Omega Bias	-105 V	Cell Exit	-50 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	---	Energy Discrimination	3.5 V
He Flow	3.8 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	124	Axis Gain	0.9990	QP Bias	-4.5 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch

Torch H	-0.3 mm	Torch V	0.1 mm
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EM

Discriminator	4.0 mV	Analog HV	2247 V	Pulse HV	1318 V
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3 of 3

2021-09-30 2:44 PM

General

Document Name: Test Report

Batch Summary Report

Batch Folder: C:\Batch2021\BG He.b\
Analysis File: BG He.batch.bin
Tune Step: #1 He

	Rjct	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 14:21:47	BG He.d	BG He	Sample		1.0000

Document Name:

Test Report

Batch Summary Report

Analyte Table

		78	[He1]
	Sample Name	CPS	
1	BG He	42.8500	

Page 2 / 2

2021-09-30 14:23:40

General

Document Name:

Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\BG H2 new.b\
Analysis File: BG H2 new.batch.bin
Tune Step: #1 H2

	Rict	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:08:58	BG H2.d	BG H2	Sample		1.0000

Document Name:

Test Report

Batch Summary Report

Analyte Table

		78	[H2]
	Sample Name		CPS
1	BG H2		2.1500

Page 2 / 2

2021-09-30 15:10:31

General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\20 Min.b\
Analysis File: 20 Min.batch.bin
Tune Step: #1 No Gas

	Rect	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:17:44	20 Min.d	20 Min	Sample		1.0000

Document Name:

Test Report

Batch Summary Report

Analyte Table

		7 [No Gas]	9 [No Gas]	59 [No Gas]	89 [No Gas]	140 [No Gas]	205 [No Gas]
	Sample Name	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD
1	20 Min	0.96400	7.02464	0.46857	0.51495	0.61014	0.73011

Electronic Signature

Purpose

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

Details

Full Name of Signer:	Panthep Kurasathain
Logged On User Name:	panthep_kurasathain@agilent.com
Signature Creation Date:	September 30, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: panthep_kurasathain
 Hostname: ASBKKWX315

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

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:50:07 PM	Audit	SessionCreated	Session	None
September 30, 2021 3:50:07 PM	Start	Configuration	Session	None
September 30, 2021 3:50:07 PM	Audit	Entitlement	Licensing	User Is FieldEngineer and does not require an unlock code
September 30, 2021 3:52:52 PM	Audit	EqpLoaded	Session	EQP details for primary technique [lcpMs] - File path: [ProtocolPacks/lcpMs/Configurations/02.50/lcpMs.02.50.eqp], EQP File Name: [lcpMs.02.50.eqp], EQP Name: [AgilentRecommended]
September 30, 2021 3:52:54 PM	End	Configuration	Session	None
September 30, 2021 3:52:57 PM	Start	Qualification	Session	OQ
September 30, 2021 3:52:57 PM	Start	Execution	Autosampler Check : SPS4: Autosampler Check	None
September 30, 2021 3:53:03 PM	End	Execution	Autosampler Check : SPS4: Autosampler Check	Run Count : 1
September 30, 2021 3:53:04 PM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	None
September 30, 2021 3:53:08 PM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	Run Count : 1

User Name: panthep_kurasathain
 Hostname: ASBKKWX315

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

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:53:10 PM	Start	Execution	Autotune : G8403A: Autotune 1	None
September 30, 2021 3:55:08 PM	End	Execution	Autotune : G8403A: Autotune 1	Run Count : 1
September 30, 2021 3:55:12 PM	Start	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	None
September 30, 2021 3:55:40 PM	End	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	Run Count : 1
September 30, 2021 3:55:43 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	None
September 30, 2021 3:56:17 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	Run Count : 1
September 30, 2021 3:56:19 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	None
September 30, 2021 3:56:38 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	Run Count : 1
September 30, 2021 3:56:41 PM	Start	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	None
September 30, 2021 3:57:22 PM	End	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
September 30, 2021 3:57:24 PM	End	Qualification	Session	OQ
September 30, 2021 3:57:24 PM	Start	Reporting	Session	None

User Name: panthep_kurasathain
Hostname: ASBKKWX315

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

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 4:03:07 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:03:17 PM	Audit	Reporting	Session	Report Generated : Report
September 30, 2021 4:03:59 PM	Start	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	End	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	Start	Reporting	Session	None
September 30, 2021 4:04:26 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:04:36 PM	Audit	Reporting	Session	Report Generated : Report

REVIEW BY	Sudarot N.
APPROVED BY	Samir N.
NEXT CAL. DATE	5/06/2023

Maintenance Protocol

Atomic Fluorescence Spectrometer

**mercur DUO /
mercur DUO plus**

Serial-No.: R170A0143 Customer-No.: C104-002
Date: 6/06/2022. Carried out by: Mr. Srichai Fah-on.

