

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ



EMISSION TEST RESULT

Client: General Electric International OCo., Inc.
Date: 05 Oct 24
Start Time: 10:10
SO₂ Analyzer Model: TELEDYNE API 100EH
NO_x/O₂ Analyzer Model: TELEDYNE API 200EH
CO/CO₂ Analyzer Model: TELEDYNE API 300EH

Run # 1
Location: HRSG #1
Test Operator: Sathaporn T.
Finish Time: 10:30
Serial No.: 410
Serial No.: 735
Serial No.: 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:10	14.52	3.71	8.30	0.77	21.25	
10:11	14.51	3.67	8.27	0.80	21.02	
10:12	14.52	3.72	8.25	0.77	20.73	
10:13	14.53	3.68	8.18	0.74	21.18	
10:14	14.52	3.72	8.24	0.76	20.28	
10:15	14.52	3.73	8.21	0.78	21.07	
10:16	14.53	3.72	8.23	0.78	20.87	
10:17	14.53	3.70	8.27	0.76	19.86	
10:18	14.53	3.69	8.31	0.77	19.68	
10:19	14.53	3.72	8.44	0.78	20.70	
10:20	14.53	3.69	9.43	0.75	20.58	
10:21	14.53	3.71	9.68	0.75	20.53	
10:22	14.52	3.73	9.07	0.79	20.55	
10:23	14.53	3.70	9.02	0.80	20.49	
10:24	14.52	3.71	8.93	0.76	20.55	
10:25	14.53	3.70	8.86	0.77	20.58	
10:26	14.53	3.69	8.82	0.78	20.77	
10:27	14.53	3.67	8.89	0.75	20.45	
10:28	14.53	3.72	8.90	0.77	19.93	
10:29	14.53	3.67	8.90	0.77	20.73	
10:30	14.55	3.68	8.91	0.75	20.80	
Average	14.53	3.70	8.73	0.77	20.57	

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-062 REVISION NO. 1 ISSUE DATE: 18/01/24
ALS Laboratory Group



EMISSION TEST RESULT

Client: General Electric International OCo., Inc.
Date: 05 Oct 24
Start Time: 10:31
SO₂ Analyzer Model: TELEDYNE API 100EH
NO_x/O₂ Analyzer Model: TELEDYNE API 200EH
CO/CO₂ Analyzer Model: TELEDYNE API 300EH

Run # 2
Location: HRSG #1
Test Operator: Sathaporn T.
Finish Time: 10:51
Serial No.: 410
Serial No.: 735
Serial No.: 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:31	14.54	3.68	8.86	0.77	20.18	
10:32	14.53	3.69	8.88	0.77	20.08	
10:33	14.53	3.78	8.93	0.75	19.35	
10:34	14.53	3.70	8.95	0.76	20.49	
10:35	14.53	3.72	8.92	0.75	20.04	
10:36	14.52	3.70	8.91	0.77	19.96	
10:37	14.52	3.70	8.94	0.78	19.42	
10:38	14.53	3.69	8.89	0.74	20.70	
10:39	14.54	3.67	8.87	0.76	20.18	
10:40	14.52	3.69	8.90	0.78	19.83	
10:41	14.52	3.73	8.92	0.77	20.51	
10:42	14.52	3.72	8.87	0.78	20.87	
10:43	14.52	3.71	8.90	0.77	19.77	
10:44	14.53	3.68	8.90	0.75	20.55	
10:45	14.52	3.70	8.87	0.77	20.99	
10:46	14.52	3.70	8.86	0.77	20.01	
10:47	14.52	3.71	8.88	0.76	21.20	
10:48	14.53	3.71	8.84	0.78	20.78	
10:49	14.53	3.69	8.81	0.74	20.55	
10:50	14.52	3.71	8.82	0.75	20.30	
10:51	14.53	3.71	8.85	0.77	20.58	
Average	14.53	3.70	8.88	0.76	20.30	

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FORM NO. F-06-062 REVISION NO. 1 ISSUE DATE: 18/01/24
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EMISSION TEST RESULT

Client: General Electric International OCo., Inc.
Date: 06 Oct 24
Start Time: 10:52
SO₂ Analyzer Model: TELEDYNE API 100EH
NO_x/O₂ Analyzer Model: TELEDYNE API 200EH
CO/CO₂ Analyzer Model: TELEDYNE API 300EH

Run # 3
Location: HRSG #1
Test Operator: Sathaporn T.
Finish Time: 11:12
Serial No.: 410
Serial No.: 735
Serial No.: 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:52	14.51	3.67	8.92	0.78	19.75	
10:53	14.53	3.70	8.88	0.76	20.31	
10:54	14.54	3.66	8.95	0.76	20.48	
10:55	14.53	3.67	8.93	0.74	19.76	
10:56	14.52	3.67	8.94	0.77	19.40	
10:57	14.52	3.69	8.92	0.76	19.18	
10:58	14.52	3.69	8.92	0.79	19.60	
10:59	14.51	3.69	8.89	0.76	19.17	
11:00	14.51	3.71	8.89	0.77	19.69	
11:01	14.51	3.68	9.03	0.76	16.97	
11:02	14.50	3.73	9.06	0.76	19.68	
11:03	14.50	3.71	9.04	0.76	19.67	
11:04	14.50	3.69	8.95	0.76	19.97	
11:05	14.51	3.70	8.96	0.78	19.63	
11:06	14.50	3.70	8.89	0.75	19.70	
11:07	14.51	3.69	9.00	0.77	19.95	
11:08	14.50	3.70	9.00	0.77	19.10	
11:09	14.51	3.74	9.06	0.75	18.48	
11:10	14.51	3.67	9.13	0.75	18.24	
11:11	14.51	3.66	9.12	0.76	19.72	
11:12	14.49	3.70	9.09	0.74	18.78	
Average	14.51	3.69	9.00	0.76	19.66	

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FORM NO. F-06-062 REVISION NO. 1 ISSUE DATE: 18/01/24
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ANALYZER CALIBRATION DATA

Lot No. 24112619-1

Client: General Electric International OCo., Inc. Location: HRSG #1
Date: 06 Oct 24 Test Operator: Sathaporn T.
O₂ ANALYZER Model: TELEDYNE API 200EH Serial No.: 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	8.19	8.20	8.20	0.00
Span Gas	16.07	16.08	16.09	0.04

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	54.96	54.94	54.94	0.00
Span Gas	82.51	82.51	82.50	0.01

SO₂ ANALYZER Model: TELEDYNE API 100EH Serial No.: 410
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.53	55.52	0.01
Span Gas	79.76	79.76	79.75	0.01

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

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

Calibrated by

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FORM NO. F-06-062 REVISION NO. 4 ISSUE DATE: 18/01/24
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Lot No. 24112619-1

O ₂ ANALYZER	
Cylinder Conc. (%)	: 16.07
Span (%)	: 25

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

SO₂ ANALYZER
Cylinder Conc. (ppm) : 75.75 Span (ppm) : 100

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 100

Calibrated by	
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Calibrated by
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Environmental Field Scientist (3)

FORM NO. F-06-063 REVISION NO. 4 ISSUE DATE 18/01/24

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Run No. 7	Time Base: 21 min	Run No. 8	Time Base: 21 min
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Run	Time	Temp	Flow	Pressure	Volume	Run	Time	Temp	Flow	Pressure	Volume
Run No. 9	Time Base	21 min	Run No. 10	Time Base	21 min						

Run No. 11	Time Base 21 min	Run No. 12	Time Base 21 min
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Plant Name _____ Location _____

Arg	0.79	0.80	17.26	14.53	2.67	Avg	0.78	0.76	17.26	14.52	2.67
Run No. 3	Time Base 25 min					Run No. 4	Time Base 25 min				

Arg	0.75	0.44	0.37	0.38	0.44	Arg	0.75	0.72	0.66	0.59	0.54
Run No. 6	Time Base: 25 min					Run No. 6	Time Base: 25 min				

AVJ	0.97	0.98	0.97	0.98	0.99	avg	0.97	0.98	0.98	0.99	0.99
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Run No. 1	Time Base 21 min	Run No. 2	Time Base 21 min
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Run No. 3	Time Base 21 min	Run No. 4	Time Base 21 min
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Run No. 5	Time Base 21 min	Run No. 6	Time Base 21 min
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Date 05 Oct 24

[illegible]