Maintenance with following Operational Qualification (OQ)
(requires a separate OQ protocol)



Company	บริษัท 10110105 1101057000' จำกัด (มหาชน) อื่นๆ.
User	สุริชัย นาน้อย
Department	Lab
Street	104 ซอยพหลโยธิน 40 ถนนพหลโยธิน แขวงจตุจักร
Zip Code, City	17500 กรุงเทพมหานคร 10250
Country	ประเทศไทย
Phone	
Fax	
E-mail	

Maintenance works basic unit

tightness visual check inside the Mercur	<input checked="" type="checkbox"/>
visual check if gold-traps are broken	<input checked="" type="checkbox"/>
visual check if spectrometer is contaminated	<input checked="" type="checkbox"/>
visual check of the fluorescence cell	<input checked="" type="checkbox"/>
visual check of the absorption cell, incl. window	<input checked="" type="checkbox"/>
reactor cleaning	<input checked="" type="checkbox"/>
check pump-hose, if necessary change it	<input checked="" type="checkbox"/>
check swivel drive (SEV)	<input checked="" type="checkbox"/>
check drying-hose, output gas-liquid-separator	<input checked="" type="checkbox"/>
test Bubble-Sensor	<input checked="" type="checkbox"/>
check gas flows	<input checked="" type="checkbox"/>
check volume flows, reagents	<input checked="" type="checkbox"/>
recording stray light values	<input checked="" type="checkbox"/>
measurement with 30 ng/l	<input checked="" type="checkbox"/>

Maintenance works Autosampler

Serial No.: 52 1102 250

lubricate the dosing-winding (Teflon-grease-spray)	<input checked="" type="checkbox"/>
clean the dosing cylinder, if necessary exchange it	<input checked="" type="checkbox"/>
lubricate the winding system of the height drive with some drops of oil	<input checked="" type="checkbox"/>
check the toothed belt	<input checked="" type="checkbox"/>
check the position of the mechanical stopper (height: 13mm)	<input checked="" type="checkbox"/>
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	<input checked="" type="checkbox"/>
check the pump rate of washing cup	<input checked="" type="checkbox"/>
check the electrical hose connections for good contact	<input checked="" type="checkbox"/>
check the connectors of the magnetic valves	<input checked="" type="checkbox"/>
check the dosing hose for buckling, if necessary exchange it	<input checked="" type="checkbox"/>

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps <i>(Goldtraps 2 / NG)</i>	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor	o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	<i>1.5 bar</i>
Valve 1	10 NI/h or 0.166 NL/min	<i>0.166</i>
Valve 2	50 NI/h or 0.833 NL/min	<i>0.831</i>
Valve 3	5 NI/h or 0.083 NL/min	<i>0.084</i>
Valve 4	10 NI/h or 0.166 NL/min	<i>0.167</i>
Check liquidflow		
Acid	2.5ml/min ± 1 ml	<i>2.5 ml/min.</i>
Red.-agent	2.5ml/min ± 1 ml	<i>2.5 ml/min.</i>
Sample	10ml/min ± 2 ml	<i>10 ml/min.</i>
Adventitious light - values	(V)	from file
100	<i>0</i>	<i>0</i>
200	<i>0</i>	<i>0</i>
300	<i>0</i>	<i>0</i>
350	<i>0</i>	<i>1</i>
400	<i>1</i>	<i>3</i>
450	<i>4</i>	<i>7</i>
500	<i>9</i>	<i>17</i>
550	<i>19</i>	<i>36</i>
575	<i>26</i>	<i>51</i>
600	<i>36</i>	<i>91.</i>