_____ Co., Inc. Location _____ HRSO #1 _____

Patient Name: _____												Location: _____		HSDG #: _____	
Run # 1				Run # 2				Run # 3				Run # 4			
Date	Time	Pressure mmHg	Temperature °C	Date	Time	Pressure mmHg	Temperature °C	Date	Time	Pressure mmHg	Temperature °C	Date	Time	Pressure mmHg	Temperature °C
08-24-10	1:57:00	142.5	4.0	08-24-10	1:57:11	142.5	4.0	08-24-10	1:57:22	142.5	4.0	08-24-10	1:57:33	142.5	4.0
08-24-10	1:57:01	142.5	4.0	08-24-10	1:57:12	142.5	4.0	08-24-10	1:57:23	142.5	4.0	08-24-10	1:57:34	142.5	4.0
08-24-10	1:57:02	142.5	4.0	08-24-10	1:57:13	142.5	4.0	08-24-10	1:57:24	142.5	4.0	08-24-10	1:57:35	142.5	4.0
08-24-10	1:57:03	142.5	4.0	08-24-10	1:57:14	142.5	4.0	08-24-10	1:57:25	142.5	4.0	08-24-10	1:57:36	142.5	4.0
08-24-10	1:57:04	142.5	4.0	08-24-10	1:57:15	142.5	4.0	08-24-10	1:57:26	142.5	4.0	08-24-10	1:57:37	142.5	4.0
08-24-10	1:57:05	142.5	4.0	08-24-10	1:57:16	142.5	4.0	08-24-10	1:57:27	142.5	4.0	08-24-10	1:57:38	142.5	4.0
08-24-10	1:57:06	142.5	4.0	08-24-10	1:57:17	142.5	4.0	08-24-10	1:57:28	142.5	4.0	08-24-10	1:57:39	142.5	4.0
08-24-10	1:57:07	142.5	4.0	08-24-10	1:57:18	142.5	4.0	08-24-10	1:57:29	142.5	4.0	08-24-10	1:57:40	142.5	4.0
08-24-10	1:57:08	142.5	4.0	08-24-10	1:57:19	142.5	4.0	08-24-10	1:57:30	142.5	4.0	08-24-10	1:57:41	142.5	4.0
08-24-10	1:57:09	142.5	4.0	08-24-10	1:57:20	142.5	4.0	08-24-10	1:57:31	142.5	4.0	08-24-10	1:57:42	142.5	4.0
08-24-10	1:57:10	142.5	4.0	08-24-10	1:57:21	142.5	4.0	08-24-10	1:57:32	142.5	4.0	08-24-10	1:57:43	142.5	4.0
08-24-10	1:57:11	142.5	4.0	08-24-10	1:57:22	142.5	4.0	08-24-10	1:57:33	142.5	4.0	08-24-10	1:57:44	142.5	4.0
08-24-10	1:57:12	142.5	4.0	08-24-10	1:57:23	142.5	4.0	08-24-10	1:57:34	142.5	4.0	08-24-10	1:57:45	142.5	4.0
08-24-10	1:57:13	142.5	4.0	08-24-10	1:57:24	142.5	4.0	08-24-10	1:57:35	142.5	4.0	08-24-10	1:57:46	142.5	4.0
08-24-10	1:57:14	142.5	4.0	08-24-10	1:57:25	142.5	4.0	08-24-10	1:57:36	142.5	4.0	08-24-10	1:57:47	142.5	4.0
08-24-10	1:57:15	142.5	4.0	08-24-10	1:57:26	142.5	4.0	08-24-10	1:57:37	142.5	4.0	08-24-10	1:57:48	142.5	4.0
08-24-10	1:57:16	142.5	4.0	08-24-10	1:57:27	142.5	4.0	08-24-10	1:57:38	142.5	4.0	08-24-10	1:57:49	142.5	4.0
08-24-10	1:57:17	142.5	4.0	08-24-10	1:57:28	142.5	4.0	08-24-10	1:57:39	142.5	4.0	08-24-10	1:57:50	142.5	4.0
08-24-10	1:57:18	142.5	4.0	08-24-10	1:57:29	142.5	4.0	08-24-10	1:57:40	142.5	4.0	08-24-10	1:57:51	142.5	4.0
08-24-10	1:57:19	142.5	4.0	08-24-10	1:57:30	142.5	4.0	08-24-10	1:57:41	142.5	4.0	08-24-10	1:57:52	142.5	4.0
08-24-10	1:57:20	142.5	4.0	08-24-10	1:57:31	142.5	4.0	08-24-10	1:57:42	142.5	4.0	08-24-10	1:57:53	142.5	4.0
08-24-10	1:57:21	142.5	4.0	08-24-10	1:57:32	142.5	4.0	08-24-10	1:57:43	142.5	4.0	08-24-10	1:57:54	142.5	4.0
08-24-10	1:57:22	142.5	4.0	08-24-10	1:57:33	142.5	4.0	08-24-10	1:57:44	142.5	4.0	08-24-10	1:57:55	142.5	4.0
08-24-10	1:57:23	142.5	4.0	08-24-10	1:57:34	142.5	4.0	08-24-10	1:57:45	142.5	4.0	08-24-10	1:57:56	142.5	4.0
08-24-10	1:57:24	142.5	4.0	08-24-10	1:57:35	142.5	4.0	08-24-10	1:57:46	142.5	4.0	08-24-10	1:57:57	142.5	4.0
08-24-10	1:57:25	142.5	4.0	08-24-10	1:57:36	142.5	4.0	08-24-10	1:57:47	142.5	4.0	08-24-10	1:57:58	142.5	4.0
08-24-10	1:57:26	142.5	4.0	08-24-10	1:57:37	142.5	4.0	08-24-10	1:57:48	142.5	4.0	08-24-10	1:57:59	142.5	4.0
08-24-10	1:57:27	142.5	4.0	08-24-10	1:57:38	142.5	4.0	08-24-10	1:57:49	142.5	4.0	08-24-10	1:58:00	142.5	4.0
08-24-10	1:57:28	142.5	4.0	08-24-10	1:57:39	142.5	4.0	08-24-10	1:57:50	142.5	4.0	08-24-10	1:58:01	142.5	4.0
08-24-10	1:57:29	142.5	4.0	08-24-10	1:57:40	142.5	4.0	08-24-10	1:57:51	142.5	4.0	08-24-10	1:58:02	142.5	4.0
08-24-10	1:57:30	142.5	4.0	08-24-10	1:57:41	142.5	4.0	08-24-10	1:57:52	142.5	4.0	08-24-10	1:58:03	142.5	4.0
08-24-10	1:57:31	142.5	4.0	08-24-10	1:57:42	142.5	4.0	08-24-10	1:57:53	142.5	4.0	08-24-10	1:58:04	142.5	4.0
08-24-10	1:57:32	142.5	4.0	08-24-10	1:57:43	142.5	4.0	08-24-10	1:57:54	142.5	4.0	08-24-10	1:58:05	142.5	4.0
08-24-10	1:57:33	142.5	4.0	08-24-10	1:57:44	142.5	4.0	08-24-10	1:57:55	142.5	4.0	08-24-10	1:58:06	142.5	4.0
08-24-10	1:57:34	142.5	4.0	08-24-10	1:57:45	142.5	4.0	08-24-10	1:57:56	142.5	4.0	08-24-10	1:58:07	142.5	4.0
08-24-10	1:57:35	142.5	4.0	08-24-10	1:57:46	142.5	4.0	08-24-10	1:57:57	142.5	4.0	08-24-10	1:58:08	142.5	4.0
08-24-10	1:57:36	142.5	4.0	08-24-10	1:57:47	142.5	4.0	08-24-10	1:57:58	142.5	4.0	08-24-10	1:58:09	142.5	4.0
08-24-10	1:57:37	142.5	4.0	08-24-10	1:57:48	142.5	4.0	08-24-10	1:57:59	142.5	4.0	08-24-10	1:58:10	142.5	4.0
08-24-10	1:57:38	142.5	4.0	08-24-10	1:57:49	142.5	4.0	08-24-10	1:58:00	142.5	4.0	08-24-10	1:58:11	142.5	4.0
08-24-10	1:57:39	142.5	4.0	08-24-10	1:57:50	142.5	4.0	08-24-10	1:58:01	142.5	4.0	08-24-10	1:58:12	142.5	4.0
08-24-10	1:57:40	142.5	4.0	08-24-10	1:57:51	142.5	4.0	08-24-10	1:58:02	142.5	4.0	08-24-10	1:58:13	142.5	4.0
08-24-10	1:57:41	142.5	4.0	08-24-10	1:57:52	142.5	4.0	08-24-10	1:58:03	142.5	4.0	08-24-10	1:58:14	142.5	4.0
08-24-10	1:57:42	142.5	4.0	08-24-10	1:57:53	142.5	4.0	08-24-10	1:58:04	142.5	4.0	08-24-10	1:58:15	142.5	4.0
08-24-10	1:57:43	142.5	4.0	08-24-10	1:57:54	142.5	4.0	08-24-10	1:58:05	142.5	4.0	08-24-10	1:58:16	142.5	4.0
08-24-10	1:57:44	142.5	4.0	08-24-10	1:57:55	142.5	4.0	08-24-10	1:58:06	142.5	4.0	08-24-10	1:58:17	142.5	4.0
08-24-10	1:57:45	142.5	4.0	08-24-10	1:57:56	142.5	4.0	08-24-10	1:58:07	142.5	4.0	08-24-10	1:58:18	142.5	4.0
08-24-10	1:57:46	142.5	4.0	08-24-10	1:57:57	142.5	4.0	08-24-10	1:58:08	142.5	4.0	08-24-10	1:58:19	142.5	4.0
08-24-10	1:57:47	142.5	4.0	08-24-10	1:57:58	142.5	4.0	08-24-10	1:58:09	142.5	4.0	08-24-10	1:58:20	142.5	4.0
08-24-10	1:57:48	142.5	4.0	08-24-10	1:57:59	142.5	4.0	08-24-10	1:58:10	142.5	4.0	08-24-10	1:58:21	142.5	4.0
08-24-10	1:57:49	142.5	4.0	08-24-10	1:58:00	142.5	4.0	08-24-10	1:58:11	142.5	4.0	08-24-10	1:58:22	142.5	4.0
08-24-10	1:57:50	142.5	4.0	08-24-10	1:58:01	142.5	4.0	08-24-10	1:58:12	142.5	4.0	08-24-10	1:58:23	142.5	4.0
08-24-10	1:57:51	142.5	4.0	08-24-10	1:58:02	142.5	4.0	08-24-10	1:58:13	142.5	4.0	08-24-10	1:58:24	142.5	4.0
08-24-10	1:57:52	142.5	4.0	08-24-10	1:58:03	142.5	4.0	08-24-10	1:58:14	142.5	4.0	08-24-10	1:58:25	142.5	4.0
08-24-10	1:57:53	142.5	4.0	08-24-10	1:58:04	142.5	4.0	08-24-10	1:58:15	142.5	4.0	08-24-10	1:58:26	142.5	4.0
08-24-10	1:57:54	142.5	4.0	08-24-10	1:58:05	142.5	4.0	08-24-10	1:58:16	142.5	4.0	08-24-10	1:58:27	142.5	4.0
08-24-10	1:57:55	142.5	4.0	08-24-10	1:58:06	142.5	4.0	08-24-10	1:58:17	142.5	4.0	08-24-10	1:58:28	142.5	4.0
08-24-10	1:57:56	142.5	4.0	08-24-10	1:58:07	142.5	4.0	08-24-10	1:58:18	142.5	4.0	08-24-10	1:58:29	142.5	4.0
08-24-10	1:57:57	142.5	4.0	08-24-10	1:58:08	142.5	4.0	08-24-10	1:58:19	142.5	4.0	08-24-10	1:58:30	142.5	4.0
08-24-10	1:57:58	142.5	4.0	08-24-10	1:58:09	142.5	4.0	08-24-10	1:58:20	142.5	4.0	08-24-10	1:58:31	142.5	4.0
08-24-10	1:57:59	142.5	4.0	08-24-10	1:58:10	142.5	4.0	08-24-10	1:58:21	142.5	4.0	08-24-10	1:58:32	142.5	4.0
08-24-10	1:58:00	142.5	4.0	08-24-10	1:58:11	142.5	4.0	08-24-10	1:58:22	142.5	4.0	08-24-10	1:58:33	142.5	4.0
08-24-10	1:58:01	142.5	4.0	08-24-10	1:58:12	142.5	4.0	08-24-10	1:58:23	142.5	4.0	08-24-10	1:58:34	142.5	4.0
08-24-10	1:58:02	142.5	4.0	08-24-10	1:58:13	142.5	4.0	08-24-10	1:58:24	142.5	4.0	08-24-10	1:58:35	142.5	4.0
08-24-10	1:58:03	142.5	4.0	08-24-10	1:58:14	142.5	4.0	08-24-10	1:58:25	142.5	4.0	08-24-10	1:58:36	142.5	4.0
08-24-10	1:58:04	142.5	4.0	08-24-10	1:58:15	142.5	4.0	08-24-10	1:58:26	142.5	4.0	08-24-10	1:58:37	142.5	4.0
08-24-10	1:58:05	142.5	4.0	08-24-10	1:58:16	142.5	4.0	08-24-10	1:58:27	142.5	4.0	08-24-10	1:58:38	142.5	4.0
08-24-10	1:58:06	142.5	4.0	08-24-10	1:58:17	142.5	4.0	08-24-10	1:58:28	142.5	4.0	08-24-10	1:58:39	142.5	4.0
08-24-10	1:58:07	142.5	4.0	08-24-10	1:58:18	142.5	4.0	08-24-10	1:58:29	142.5	4.0	08-24-10	1:58:40	142.5	4.0
08-24-10	1:58:08	142.5	4.0	08-24-10	1:58:19	142.5	4.0	08-24-10	1:58:30	142.5	4.0	08-24-10	1:58:41	142.5	4.0
08-24-10	1:58:09	142.													



[illegible]

cal on HRSG #1

[illegible]



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 19449
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A021C Reference Number: 160-402020199-1
Cylinder Number: CC709609 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 22, 2021

Expiration Date: Feb 22, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2017)" document EPA 600/R-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.96 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.84 PPM	G1	+/- 0.7% NIST Traceable	02/15/2021
NITRIC OXIDE	55.00 PPM	54.89 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14080753	CC434455	49.88 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D585025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-04	CC707558	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
GMS	12420849	CC232707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	D141769	KAL003199	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

ANALYTICAL EQUIPMENT			
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration	
Nicolet i550 FTIR AUP2010245 CO	FTIR	Feb 04, 2021	
Nicolet i550 FTIR AUP2010245 NO	FTIR	Feb 11, 2021	
Nicolet i550 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021	
Nicolet i550 FTIR AUP2010245 SO2	FTIR	Feb 16, 2021	

Triad Data Available Upon Request

NOTES:
Gross Weight: 26.8 Kg
Net Weight: 4.8 Kg



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Page 1 of 160-402020199-1



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 19449
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E3HA0002 Reference Number: 160-402138485-1
Cylinder Number: ND11222 Cylinder Volume: 247.2 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jul 15, 2021

Expiration Date: Jul 15, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2017)" document EPA 600/R-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/03/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.74 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.70 PPM	G1	+/- 1.6% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010133	KAL349536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D585025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-05	CC733428	98.81 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMS	12420849	CC232707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003836	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT			
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration	
Nicolet i550 FTIR AUP2010245 CO	FTIR	Jun 24, 2021	
Nicolet i550 FTIR AUP2010245 NO	FTIR	Jul 01, 2021	
Nicolet i550 FTIR AUP2010245 NO2	FTIR	Jun 30, 2021	
Nicolet i550 FTIR AUP2010245 SO2	FTIR	Jul 09, 2021	

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.0 Kg
Net Weight: 7.6 Kg



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Page 1 of 160-402138485-1



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 19449
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001 Reference Number: 160-402830555-1
Cylinder Number: GN0029835 Cylinder Volume: 250.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12023 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Sep 05, 2023