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: ... <u>369</u> ...V		
Blank-solution		Int. <u>0.0003</u>
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int ₁ <u>0.0058</u> RSD <u>1.07</u> %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: ... <u>352</u> ...V		
Blank-solution		Int. <u>0.0040</u>
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int ₂ <u>0.0244</u> RSD <u>0.87</u> %
Fok.- factor (Int ₂ / Int ₁)	> 3.5	<u>4.206</u>
Analytical parameters Absorption cell		
Blank-solution		Ext. <u>0.0010</u>
without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext. <u>0.0048</u> RSD <u>3.92</u> %
Comments		

Mr. Srithai Pak-on
Signature Technician

Bangkok, 6/06/2022
Place, Date (DD/MM/YYYY)

สอริส ปะกอน
Signature Customer

6/06/2022
Place, Date (DD/MM/YYYY)



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)

CALIBRATION AND TESTING EQUIPMENT SERVICES

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000-24 FAX. 0-2719-9484

Cert. No.: 21TM2188

Page.: 1 of 3

Certificate of Calibration

Equipment : Autoclave

Manufacturer : AES Laboratory

Model : Masterclave 528

Serial No. : 34677152

ID No. : BKK_ML0043

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

Location : Media Preparation Room

Received Order : 1 December 2021

Calibration Date : 1 December 2021

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Khit Ruttanaprapachai

REVIEW BY	Sithichokt.
APPROVED BY	
NEXT CAL. DATE	01/06/23

Approved by :
Approved Signatory

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

Issue Date : 7 December 2021

The Uncertainties are for a confidence probability of approximately 95%.

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

A 0007203



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2112-0002OC-2
Procedure Used :-

Cert. No.: 21TM2188

Page.: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

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

4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3**

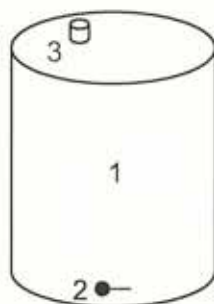
(** = Categorization of pathogens according to hazard and categories of containment, second edition, 1990)

It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source



	<u>Environmental</u>		
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	51	220
Finished of Calibration	25	53	221

<u>Position</u>	<u>Description</u>	<u>Ref. Std. ID No.:</u>
1 =	Center of chamber	19-14TC-01
2 =	Temperature sensor	19-14TC-02
3 =	Exhaust port	19-14TC-03

Maku



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2112-0002OC-2

Cert. No.: 21TM2188

Page.: 3 of 3

Result of Calibration :- (*) Without Adjustment

Operating parameter Set : Temperature = 121.0 °C

Sterilization period = 15 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (bar)	Uncertainty (± °C)	Coverage Factor <i>k</i>
121.0	120.7	1	120.792	0.078	1.1	0.75	2
		2	120.674				
		3	120.815				

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

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

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

-o0o-

Malu.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM102

Page.: 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : SHEL-LAB
Model : 1915A
Serial No. : 0200599
ID No. : BKK_ML0010
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Location : Incubation & Micrological Reading
Received Order : 21 January 2022
Calibration Date : 21 January 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Krisda Malee

REVIEW BY	Sithichok T.
APPROVED BY	[Signature]
NEXT CAL. DATE	22/07/23

Approved by :

Malu

Approved Signatory

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

Issue Date :

3 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0037377



Equipment : Incubator
 Condition As-Received : Used Item
 Reference : 2201-0616OC-1

Cert. No.: 22TM102

Page.: 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	21LM7	16 Jun 2022

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

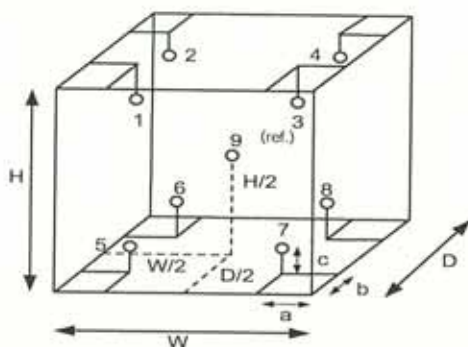
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	26	25
REL.Humid. (%)	53	54
AC Supply (Volt)	220	221



Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-06
7	18-18RTD-07
8	18-18RTD-08
9 (ref.)	18-18RTD-09

Probe Installation Details :

a = 10 cm
 b = 10 cm
 c = 10 cm

Dimension of Chamber :

D = 0.90 m
 W = 0.75 m
 H = 1.2 m
 Capacity = 0.81 m³

Malu .