Expiration Date: Sep 05, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2017)" document EPA 600/R-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	15.01 %	14.97 %	G1	+/- 0.4% NIST Traceable	09/09/2023
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06010005	40271576	23.2 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT			
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration	
SIEMENS OXYMAT 6 - N1-WS-951 - O2	PARAMAGNETIC	Aug 15, 2023	

Triad Data Available Upon Request

NOTES:
Gross Weight: 50.0 Kg
Net Weight: 8.4 Kg



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Page 1 of 1



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 19449
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02N184E3HA0000 Reference Number: 160-401948144-1
Cylinder Number: GN0025086 Cylinder Volume: 248.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 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 2017)" document EPA 600/R-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.186 %	G1	+/- 0.3% NIST Traceable	11/11/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010002	1038055	9.987 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

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

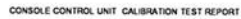
Triad Data Available Upon Request

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



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Page 1 of 160-401948144-1



Barometric Pressure (mmHg)	754
Relative Humidity (%)	53.0
Temperature (C°)	27.0
Reference Dry Gas Meter Data	
Reference Dry Gas Meter ID	13441-S1
Serial No	A203324
Correction Factor (%)	0.828
Next Calibration Date	7 Nov 24

Reference Dry Gas Meter Data	
Reference Dry Gas Meter ID	34K-15
Serial No	A200378
Correction Factor (%)	0.026
Next Calibration Date	7 Nov 2010

* All of 1980 mg of reference to dry gas = 100 to 1000 of 10000 values ± 0.02 from average

[illegible]

Procedure 40 C 4 60 APP A VI™ SIC 53 & 7

Cal. ordered by Gen. A. J. [illegible]

Approved by Nathaniel Longmire

(Vf. Satz 2.2.10)

(M. N. Khatun & J. S. Grewal)

Food Services Food & Vtg



Next Cal. Date : 31 Jan 25
Temperature (°C) : 27.0

Reference Stopwatch Data

Stopwatch ID No. :	RYG_FS0540
Model :	F808
Serial No. :	E18061
Calibration Date :	4 Jul 24
Certificate No. :	E-2407022

Console Control Meter Data

Dry Gas Meter No.: BKK_FS0527
Model : XC-572-V
Serial No : 1508053

	Average
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SD

Approved by: Nallhapol Jiengwareewong
Mr Nallhapol Jiengwareewong
RYG Field Service Specialist (1)

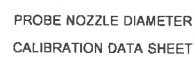


MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่อนุญาต

Calibrated by: Mr. Saksil Phaisanphisit
RYG Field Services Scientist (4)

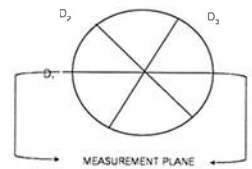
Approved by: 
(Mr. Natthapol Jengwaraswong)
RYG Field Services Specialist (1)

FORM NO. F 06.027 REVISION NO. 2 ISSUE DATE 18/2/01



Where:

- D_1, D_2 Two 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 $(D_1 + D_2) \div 2 \times 1.732$



Calibrated by Saksit Phaisanphusit
(Mr. Saksit Phaisanphusit)
Field Scientist (4)

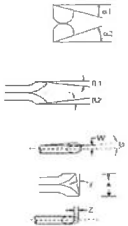
Approved by 
(Mr. Natthapol Jungsawasong)
Field Specialist (1)

PLATE NO. 7 (IN 12th REVISION) DATE PAID 9-1-1918



Type S Pitot Tube Calibration

Date Calibration 31-Jul-24
Pitot ID BKK_FS0532
Pitot SN -
Due Date 31-Jan-25
Inclinometer ID BKK_FS1131
Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	-2.4	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	-1.2	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-2.0	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	1.3	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	0.3	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125''$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031''$	OK
Dt	0.310	$0.188'' \leq Dt \leq 0.375''$	OK
A/2Dt	1.468	$1.05 \leq A/2Dt \leq 1.5$	OK
A	0.91	$2.1Dt \leq A \leq 3Dt$	OK

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

Calibrated by: Saksit Phaisanphut
(Mr. Saksit Phaisanphut)
RYG Field Services Scientist (4)

Approved By: Nattapong Jangwarewong
(Mr. Nattapong Jangwarewong)
RYG Field Services Specialist (1)

FORM NO. F06-124 REVISION NO. 0 ISSUE DATE: 25/12/23

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-8, e-mail: service.thailand@sartorius.com



NSC-TIS-1517025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY: Thirawat
APPROVED BY: [Signature]
NEXT CAL. DATE: 31/01/2025

Model Number: MSU224S-100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No.: RYG_EN0003
Manufacturer: Sartorius
Certificate No.: 24BCI0073
Issued Date: Friday, February 23, 2024
Reference No.: 229196
Page No.: 1 of 2

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

Calibrated By: Mr. Chonchai Inthana
Calibration Date: Thursday, February 22, 2024
Calibration Procedure No.: This calibration was conducted by using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14: 2019

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambients Conditions:
Temperature: 23.7 °C \pm 5.0 °C
Humidity: 62.0 % RH \pm 10.0 % RH
Pressure: - \pm -
Reasons for calibration:
☒ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance
Equipment Condition: ☒ Good Operation ☐ Fair

Measurement Method UKAS Publication Ref: Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Bargometer/Temp. Lutron MHB-382SD	DKSH	C1923184S	23-Aug-2024

This certificate relate and apply this equipment only.
This certificate may not be reproduced either in full or part without the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.

[Signature]
Mr. Chonchai Inthana (Technical Manager)
SOP FM 33 03 February 2022



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-8 Fax: +66 2643 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSU224S-100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No.: RYG_EN0003
Manufacturer: Sartorius
Certificate No.: 24BCI0073
Issued Date: Friday, February 23, 2024
Reference No.: 229196
Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the result of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).		
Nominal Value : (Low Load)	20.0000 g	200.0001 g	Nominal value :	100 g	g
Tolerance	0.0001 g	0.0001 g	Tolerance	0.0004 g	g
Nominal Value : (High Load)	200 g	200.0001 g			
Tolerance	0.0001 g	0.0001 g			
Standard Deviation	0.00005	0.00005			

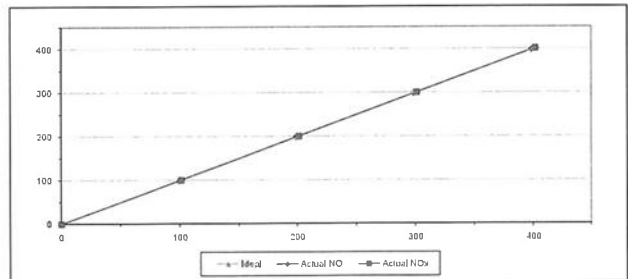
Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00013
1	1.0000	1.0000	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	50.0000	50.0000	0.0000	0.00024
100	100.0000	99.9999	-0.0001	0.00018
200	200.0000	199.9999	-0.0001	0.00029
End of Report.				



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	7238	Equipment ID	RYG_FS0533
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.86	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.10	1.10	1.10
2	200.00	198.90	-1.10	-0.55	201.20	1.20	0.60
3	300.00	298.80	-1.20	-0.40	301.10	1.10	0.37
4	400.00	398.30	-1.70	-0.42	401.60	1.60	0.45
AVERAGE (%)				-0.35			0.52



Calibrated By

Approved By

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

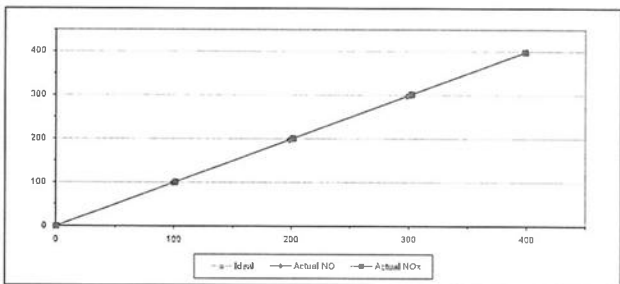
(Mr. Sarayuth Jitranont)
Assistant General Manager



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	2198	Equipment ID	RYG_FS0252
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.86	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	8-Feb-22	Expired Date	8-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	101.00	1.00	1.00
2	200.00	198.00	-2.00	-1.00	201.30	1.30	0.65
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	398.20	-1.80	-0.45	398.60	-1.40	-0.35
AVERAGE (%)				-0.63			0.43



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

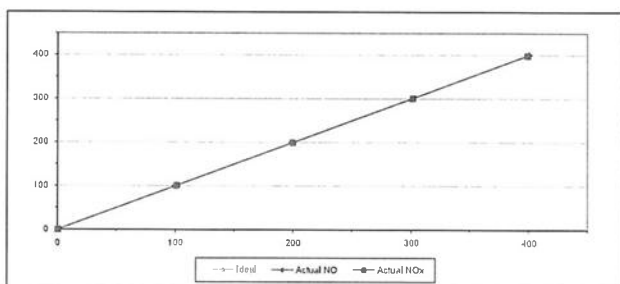
ALS Laboratory Group
FORM NO. F-05-056 REVISION NO. - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	NV0ER3YH	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.86	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	8-Feb-22	Expired Date	8-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.20	1.20	1.20
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.40	1.40	0.47
4	400.00	400.30	0.30	0.08	398.80	-1.20	-0.30
AVERAGE (%)				-0.13			0.28



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

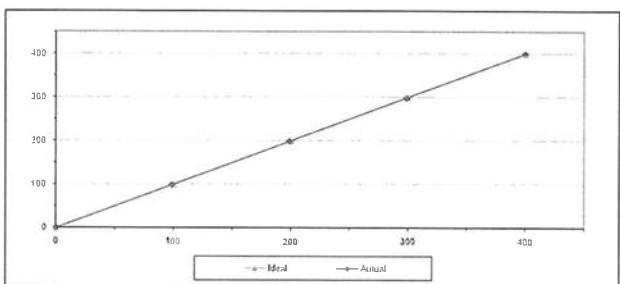
ALS Laboratory Group
FORM NO. F-05-056 REVISION NO. - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	6080	Equipment ID	RYG_FS0532
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	8-Feb-22	Expired Date	8-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	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	298.70	-1.30	-0.43
4	400.00	399.60	-0.40	-0.10
AVERAGE (%)				-0.47



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

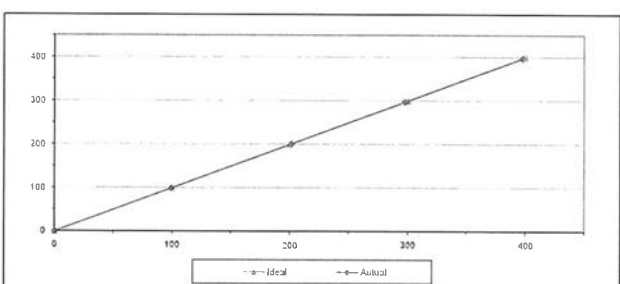
ALS Laboratory Group
FORM NO. F-05-056 REVISION NO. - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1773	Equipment ID	RYG_FS0251
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	8-Feb-22	Expired Date	8-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.50	-0.40	-0.40
2	200.00	201.20	1.20	0.60
3	300.00	297.30	-2.70	-0.90
4	400.00	397.60	-2.40	-0.60
AVERAGE (%)				-0.24



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group
FORM NO. F-05-056 REVISION NO. - ISSUE DATE: 02/04/12

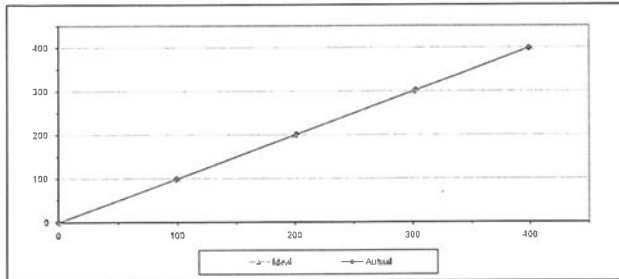


MULTIPOINT CALIBRATION REPORT



Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	PAUY077A	Equipment ID	RYG_FS0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

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



Calibrated By

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

Approved By

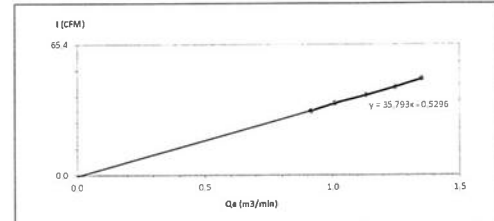
(Signature)
(Mr. Sarayuth Jitranont)
Assistant General Manager

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

High Volume Air Sampler Calibration Worksheet

Project Site:	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg):	755.5
Calibrate Location:	A1: 5611011330	Temperature (°C):	32.2
Calibrate Date:	2-Oct-24	High Volume ID:	RYG_FS0160
Calibration Sheet No.:	C-021024-RYG_FS0160B	High Volume Model:	TE-500-X
Calibrator ID:	RYG-FS0205	High Volume S/N:	6267
Calibrator Model:	TE-502HA	Calibrator Slope:	0.95561
Calibrator S/N:	1166	Calibrator Intercept:	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.915	32	Slope: 35.732 Intercept: -0.5296 Correlation Coefficient: 0.9991
2	2.2	1.099	36	
3	2.8	1.136	40	
4	3.4	1.249	44	
5	4.0	1.354	48	



Calibrated by

(Signature)
(Mr. Natthavut Duangpang)
Field Scientist (2)

Approved by:

(Signature)
(Mr. Noppong Juntaruporn)
Enviro Field Coordinator Scientist (3)

FORM NO.: F-06-071 REVISION NO.: 2 ISSUE DATE: 29/11/28

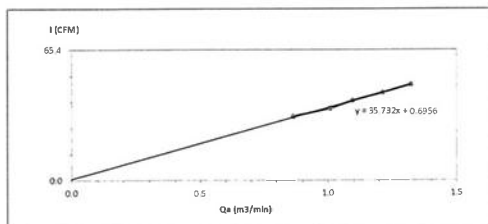


High Volume Air Sampler Calibration Worksheet



Project Site:	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg):	755.5
Calibrate Location:	A2: 5611011330	Temperature (°C):	32.2
Calibrate Date:	2-Oct-24	High Volume ID:	RYG_FS0187
Calibration Sheet No.:	C-021024-RYG_FS0187	High Volume Model:	TE-500-X
Calibrator ID:	RYG-FS0205	High Volume S/N:	4795
Calibrator Model:	TE-502HA	Calibrator Slope:	0.95561
Calibrator S/N:	1166	Calibrator Intercept:	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.915	32	Slope: 35.732 Intercept: -0.5296 Correlation Coefficient: 0.9992
2	2.2	1.099	36	
3	2.8	1.136	40	
4	3.4	1.249	44	
5	4.0	1.354	48	



Calibrated by

(Signature)
(Mr. Natthavut Duangpang)
Field Scientist (2)

Approved by:

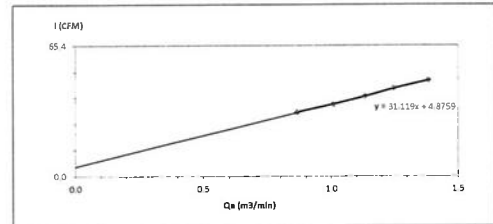
(Signature)
(Mr. Noppong Juntaruporn)
Enviro Field Coordinator Scientist (3)

FORM NO.: F-06-071 REVISION NO.: 2 ISSUE DATE: 29/11/28

High Volume Air Sampler Calibration Worksheet

Project Site:	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg):	755.5
Calibrate Location:	A3: 5611011330	Temperature (°C):	32.2
Calibrate Date:	2-Oct-24	High Volume ID:	RYG_FS0188
Calibration Sheet No.:	C-021024-RYG_FS0188	High Volume Model:	TE-500-X
Calibrator ID:	RYG-FS0205	High Volume S/N:	4796
Calibrator Model:	TE-502HA	Calibrator Slope:	0.95561
Calibrator S/N:	1166	Calibrator Intercept:	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.914	32	Slope: 31.119 Intercept: 4.8759 Correlation Coefficient: 0.9992
2	2.2	1.099	36	
3	2.8	1.136	40	
4	3.4	1.249	44	
5	4.0	1.354	48	



Calibrated by

(Signature)
(Mr. Natthavut Duangpang)
Field Scientist (2)

Approved by:

(Signature)
(Mr. Noppong Juntaruporn)
Enviro Field Coordinator Scientist (3)

FORM NO.: F-06-071 REVISION NO.: 2 ISSUE DATE: 29/11/28



SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BCI0068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409864 Reference No. : 229196
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 1 of 2

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

Calibrated By : Mr.Chonchai Inthana Calibration Procedure No. : This calibration was conducted by
Calibration Date : Thursday, February 22, 2024 Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data : Ambients Conditions:
Capacity : 150 g Readability : 0.0001 g Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure :
Reasons for calibration : ☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance ☐ Equipment Condition: ☒ Good Operation ☐ Fair

Measurement Method UKAS Publication Ref : Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	TCS	IM23081975	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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

Mr.Chonchai Inthana (Technical Manager)
S T A M P
SARTORIUS
HSC-TIS-TIS 17025

SOP FM 33 03 February 2022

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BCI0068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409864 Reference No. : 229196
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings under identical 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.			The off-center loading error is yielded by the difference between the residual of the load, i.e. 100 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four residual measurement points (positions defined according to OIML R76).		
Nominal Value : (Low Load)	10.0000 g	99.9999 g	Nominal value :	50 g	
Tolerance	10.0000 g	100.0000 g	Tolerance	0.0004 g	
0.0001 g	10.0000 g	100.0001 g	Difference		
Nominal Value : (High Load)	10.0000 g	100.0001 g	1		
Tolerance	10.0000 g	100.0000 g	2	-0.0001	
0.0001 g	10.0000 g	100.0002 g	3	0.0001	
	9.9999 g	100.0000 g	4	0.0002	
	9.9999 g	100.0001 g	5	0.0000	
	9.9999 g	100.0001 g	6		
Standard Deviation	0.00005	0.00006			

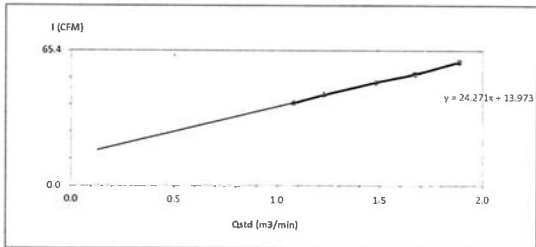
Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear shape.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000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

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site :	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg) :	755.5
Calibrate Location :	AL : หมู่ 10 ตำบลพนาเมือง	Temperature (°C) :	32.2
Calibrate Date :	2-Oct-24	High Volume ID :	RYG_PS0662
Calibration Sheet No. :	C-021024-RYG_PS0662	High Volume Model :	TE-5009X
Calibrator ID :	RYG_PS0205	High Volume S/N :	6250
Calibrator Model :	TE-5028A	Calibrator Slope :	1.52567
Calibrator S/N :	1166	Calibrator Intercept :	-0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	F: Chart (CFM)	Linear Regression
1	2.6	1.0774	40	Slope: 24.2712
2	3.1	1.2168	44	Intercept: 13.9731
3	5.0	1.4801	50	Correlation Coefficient: 0.9992
4	6.4	1.6098	54	
5	9.2	1.8153	60	



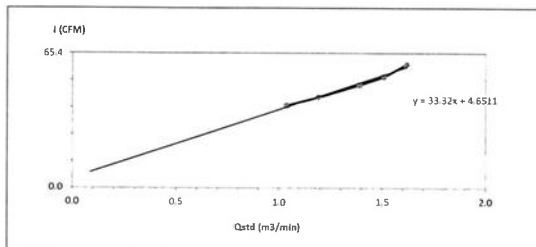
Calibrated by : Mr.Nattawut Duanggang
Field Scientist(2)

Approved by : Mr.Noppang Juntarupan
Enviro Field Coordinator Scientist (2)

High Volume Air Sampler Calibration Worksheet

Project Site :	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg) :	755.5
Calibrate Location :	AL : บ้านดอน	Temperature (°C) :	32.2
Calibrate Date :	2-Oct-24	High Volume ID :	RYG_PS0177
Calibration Sheet No. :	C-021024-RYG_PS0177	High Volume Model :	TE-5170D
Calibrator ID :	RYG_PS0205	High Volume S/N :	4803
Calibrator Model :	TE-5028A	Calibrator Slope :	1.52567
Calibrator S/N :	1166	Calibrator Intercept :	-0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	F: Chart (CFM)	Linear Regression
1	2.4	1.0365	40	Slope: 33.3202
2	3.2	1.1912	44	Intercept: 4.6511
3	4.1	1.3407	50	Correlation Coefficient: 0.9909
4	5.2	1.5087	54	
5	6.0	1.6179	60	



Calibrated by : Mr.Nattawut Duanggang
Field Scientist(2)

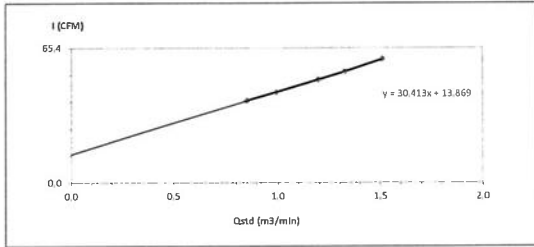
Approved by : Mr.Noppang Juntarupan
Enviro Field Coordinator Scientist (2)



High Volume Air Sampler Calibration Worksheet

Project Site:	General Electric International Operations Company Inc.	Barometric Pressure (mm Hg):	755.5
Calibrate Location:	A3, Samudrasuan	Temperature (°C):	32.2
Calibrate Date:	2-Oct-24	High Volume ID:	RYG_PS0663
Calibrationsheet No:	C-021024-RYG_PS0663	High Volume Model:	TE-S009X
Calibrator ID:	RYG_PS0205	High Volume S/N:	0260
Calibrator Model:	TE-S028A	Calibrator Slope:	1.52507
Calibrator S/N:	1166	Calibrator Intercept:	-0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.8529	40	Slope: 30.4126
2	2.2	0.9939	44	Intercept: 13.6086
3	3.2	1.1913	50	Correlation Coefficient: 0.9996
4	4.0	1.3276	54	
5	5.2	1.5087	60	



Calibrated by: Mathawat D.
(Mr. Mathawat Duangpang)
Field Scientist (2)

Approved by: Mr. Noppang Juntarapan
(Mr. Noppang Juntarapan)
Senior Field Coordinator Scientist (3)

FORM NO. F-06-073 REVISION NO. 2 ISSUE DATE: 20/1/23



JIRANATEE ASSOCIATES CO., LTD.
15/15, 07750-34
Pochumee 37/1, Rd. Amphur, Bangkok
Bangkok 10110 (Thailand)
Tel: +662-040413
Mobile: +662-099453
Email: jiranatee@jiranatee.com
Website: www.jiranatee.com

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



Certificate Number
CWS-031-47

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Cup anemometer
Novatime
Sensor: WS-027
Data logger: 110 WS-250L-D
Sensor: WS02 AS660
Data logger: AS660
RYG_PS0205
Used item
JAS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

08 Aug 2024
21 Aug 2024
21 Aug 2024

ENVIRONMENTAL CONDITIONS:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

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

Preconditioning
Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (23.6) °C, (41.8) %RH and (1002.8) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calculated by:
[X] Mr. Somwit Thachai
[X] Miss Siraporn Lertkarnsri



Approved signature: Mr. Parima Booncharoen
Calibration Department Manager

REVIEW BY: Mr. Parima Booncharoen
APPROVED BY: Mr. Parima Booncharoen
NEXT CAL DATE: 21/8/26

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

Certificate Number
CWS-031-47

Page 2 of 2 Pages

MEASUREMENT RESULTS

The Cup anemometer, Wind Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calibrated by a standard air velocity instrument which was installed 50 mm away from wind tunnel inside but installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calibrated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel inside and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