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2201-0616OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM102

Page.: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.043	0.41	0.42	0.30	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
35.0	34.801	34.868	34.862	35.012	35.040	35.010	35.084	35.040	35.178

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

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

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

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

UUC* : Unit Under Calibration

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

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

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Malu.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 21TM1101

Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Binder

Model : ED240/E2

Serial No. : 00-15533

ID No. : BKK_ML0013

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

Location : Media Preparation Room

Received Order : 7 June 2021

Calibration Date : 7 June 2021

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by :

Malee

Approved Signatory

() Pornthippa Tameyakul

(☒) Malee Butkruea

() Suwit Imjai

Issue Date : 21 June 2021

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2106-0101OC-2

Cert. No.: 21TM1101
 Page.: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013823	21LM3	26 Feb 2022

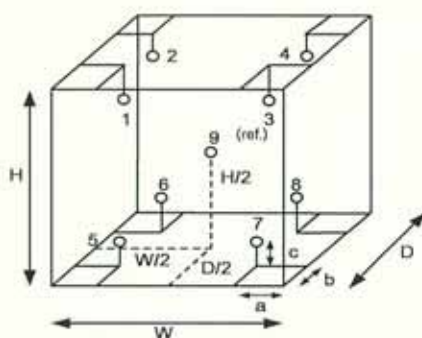
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	26	27
REL.Humid. (%)	65	72
AC Supply (Volt)	220	222

Position :	Ref. Std. ID No.:
1	19-17TC-01
2	19-17TC-02
3	19-17TC-03
4	19-17TC-04
5	19-17TC-05
6	19-17TC-06
7	19-17TC-07
8	19-17TC-08
9 (ref.)	19-17TC-09

Probe Installation Details :

a = 5.0 cm
 b = 5.0 cm
 c = 5.0 cm

Dimension of Chamber :

D = 0.50 m
 W = 0.80 m
 H = 0.60 m
 Capacity = 0.24 m³

make .



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2106-0101OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 21TM1101
Page.: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
180	180	180	0.67	2.4	3.3	1.5	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
180	179.315	181.249	178.684	180.035	179.941	180.511	178.429	180.268	179.065

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

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

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

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

UUC* : Unit Under Calibration

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

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

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Maku



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM677

Page.: 1 of 3

Certificate of Calibration

Equipment :	Water Bath
Manufacturer :	Memmert
Model :	WNE 45
Serial No. :	L712.0429
ID No. :	BKK_ML0056
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang , Bangkok 10250 Thailand
Location :	Incubator & Microbiological Reading
Received Order :	20 May 2022
Calibration Date :	20 May 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by :


Approved Signatory

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

Issue Date : 24 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0041433



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2205-0404OC-1

Cert. No.: 22TM677

Page.: 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument

Model

Serial No.

Cert. No.

Due Date

1) Data Acquisition

34972A

MY57013823

22LM24

26 Feb 2023

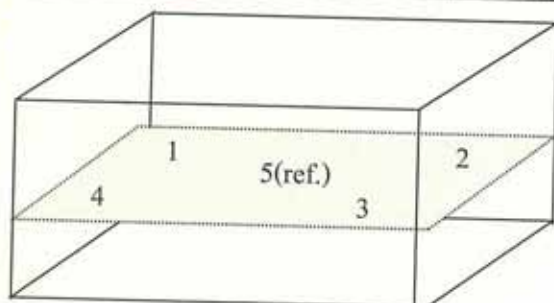
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

	Environmental		AC Voltage Supply (Volt)
	(°C)	(%R.H.)	
Beginning of Calibration	24	47	220
Finished of Calibration	24	52	221



Front

Position :	Ref. Std. S/N.:
1	4804539-006
2	4804539-007
3	4804539-008
4	4804539-009
5(ref.)	4804539-010

Signature



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2205-0404OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 22TM677

Page.: 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.4	44.4	44.539	44.497	44.476	44.506	44.507

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
44.5	0.068	0.030	0.15	2

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

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

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

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

-o0o-

Chait