U _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	U _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.955	23.76	23.55	0.8	-0.2	0.31
2.010	23.46	23.55	1.8	-0.2	0.31
2.957	23.64	23.55	2.9	-0.1	0.31
4.037	23.66	23.55	3.8	-0.2	0.31
4.98	23.61	23.55	4.9	-0.1	0.31
5.95	23.53	23.55	6.0	0.0	0.31
7.04	23.50	23.55	7.0	0.0	0.31
7.97	22.84	23.55	8.0	0.0	0.31
8.99	23.24	23.55	9.1	-0.1	0.31
9.97	22.92	23.55	10.2	0.2	0.31
10.36	23.40	23.55	11.1	0.1	0.31
12.03	23.08	23.55	12.3	0.3	0.31
12.95	23.40	23.55	13.3	0.3	0.31
14.89	23.20	23.55	14.3	0.2	0.31
15.02	23.40	23.55	15.3	0.1	0.31
15.97	23.30	23.55	16.4	0.4	0.31

Remark:

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

* Velocity of standard

* Velocity of Wind Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the Cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The position of the set-up is accurate to scale due to image geometry



JIRANATEE ASSOCIATES CO., LTD.
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Mobile: +662-099453
Email: jiranatee@jiranatee.com
Website: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS 17025
CALIBRATION 0367
Wind direction measurement laboratory
Calibration services department



Certificate Number
CWD-031-47

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Wind Direction Sensor
Novatime
Sensor: WS-037
Data logger: 110 WS-250L-D
Sensor: WS02 AS660
Data logger: AS660
RYG_PS0205
Used item
JAS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

08 Aug 2024
21 Aug 2024
21 Aug 2024

ENVIRONMENTAL CONDITIONS:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

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

Preconditioning
Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (23.7) °C, (46.3) %RH and (1007.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calculated by:
[X] Mr. Somwit Thachai
[X] Miss Siraporn Lertkarnsri



Approved signature: Mr. Parima Booncharoen
Calibration Department Manager

Remark:
* Wind direction area of the wind tunnel
* Included cross-section area of the tested object include mounting pipe
* Diameter of mounting pipe
* Ratio 1/-

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

Certificate Number
CWD-031-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed	D _{cal}	D _{unc}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	88	-2	0.80
	135.000	133	-2	0.80
	180.000	181	1	0.80
	225.000	229	4	0.80
	270.000	273	3	0.80
	315.000	318	3	0.80

Remarks:

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

² Direction of standard

³ Direction of Unit under Calibration

End of Certificate of Calibration



J NAC
JIRANATEE ASSOCIATES CO., LTD.
Jiranatee Associates Co., Ltd.
63/14-15, 62/29-30
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-TIS 17025
CALIBRATION 0367
Temperature measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-156-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novolyte
MODEL/TYPE : 110-W5-25DL-D
SERIAL NUMBER : AS660
ID NUMBER : RVG_F30530
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khuang Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 21 Aug 2024
ISSUE DATE : 21 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:
The temperature calibration was done by In-House calibration method as WS-CL-002 according to comparison method with standard digital thermometer, reference 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 (NIMT) Certificate number: 17-0047-24, Certificate number: ER-0102-23.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 AS200, Serial No.: 667682-03,
Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DTI-2000-A-KNPE, Serial No.: 671402-00591 Due date: 14 Sep 2024

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

Calibrated by:
☐ Mr. Suphachai Thachalad
☒ Mr. Nattaporn Leritornsilol
☐ Miss Ruangsri Poommim



Approved signature:
Mr. Potyia Booncharoen
Calibration Department Manager

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

J NAC
JIRANATEE ASSOCIATES CO., LTD.

Continuation of Certificate of Calibration Number CDT-156-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 10 °C to 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: S4620631.
Dimension: Diameter 32 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	19.6	-0.4	0.099
80	25.053	24.6	-0.5	0.099
80	30.045	29.7	-0.3	0.099
80	35.026	34.5	-0.5	0.099
80	40.018	39.4	-0.6	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



J NAC
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Jiranatee Associates Co., Ltd.
63/14-15, 62/29-30
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-TIS 17025
CALIBRATION 0367
Relative Humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-032-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novolyte
MODEL/TYPE : Data Logger: 110-W5-25DL-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: AS660
Sensor: S4620631
ID NUMBER : RVG_F30530
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khuang Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 18 Aug 2024
MEASUREMENT DATE : 21 Aug 2024
ISSUE DATE : 21 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

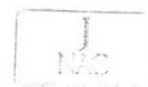
The table on next page give the measured values.

Calibration procedure:
The relative humidity and air temperature calibration was done by In-House calibration method as WS-CL-009 and WS-CL-010 according to comparison method with standard digital thermometer, reference and standard humidity generator chamber.

Traceability:
The measurements are traceable to the international system of units (SI) through National Institute of Metrology (NIMT) Certificate number: 17-0047-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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

Calibrated by:
☐ Mr. Suphachai Thachalad
☒ Mr. Nattaporn Leritornsilol
☐ Miss Ruangsri Poommim



Approved signature:
Mr. Potyia Booncharoen
Calibration Department Manager

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

Certificate Number
CWS-036-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D _{ref} Degree (°)	D _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	45.000	41	-4	0.90
	50.000	87	-3	0.90
	135.000	134	-1	0.90
	180.000	182	2	0.90
	225.000	230	5	0.90
	270.000	275	5	0.90
	315.000	320	5	0.90
	360.000	359	-1	0.90

Remarks:

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

² Direction of standard.

³ Direction of Unit Under Calibration.

End of Certificate of Calibration



Jiranatee Associates Co., Ltd.
10/14-15, 17/15 Bk.
Pattana 2/25, Rd. Watthana, Bangkok,
Bangkok 10110 (Thailand)
Tel: +662-000111
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Email: jira.assoc@jira.assoc.com
Web: www.jira.assoc.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-175 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.



Certificate Number

CWS-036-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

1 Cup anemometer

1 Nacoma

1 Sensor: WS-03F

1 Data logger: 110-WS-25DL-D

1 Sensor: WS0-05789

1 Data logger: AS789

1 RYG, F50531

1 Used item

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

104 Phatthanabon 40, Phatthanabon Rd, Khwaeng Sun Luang,

1 Khet Sun Luang, Bangkok 10250 Thailand.

Calibration procedure:

The Cup anemometer was calibrated against Standard air velocity transducer model: WS-22 and data logger with precision differential pressure meter model: DPM255000 on the test section of the type wind tunnel with 300 mm cross section area. The WS-22 was based on IEC 61400-12-1. Wind energy generation system - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration reference.

Traceability:

This certificate provides a traceability of the measurement to the national standards, and to the realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate Number: NM-007-14 and NM-005-23.

Uncertainty of Measurement:

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

REVIEW BY: *Handwritten signature*

APPROVED BY: *Handwritten signature*

NEXT CAL DATE: 31/12/26

RECEIVED DATE

08 Aug 2024

MEASUREMENT DATE

28 Aug 2024

ISSUE DATE

28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.1 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

1 Wind tunnel cross-section area

900 cm²

1 Wind direction frontal area

100 cm²

1 Diameter of mounting pipe

0.111 m

1 Blockage ratio of test object

0.111

Preconditioning

1 24 hours at ambient conditions.

Measurement Condition

1 The average values during measurement are (23.0) °C, (63.7) %RH and (1003.6) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

1 Mr. Soravit Thongkiet

1 Miss Jiraporn Lertkarn



Approved signatory:

Mr. Pavin Banchuan
Calibration Department Manager

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

Certificate Number
CWS-036-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was checked at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calibrated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 10 m/s was calibrated by a pilot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the upper plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.627	24.10	23.50	0.9	-0.1	0.31
2.054	23.72	23.30	1.9	-0.2	0.31
2.991	24.02	23.50	2.9	-0.1	0.31
4.683	24.04	23.50	3.9	-0.2	0.31
4.98	23.70	23.50	5.0	0.0	0.31
6.07	23.60	23.50	6.0	0.0	0.31
7.03	23.70	23.50	7.1	0.1	0.31
7.94	23.58	23.50	8.1	0.1	0.31
8.39	23.70	23.50	9.1	0.1	0.31
9.97	23.50	23.30	10.1	0.1	0.31
10.96	23.75	23.30	11.2	0.2	0.31
12.03	23.50	23.30	12.2	0.2	0.31
12.97	23.80	23.50	13.3	0.3	0.31
14.03	23.56	23.30	14.5	0.3	0.31
15.03	23.80	23.30	15.3	0.3	0.31
16.02	23.70	23.30	16.3	0.3	0.31

Remarks:

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

² Velocity of standard.

³ Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration



Jiranatee Associates Co., Ltd.
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-175 17025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department.



Certificate Number

CWS-036-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

1 Wind Direction Sensor

1 Nacoma

1 Sensor: WS-03F

1 Data logger: 110 WS-25DL-D

1 Sensor: WS0-05789

1 Data logger: AS789

1 RYG, F50531

1 Used item

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

104 Phatthanabon 40, Phatthanabon Rd, Khwaeng Sun Luang,

1 Khet Sun Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: ARI0075-DIM4 P/S-02 on a close fitting, of Effel-type wind tunnel with 300 mm cross section area. The WS-03F was based on IEC 61400-12-1. Wind energy generation system - Part 12-1. Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration reference.

Traceability:

This certificate provides a traceability of the measurement to the national standards, and to the realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate Number: NM-007-14 and NM-005-23.

Uncertainty of Measurement:

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

REVIEW BY: *Handwritten signature*

APPROVED BY: *Handwritten signature*

NEXT CAL DATE: 31/12/26

RECEIVED DATE

08 Aug 2024

MEASUREMENT DATE

28 Aug 2024

ISSUE DATE

28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.1 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

1 Wind tunnel cross-section area

900 cm²

1 Wind direction frontal area

100 cm²

1 Diameter of mounting pipe

0.111 m

1 Blockage ratio of test object

0.111

Preconditioning

1 24 hours at ambient conditions.

Measurement Condition

1 The average values during measurement are (23.0) °C, (63.0) %RH and (1003.6) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

1 Mr. Soravit Thongkiet

1 Miss Jiraporn Lertkarn



Approved signatory:

Mr. Pavin Banchuan
Calibration Department Manager

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

Certificate Number
CWD-036-57

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

At speed m/s	D ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U(95%) Degree (°)
	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	133	-2	0.80
	180.000	180	0	0.80
	225.000	237	12	0.80
	270.000	273	3	0.80
	315.000	318	3	0.80

Remarks:

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

² Direct air standard.

³ Direction of Unit used in Calibration.

End of Certificate of Calibration



Immersion Association Co., Ltd.
61/2-115, 67/25-16
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Bangkok 10250 (Thailand)
Tel: +66 (0)2 606 8112
Email: info@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-17025
CALIBRATION 0367
Temperature measurement laboratory
Calibration services department



NSC-TIS-17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CDT-163-67

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Novallion
MODEL/TYPE : L10-W5-250L-D
SERIAL NUMBER : AS789
ID NUMBER : RYG_F50531
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phutthananak 40, Phutthananak Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 28 Aug 2024
ISSUE DATE : 28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by in-house calibration method as W-CI-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale 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: T1-0047-24, Certificate number: FR-0103-23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 A500, Serial No. 467582 09,
Due date: 28 Mar 2025
2. Digital Temperature Indicator
Model: DTI-1000-A MKII, Serial No. 571407-00591 Due date: 14 Sep 2024

Uncertainty of Measurement:

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

Calibrated by:
☐ Mr. Sornwit Thacholad
☒ Mr. Jitraporn Lertsamphol
☐ Miss Ruangrump Poommit



Approved signatory:

Mr. Parinya Boonscharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-163-67

Page 2 of 2 Pages

Result of Calibration: [X] Without Adjustment [] With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: T0210901,
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.049	19.6	-0.4	0.099
80	25.053	24.6	-0.5	0.099
80	30.044	29.7	-0.3	0.099
80	35.027	34.5	-0.5	0.099
80	40.019	39.5	-0.5	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



Immersion Association Co., Ltd.
61/2-115, 67/25-16
Pattana 7/21, Rd. Wuthayua, Bangkok 10250 (Thailand)
Tel: +66 (0)2 606 8112
Email: info@jiranatee.com
Web site: www.jiranatee.com

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

Relative humidity and Air Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CRT-033-47

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novallion
MODEL/TYPE : Data Logger: L10-W5-250L-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: AS789
Sensor: T0210901
ID NUMBER : RYG_F50531
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phutthananak 40, Phutthananak Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 28 Aug 2024
ISSUE DATE : 28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Relative humidity and Air Temperature calibration was done by in-house calibration method as W-CI-002 and W-CI-003 according to comparison method with standard hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: T1-0047-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

Uncertainty of Measurement:

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

Calibrated by:
☐ Mr. Sornwit Thacholad
☒ Mr. Jitraporn Lertsamphol
☐ Miss Ruangrump Poommit



Approved signatory:

Mr. Parinya Boonscharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number: CRT-033-67

Page 2 of 2 Pages

Measurement Results:

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.

Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
23.82	59.61	17.9	-1.7	0.83
29.58	50.79	47.5	-3.2	1.3
35.85	82.37	77.6	-4.8	2.3

UUC: Unit Under Calibration

End of Certificate of Calibration



Request No. 21-67/0292

MTC No. EEL, BP, 83/0267

CALIBRATION CERTIFICATE

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

Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : Rion
Model : NC-74
Serial No. : 34178121 (ID: RYG_FS021.3)
Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037,
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484,
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214,
4. Digital Multimeter Agilent 34401A S/N MY44005560,
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001,
6. Audio Analyzer Keithley 2015-P S/N4106495,
7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 19 Feb, 2024

Date of Calibration : 28 Feb, 2024

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FMILMTC002 Rev.5

Request No. 21-67/0292 MTC No. EEL, BP, 83/0267

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

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

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

1. Sound Pressure Level

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

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjær 4180	1003.1	3.1	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjær 4180	1.80	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Calibrated by :

(Mr. Weerachai Deechaiyac)

Approved by :

(Mr. Prayut Kiatwong)

Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb, 2024

Date of Issue : 29 Feb, 2024

Ref: 2011267021900719001

End of Certificate

2/2

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Request No. 21-67/0232

MTC No. EEL, BP, 172/0167

CALIBRATION CERTIFICATE

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

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-42
Serial No. : 00296515 (ID: RYG_FS0432)
Microphone : Type UC-52 No.179119
Preamplifier : Type NH-24 No.87526
Standards used :
1. Band Pass Filter Wavelec 752A S/N 90010494,
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871,
3. Decade Attenuator Ando AI-205 S/N 00464602,
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668,
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037,
6. Digital Multimeter Fluke 8520A S/N 49859007,
7. Pistonphone Rion NC-72 S/N 00402446,
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

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

Date of Receipt : 24 Jan, 2024

Date of Calibration : 22-28 Feb, 2024

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FMILMTC002 Rev.4

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- 9, Power Amplifier Brüel & Kjær 2700 S/N 1517650,
- 10, Speaker Tannoy Limited, Great Britain British Patent No, 215300,
- 11, Digital Multimeter Agilent 34401A S/N MY-44005560,
- 12, Programmable Attenuator Tannagawa TPA-303A S/N 2212,

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb, 2024

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FMBL/MTC.002 Rev.4

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat	
125	0.1	0.2	0.2	0.45
1 000	-0.1	-0.1	-0.1	0.45
8 000	0.0	0.0	-0.1	0.45

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat	
63	-0.1	0.0	0.0	0.20
125	-0.1	0.0	0.0	0.20
250	-0.1	0.0	0.0	0.20
500	0.0	0.0	0.0	0.20
1 000	0.0	0.0	0.0	0.20
2 000	0.0	0.0	0.0	0.20
4 000	0.0	0.0	0.0	0.20
8 000	0.0	0.0	0.0	0.20

Date of Calibration : 22-28 Feb, 2024

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust			
113.96	114.1	113.9	-0.1	1.0	0.30

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.1	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	11.9	0.10	N/A
C-Weight	17.4	0.10	N/A
Flat	23.2	0.10	N/A

Date of Calibration : 22-28 Feb, 2024

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Log	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 172/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.1	0.1	1.1	0.30	0.3
130	130.1	0.1	1.1	0.30	0.3
129	129.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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FIML MTC 002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 172/0167

8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Th (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

Date of Calibration : 22-28 Feb. 2024

8/9

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FIML MTC 002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 172/0167

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	28.0	0.0	1.1	0.30	0.3
27	27.0	0.0	1.1	0.30	0.3
26	26.0	0.0	1.1	0.30	0.3
25	25.0	0.0	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 172/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	1.5	0.55
135.4	135.4			

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by
(Mr. Pannasit Phasingsri)

Approved by:
(Mr. Pannasit Phasingsri)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref: 2011267013400347002

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 174-0167

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.

Address : 104 Phantlankan 40, Phantlankan Rd., Khwaeng Phatthana, Khet Suan Luang, Bangkok 10250,

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296517 (ID: RYG_FS0434)

Microphone : Type UC-52 No.135220

Preamplifier : Type NH-24 No.87527

Standards used :

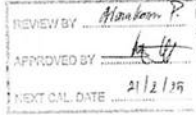
1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 120337.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa



Date of Receipt : 24 Jan, 2024

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 174-0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation	Acceptance limit	Uncertainty	Maximum-permitted uncertainty
	Before adjust	After adjust	Class 2 (±dB)	(±dB)	of measurement (±dB)
113.96	114.3	113.9	+0.1	1.0	0.30
					N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.5 dB.

2. Self-generated noise

2.1 Normal test

Measured value	Uncertainty	Maximum-permitted uncertainty
(dB)	(±dB)	of measurement (±dB)
19.7	0.10	N/A

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

Frequency	Measured value	Uncertainty	Maximum-permitted uncertainty
Weighting	(dB)	(±dB)	of measurement (±dB)
A-Weight	14.1	0.10	N/A
C-Weight	19.6	0.10	N/A
Flat	24.9	0.10	N/A

Date of Calibration : 22-28 Feb, 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 174-0167

9, Power Amplifier Brüel&Kjær 2706 S/N 1517650,

10, Speaker Tannoy Limited, Great Britain British Patent No. 215300,

11, Digital Multimeter Agilent 34401A S/N MY44005560,

12, Programmable Attenuator Tamagawa TPA-303A S/N 2212,

Calibration Procedure

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

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

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

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

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 174-0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	A-weight	C-weight	Flat	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
125	#DIV/0!	#DIV/0!	#DIV/0!	1.5	#DIV/0!	0.6
1 000	#DIV/0!	#DIV/0!	#DIV/0!	1.0	#DIV/0!	0.6
8 000	#DIV/0!	#DIV/0!	#DIV/0!	5.0	#DIV/0!	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	A-weight	C-weight	Flat	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
63	+0.1	+0.1	+0.1	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	-0.1	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	+0.1	2.0	0.20	0.6
4 000	0.0	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 22-28 Feb, 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 174/0167

5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22-28 Feb, 2024

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	+0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	+0.1	1.1	0.30	0.3
34	33.9	+0.1	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
28	27.9	+0.1	1.1	0.30	0.3
27	26.9	+0.1	1.1	0.30	0.3
26	25.9	+0.1	1.1	0.30	0.3
25	24.9	+0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration 22-28 Feb, 2024

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration 22-28 Feb, 2024

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Request No. 21-67/0232

MTC No. EEL, BP, 174/0167

8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	+0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	119.5	+0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

Date of Calibration 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 174/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Positive one-half cycle	Negative one-half cycle				
135.4	135.4	0.0	1.5	0.55	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by:
(Mr. Pannasit Phasingsri)

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

Date of Calibration : 22-28 Feb, 2024

Date of Issue : 29 Feb, 2024

Ref: 2011267012400347004

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

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

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296516 (ID: RYG_FS0433)

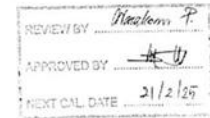
Microphone : Type UC-52 No.180412

Preamplifier : Type NIT-24 No.88182

Standards used :

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

Ambient Environment

Temperature : (23 \pm 3) °CRelative Humidity : (50 \pm 15) %Ambient Pressure : (101.325 \pm 1.5) kPa

Date of Receipt : 24 Jan, 2024

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
113.96	114.1	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
18.9	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	12.3	0.10	N/A
C-Weight	17.7	0.10	N/A
Flat	23.1	0.10	N/A

Date of Calibration : 22-28 Feb, 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.0	0.2	0.1	1.5	0.45	0.6
1 000	0.0	0.0	0.0	1.0	0.45	0.6
8 000	-0.3	-0.3	-0.3	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	0.0	2.0	0.20	0.6
4 000	0.0	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 173/0167

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54.0	0.0	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.8	-0.2	1.1	0.30	0.3
28	27.8	-0.2	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.8	-0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	±1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, 1/3 (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0, -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5, -5.0	0.20	0.3
Slow	200	119.5	+0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0, -5.0	0.20	0.3

Date of Calibration : 22-28 Feb, 2024

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FMEL/MTC 002 Rev.4

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Srinthorn Road, Bangbunru, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACC24008
Pages : 1 of 3

Calibration Certificate

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

Condition As Found : GOOD

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

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

Received Date : 19 JANUARY 2024
Calibration Date : 26 JANUARY 2024
Date of Issue : 29 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	134.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	1.5	0.55
135.4	135.4			0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Mr. Pannasit Phasingsri

Approved by :

Mr. Pannasit Phasingsri

Electrical and Electronic Standards Laboratory

Date of Calibration : 22-28 Feb, 2024

Date of Issue : 29 Feb, 2024

Industrial Metrology and Testing Service Centre

Ref: 2011267012400347003

End of Certificate

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CALIBRATION LABORATORY

451-451/1 Srinthorn Road, Bangbunru, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com

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Cert. No. : ACC24008
Jub No. : VC67AC0058
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EF-0012-23	10-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchurai

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Cert. No. : ACC24008
Job No. : VC67AC0058
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	93.98	-0.02	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1000.0	0.0	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
0.83	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

T. Petum

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Cert. No. : ACL24074
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122607 / 145554 / 34373
ID No.: RYG_FS0019

Condition As Found : GOOD

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

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

Received Date : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petum
(Thanakul Petichum)

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Cert. No. : ACL24074
Job No. : VC67AC0054
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand),

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

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Cert. No. : ACL24074
Job No. : VC67AC0054
Pages : 3 of 8

Summary of Measurement Result :

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

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Job No. : VC67AC0054
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.0

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	22.7

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	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.4	-1.4	-1.3	±5.0

7. Return

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Cert. No. : ACL24074
Job No. : VC67AC0054
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	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

7. Return

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Job No. : VC67AC0054
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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

7. Return

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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	Tone burst duration, Tb (ms)	Cycles	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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

7. Return

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11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petchuraj

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Cert. No. : ACL24075
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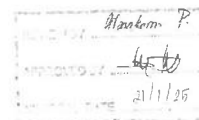
Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 01222716 / 143832 / 22763
ID No. : RYG_FS0020

Condition As Found : GOOD

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

Location : *
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024



Calibrated by : Nuthakorn Pisutpaisan

Approved by :

T. Petchuraj
(Thunakul Petchuraj)

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Cert. No. : ACL24075
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Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchuraj

Summary of Measurement Result :

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

T. Petchuraj

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Cert. No. : ACL24075
Job No. : VC67AC0054
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
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	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.7	-0.6	-0.6	±5.0

T. Petch

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Job No. : VC67AC0054
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	24.9	-0.1	± 1.1

T. Petch

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Cert. No. : ACL24075
Job No. : VC67AC0054
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	±3.0
One	136.4	135.3	-1.1	±3.0

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

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Job No. : VC67AC0054
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

T. Petchurai

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Cert. No. : ACL24094
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI-42 / Microphone UC-52 / Preamplifier NI1-24
Serial No. : 01222723 / 143841 / 22770
ID No. : RYG_FS0022

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 2.0) %

Received Date : 19 JANUARY 2024
Calibration Date : 25-26 JANUARY 2024
Date of Issue : 29 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Cert. No. : ACL24094
Job No. : VC67AC0058
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference
Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchurai

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CALIBRATION LABORATORY

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Cert. No. : ACL24094
Job No. : VC67AC0058
Pages : 3 of 8

Summary of Measurement Result :

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

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Job No. : VC67AC0058
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.4
Flat	24.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.7	±5.0

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Pages : 4 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.1	0.1	± 1.1

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

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Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.8	89.6	-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

T. Petch.

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Cert. No. : ACC24037
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178123
ID No. : RYG_FS0215

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 09 AUGUST 2024
Calibration Date : 23 AUGUST 2024
Date of Issue : 26 AUGUST 2024

REVIEW BY	<i>Handwritten signature</i>
APPROVED BY	<i>Handwritten signature</i>
NEXT CAL. DATE	09/05/25

Calibrated by : Nattakorn Pisutpaisan

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

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Cert. No. : ACC24037
Job No. : VC67AC0140
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by follow on IEC-60942:2003 Standard.
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference
microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	33461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25
Audio Analyzer	AVR-3360A	V744B6069	EF-0009-24	09-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

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Cert. No. : ACC24037
Job No. : VC67AC0140
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	94.06	0.06	0.45	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1001.4	0.1	0.1	1.0

3. Total distortion

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

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

End of Calibration Certificate

T. Petch.

T. Petch.

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Cert. No. : ACL24033
Pages : 1 of 8

Calibration Certificate

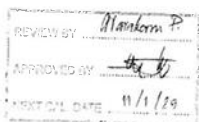
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623392 / 198639 / 26420
ID No.: RYG_FS0617

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024



Calibrated by : Nathakorn Pisuaisang

Approved by :

T. Petchuni
(Thanakul Petchuni)

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Cert. No. : ACL24033
Job No. : VC67AC0052
Pages : 3 of 8

Summary of Measurement Result :

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

T. Petchuni

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Cert. No. : ACL24033
Job No. : VC67AC0052
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standards Instruments :

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

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :

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

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Cert. No. : ACL24033
Job No. : VC67AC0052
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A-weight	13.8
C-weight	20.6
Flat	26.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.2	1.3	1.3	± 5.0

T. Petchuni

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Job No. : VC67AC0052
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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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	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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11. Overload indication

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

T. Pich

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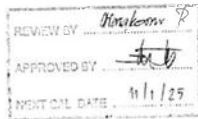
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NF-24
Serial No. : 00623393 / 198640 / 26421
ID No. : RYG_FS0618

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024



Calibrated by : Nuthakorn Pisutpaisan

Approved by : *T. Petchurai*
(Thannakul Petchurai)

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Pages : 3 of 8

Summary of Measurement Result :

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

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Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

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

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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	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	10.8
C - weight	17.4
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.3	-0.2	-0.2	± 5.0

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Job No. : VC67AC0052
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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
One	126.4	125.5	-0.9	± 3.0

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

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11. Overload indication

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

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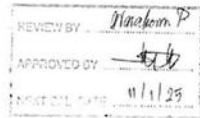
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623394 / 198641 / 26422
ID No.: RYG_FS0619

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024



Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Job No. : VC67AC0052
Pages : 3 of 8

Summary of Measurement Result :

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

T. Petchurai

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Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30-0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29-0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31-0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :

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

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Job No. : VC67AC0052
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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	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	10.8
C-weight	17.1
Flat	22.9

3. Acoustical signal tests of frequency weightings

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

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

T. Petchurai

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CALIBRATION LABORATORY

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

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Cert. No. : ACL24035
Job No. : VC67AC0052
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighing 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	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
3000	0.0	0.1	0.0	+2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	+5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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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	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

T. Petch

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Cert. No. : ACL24035
Job No. : VC67AC0052
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.6	-0.8	±3.0

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

T. Petch

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Cert. No. : ACL24035
Job No. : VC67AC0052
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

T. Petch



Certificate of Calibration

Certificate No.: 23E3924
Page: 1 of 2

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 08 December 2023
Calibration Date: 14 December 2023
Reference: 2312-0151DSO Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 10) %
618/10 Moo 5, T Maenam Khu, A Phluakdaeng,
Rayong 21140, Thailand

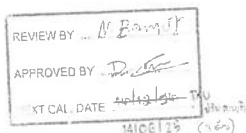
Procedure used: Calibration were conducted using calibration procedure No. CP-E17 according to EURAMET cg-15

Condition of this result of calibration

1. Reference standards Instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435602	EE-0041-23	20 Apr 2024

2. This result of calibration was made on request at the point specified by customer.
3. This certificate is valid only to the item calibrated on date and place of calibration.
4. This Certification is traceable to the International System of Unit maintained through:-
- National Institute of Metrology Thailand (NIMT)



Calibrated by: Natchanok Prasomsophon
Issue Date: 15 December 2023

Approved Signatory:
[] Phaisan Prabpolpai
[x] Nontawat Khanchai
[] Pongpagon Boonayaporn

H 0331106



Cert.No.: 23CH1574
Page.: 1 of 3

Certificate of Calibration

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 08 December 2023
Calibration Date: 15 December 2023
Reference: 2312-0151DSO-3
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
618/10 Moo 5, T Maenam Khu, A Phluakdaeng,
Rayong 21140, Thailand
Ambient Temperature: (25 ± 2.5) °C
Relative Humidity: (50 ± 15) %
Calibration Procedure:
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH6 by comparison with standard thermometer

Calibrated by: Warakorn Lernagratkul

Approved by: [Signature]
Approved Signatory

() Sathip Meangmel
() Warakorn Lernagratkul
(x) Pongpan Paipim

Issue Date: 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate is valid only to the item calibrated on date and place of calibration.
This certificate is traceable to the International System of Unit maintained through:-
- Technology Promotion Association (Thailand-Japan)



Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC118	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	231908	28 July 2024

This certification is traceable to the International System of Unit maintained through:-
- Technology Promotion Association (Thailand-Japan)

2. Certified Reference Materials

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.868	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function: mV Measurement

Performing standard curve by Fluke at pH (4.7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: B934291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 23CH1574
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 : 3225368	4.008	4.013	184.1	0.0045	2.00
	6.866	6.998	8.7	0.0084	2.00
	9.997	10.002	-184.7	0.0088	2.11

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLabSExpert Pro-ISM

- Serial No. : 3225365

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	24.3	-0.703	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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A 1193851



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TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 23TW168
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG_EN0032

Received Date : 21 July 2023

Test Date : 24 July 2023

Reference : 2307-0713DSC-1

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Laboratory Condition : Temperature (25 ± 5) $^{\circ}\text{C}$

Humidity (50 ± 20) %

Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean

Approved by :

Saitthip
Approved Signatory

() Malee Butkruea
(✓) Saitthip Maangmai
() Warakorn Lemgatrakul

Issue Date : 26 July 2023

H 0320211



Cert.No.: 23TW168
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory.

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A 1172155



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Cert. No.: 23LM125
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG_EN0032

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,
Rayong 21140 Thailand

Location : TPA On Site Calibration Laboratory

Received Order : 25 July 2023

Calibrated Date : 27 July 2023

Ambient Temperature : (26 ± 10) $^{\circ}\text{C}$

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Preecha Hiahib

Approved by :

Preecha
Approved Signatory

() Ponthippa Tameyakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616

Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713DS-C2
Procedure Used :-
 Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
 The temperature scale used was based on ITS-90.
Condition of this result of calibration
 1. Reference standard Instrument:-
Instrument **Serial No.** **Cert. No.** **Traceable** **Due Date**
 1) Digital Thermometer 2189080 221285 TPA 21 Oct 2023
 2. This certificate is valid only to the item calibrated on date and place of calibration.
 3. This certification is traceable to the International System of Unit.
Remark : TPA : Technology Promotion Association (Thailand - Japan)
Result of Calibration :- (*) Without Adjustment
Function : Temperature measurement.
 This instrument was connected with temperature sensor, S/N: 1228475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC* : Unit Under Calibration

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor *k*, providing a level of confidence of approximately 95 %.


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a 1159515

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 TEL. 0-2711 009-29 FAX 0-2719 1984

Cert. No. : 23TM962
Page : 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818.0084
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
 (Rayong Branch)
 618/10 Moo 5 T: Maenam Khu,
 A. Phukdaeng, Rayong 21140 Thailand
Location : BOD Room
Received Order : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pallanapongpaiboon
Approved by : 
 Approved Signatory
 () Porthippa Tameyakul
 () Malee Bulkruea
 (✓) Suwit Injal
Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0054967

Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Procedure Used :-
 Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
 The temperature scale used was based on ITS-90.
Condition of this result of calibration
 1. Reference standard Instrument:-
Instrument **Model** **Serial No.** **Cert. No.** **Due Date**
 1) Data Acquisition 34972A MY57013711 22LM93 02 Jul 2023
 2. This certificate is valid only to the item calibrated on date and place of calibration.
 3. This certification is traceable to the International System of Unit.
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Environment during calibration

	Beginning	Finished
Temp. (°C)	23	23
REL Humid. (%)	54	56
AC Supply (Volt)	223	222

Position : **Ref. Std. ID No. :**

1	1B-18RTD-01
2	1B-18RTD-02
3	1B-18RTD-03
4	1B-18RTD-04
5	1B-18RTD-05
6	1B-18RTD-10
7	1B-18RTD-07
8	22-18RTD-08
9 (ref.)	1B-18RTD-09

Probe Installation Details : **Dimension of Chamber :**

a = 10 cm D = 0.50 m
 b = 10 cm W = 1.0 m
 c = 10 cm H = 1.2 m
 Capacity = 0.75 m³

-00-

a 1165130

Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.116	0.30

Average* : The average of 30 values in each position.
 Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
 Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
 Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
 UUC* : Unit Under Calibration
 Note : The reported uncertainty of measurement was included stability and excluded uniformity.

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor *k*, providing a level of confidence of approximately 95 %.

-00-

a 1165129



Certificate of Calibration

Cert. No.: 24TM1663
Page : 1 of 3

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP750

Serial No. : V819.0084

ID No. : RYG_END154

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng,
Rayong 21140, Thailand

Location : BOD Room

Received Order : 01 November 2024

Calibration Date : 01 November 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

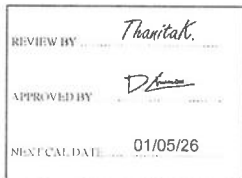
AC Line Voltage : (220 ± 22) V

Calibrated by : Krisda Malae

Approved by :

() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 07 November 2024



Equipment : Low Temp. Incubator

Condition As-Received : Used Item

Reference : 2411-0002OC-1

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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 Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY4-073381 24LM73 TPA 18 May 2025

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

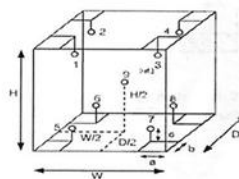
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.60 m
W = 1.0 m
H = 1.2 m
Capacity = 0.72 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	25
REL-Humid. (%)	55	53
AC Supply (Volt)	220	221

Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	23-01RTD-07
8	1RTD-2/8
9 (ref.)	23-01RTD-09

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM1663
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor
20.0	20.0	20.0	0.026	0.26	0.53	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.071	19.915	20.273	20.179	19.977	19.782	20.056	20.026	20.033	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity.

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k_c providing a level of confidence of approximately 95 %.

-000-



Certificate of Calibration

Equipment : SPECTROPHOTOMETER
Model : DR6000
Serial No. (or ID.): 1627845 (RYG_END0037)
Manufacturer : HACH
Condition : In Condition

Certificate No.: C06230441
Issued Date : 19 September 2023
Job No.: WO-00005382
Page : 1 of 3

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

Environment Condition : Temperature 23.9 °C ± 0.2
Humidity 85.3 %RH ± 1.4

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) (Wet Chemistry)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.

Calibration By: Mr.Nattapol Rungrueang

Calibration Date: 18 September 2023

The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584
The standard for Photometric Certificate No. 9114984 and 111588
The standard for Stray light Certificate No. 111586 and 111585
The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapol Rungrueang)
Person in charge

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 standards or other recognized national standard laboratories.

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

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

DKSH Technology Limited
2525 Sukhumvit Road, Bangkok, Thailand 10110
Phone: +66 2038 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CAL-FM-C08-15: 12 Sep 2022

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.3	0.31	0.13	
536.66	536.6	0.06	0.13	
637.98	638.3	-0.32	0.13	
748.46	748.7	-0.22	0.13	
807.03	807.4	-0.37	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9408	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
DKSH Technology Limited
2525 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2525 Sukhumvit Road, Bangna, Bangkok, Thailand 10260
Phone: +66 2626 7000 Email: info@dksh.com Website: www.dksh.com

Delivering Growth - In Asia and Beyond.

CAL-FM-C08-15: 12 Sep 2022

Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0090	0.000	0.0090	0.0080
	0.7355	0.737	-0.0015	0.0080
257 nm	0.0090	0.000	0.0090	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0090	0.000	0.0090	0.0080
	0.2864	0.280	-0.0036	0.0080
350 nm	0.0090	0.000	0.0090	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard: cut-off		UUC: Wavelength (nm)	UUC: Transmittance (%T)	Absorbance (A)
260.82 +/- 0.11 nm		260.8	1.3	1.888
391.44 +/- 0.11 nm		391.4	1.3	1.886
Spectral Resolution *				
Nominal Concentration 0.02 % v/v		Peak	Trough	Ratio
Standard Wavelength (nm)		268.66	266.69	1.38
UUC: Wavelength (nm)		268.2	266.1	2.00
Std Absorbance (A)		0.4566	0.2780	
Absorbance (A)		0.413	0.300	

* Calibration Marked "Not TISI Accredited" in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
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CAL-FM-C08-15: 12 Sep 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER		รุ่น: DR6000	หมายเลขเครื่อง: 1627845	
ตรวจสอบ (วัน)		ตรวจสอบ (ส่ง)		หมายเหตุ
18 Sep 2023		18 Sep 2023		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายในหลอดเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Spectrophotometer				
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	9.2 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	741.5 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
pH Meter and Conductivity Meter				
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาป้องกันลม Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>
Turbidimeter				
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่น้อย 3.0)	<input type="checkbox"/>	<input type="checkbox"/>
Automatic Titrator				
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายमाणและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>

เงื่อนไขเพิ่มเติม: *656.1nm=656.1nm

*486.0nm=485.5nm

Mr.Nattapat Rungrasang
Service Engineer

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
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CAL-FM-R31-03: 20 Jul 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH1080
Page: 1 of 2

Equipment :
Manufacturer :
Model :
Serial No. :
ID No. :
Condition As-Received :
Received Date :
Calibration Date :
Reference :
Submitted by :

pH Meter
Mettler Toledo
Seven2Go S2
C232583428
RVG_FS0506
Used Item

29 August 2024

30 August 2024

2408-0989DSC-3

Ambient Temperature :
Relative Humidity :
Calibration Procedure :

(25 ± 2.5) °C
(50 ± 15) %
In-house method :
- CP-CHS by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)

Calibrated by :

Warakorn Lemgagrakul

Approved by :

Sathip
Approved Signatory

() Unnophol Harachai
() Porpan Paipim
(✓) Sathip Meangmai

Issue Date :

2 September 2024

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.: 24CH1080
Page: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	58440003	130RC120	23E3607	13 Nov 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials

The measurement results are traceable to SI through Hach Lange GmbH Ltd., Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00
The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.005	Hach Lange GmbH	C03146	23 Feb 2025
pH 7.000	Hach Lange GmbH	C03020	13 Dec 2024
pH 9.997	CPA chem	970853	25 Apr 2025

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 Document Process Calibrator 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	mV	pH		
pH Meter S/N.: C232588428	4.00	177.48	178	4.00	0.58	0.58	2.00
	7.00	0.00	0	7.00	0.58		
	10.00	-177.48	-178	10.00	0.58		

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 3293229	4.006	4.02	181	0.0091	2.05
	7.000	7.00	7	0.0092	2.05
	9.997	10.00	-168	0.011	2.07

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:0-2717-3000-29 FAX:0-2719-9484



Certificate of Calibration

Cert. No.: 24LM140
Page: 1 of 2

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go S2

Serial No. : C232588428

ID No. : RYG_FS0606

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5, T.Maenam Khu,
A.Pluakdaeng,
Rayong 21140, Thailand

Location : TPA On Site Calibration Laboratory

Received Order : 29 August 2024

Calibrated Date : 30 August 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lornagatrakul

Approved by :

() Ponpan Paipim

() Suwit Imjai

(✓) Kunchit Promprat

Issue Date : 02 September 2024

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 : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2408-0988DSC-4

Cert. No.: 24LM140
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to companion with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	20410013	24I851	TPA	08 Aug 2025

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

3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- () Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N. 3293229

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.001	25.1	0.099	0.16	2.00
30.0	100	30.004	30.1	0.096	0.16	2.00
40.0	100	40.004	40.2	0.196	0.16	2.00
50.0	100	50.003	50.2	0.197	0.16	2.00

UUC* : Unit Under Calibration

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

-000-

Sartorius (Thailand) Co., Ltd.
129 Raura 3 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8381-9, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius

Certificate No. : 24B-00059

Issued Date : Friday, February 23, 2024

Reference No. : 228196

Page No. : 1 of 2

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

616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

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

616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Thursday, February 22, 2024

Calibration Procedure No. : This calibration was conducted by

Using in-house calibration procedure number (WI-003)

Based on UKAS LAB 14 : 2019

Metrological data :

Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:

Temperature : 24.2 °C ± 5.0 °C

Humidity : 57.0 % RH ± 10.0 % RH

Pressure : ±

Reasons for calibration

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

Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.

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Sartorius (Thailand) Co., Ltd

Mr.Chonchai Inthana(Technical Manager)

SOP FM 33 03 February 2022

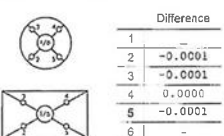


Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No : RYG_EN0002
Manufacturer : Sartorius

Certificate No. : 24BCI0069
Issued Date : Friday, February 23, 2024
Reference No. : 229196
Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability				Eccentricity (Off-center loading error)			
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant load conditions when the same load with a measurement points is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.				The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).			
Nominal Value : (Low Load)	20.0000	199.9999		Nominal value :	100	g	
20 g	20.0000	200.0000		Tolerance	0.0004	g	
Tolerance	0.0001 g	20.0001	200.0000				
	20.0000	199.9999					
	20.0001	200.0000					
Nominal Value : (High Load)	19.9999	200.0000					
200 g	20.0000	200.0000					
Tolerance	0.0001 g	20.0000	199.9999				
	19.9999	200.0001					
	19.9999	200.0000					
Standard Deviation	0.00007	0.00006					

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00018
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022



Certificate of Calibration

Cert. No. : 24TM632
Page : 1 of 3


Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UFE 500
Serial No. : G511.1572
ID No. : RYG_EN0010

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140 Thailand

Location : Oven Room

Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (28 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by : 
Approved Signatory

() Pornthippa Tameyakul
() Unnopphol Harachai
(x) Suwit Imjai

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 : 2403-05630C-1
Procedure Used :-

Cert. No. : 24TM632
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

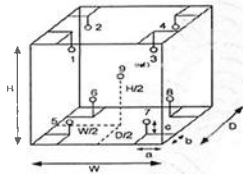
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- () Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 50 cm D = 0.40 m
b = 50 cm W = 0.56 m
c = 50 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL Humid. (%)	57	59
AC Supply (Volt)	222	224

Ref. Std. ID No. : @ Calibration Point		
Position :	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-05630C-1
Result of Calibration :- () Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No. : 24TM632
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	103.921	103.786	103.757	103.759	103.950	103.817	104.213	103.672	103.673	0.42
180.0	179.614	179.270	179.145	179.599	180.001	180.423	180.293	180.629	179.429	1.1

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 %.

-080-



Certificate of Calibration

Cert. No.: 24TM634
Page : 1 of 3

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 110
Serial No. : B423 0853
ID No. : RYG_EN0213
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 - 22 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpaiboon
Approved by :
() Pornthippa Tameyakul
() Unnopphol Harachai
(x) Suwit Imjai

REVIEW BY:
APPROVED BY:
NEXT CAL DATE: 21/03/25

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Procedure Used :-

Cert. No.: 24TM634
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

3. This certification is traceable to the International System of Unit.

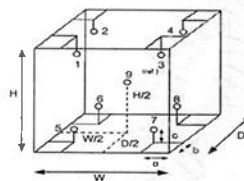
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	59	59
AC Supply (Volt)	224	223



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.58 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Ref. Std. ID No.: @ Calibration Point		
Position :	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09

Certificate of Calibration

Cert. No.: 24TM635
Page : 1 of 3

Equipment : Water Bath
Manufacturer : Memmert
Model : WNB22
Serial No. : L513.0648
ID No. : RYG_EN0061
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand
Location : Wet Chemistry Lab
Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpaiboon
Approved by :
() Pornthippa Tameyakul
() Unnopphol Harachai
(x) Suwit Imjai
Issue Date : 23 March 2024

REVIEW BY:
APPROVED BY:
NEXT CAL DATE: 21/09/25

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM634
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.065	0.52	0.90	2
180.0	180.0	180.0	0.20	1.2	2.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.999	180.127	180.138	180.895	179.313	180.211	1.1

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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Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Procedure Used :-

Cert. No.: 24TM635
Page : 2 of 3

Calibration was conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

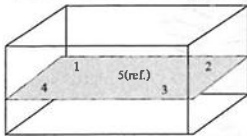
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	25	55	222
Finished of Calibration	25	57	223



Front

Position :	Ref. Std. ID No.:
1	4803988-001
2	4803988-002
3	4803988-003
4	4803988-004
5(ref.)	4803988-005



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM635
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.428	84.424	84.489	84.507	84.477	0.18

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	2

Average* : The average of 30 values in each position.

Uniformity* : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability* : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhui, 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.com

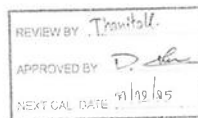


Certificate No. T241120

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)
Manufacturer : MODULAR
Model : IREVCOHCOO
Serial No. : C00351459
Customer Code : RYG_EN0184
ID No. : T1939A5
Customer : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu,
A.Phuakdaeng, Rayong 21140
Customer Location : Laboratory
Date of Receipt : 5 June 2024
Calibrated By : Sujjar Naknakred (Site Calibration Manager)
Approved By : Preecha Phisassutthikul (Temperature Calibration Manager)
Date of Issue : 12 JUN 2024



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 Metrology.



Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhui, Saraburi 18110, Thailand



Certificate No. T241120

Page 2 of 4

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 11 June 2024
Environment : Temperature : 23.1-24.1 °C
Line Voltage : 222.3-226.3 V
Relative Humidity : 55 - 65 %RH

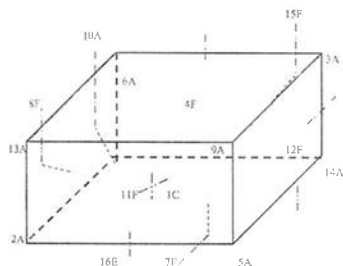
Condition of this results of calibration :

- This equipment was calibrated by insert nine standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986). All data shown 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	T240713	19 April 2025
TC	TYPE T	TN171-TN180	T240713	19 April 2025
DATA LOGGER	34970A	T149	T240713	19 April 2025
- This certificate is traceable to : National Institute of Metrology (Thailand) through Metrological Center (NSC-TISPTIS 17025 CALIBRATION 0244)
- Condition of calibrated item : good
Equipment Description :
Time Constant : 3 Hour 30 Minute At 3 °C
Fresh Air Damp : ☐ Open ☐ Min ☐ Medium ☐ Max
☒ Not Available
- Adjustment : () without adjustment (X) after adjustment

Approved By:

Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C =	TN161
2A =	TN162
3A =	TN163
4F =	TN164
5A =	TN165
6A =	TN166
7E =	TN167
8F =	TN168
9A =	TN169
10A =	TN170

11F =	TN171
12F =	TN172
13A =	TN173
14A =	TN174
15F =	TN175
16E =	TN176

Approved By: 

TM-4.15.118-14-08-06

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.73	2.70	2.77	2.78	2.99	2.35	3.09	3.21	3.08	2.90
	TN171	TN172	TN173	TN174	TN175	TN176				
	3.39	3.01	2.92	2.81	3.42	3.42				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min	Max					
3.0	2.9	4.4	3.7	2.97	1.32	1.13	2.02

* 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: 

TM-4.15.118-14-08-06



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
134/1 PATTANAKARN ROAD 501 18, SUAN LUANG, SUAN LUKHANG BANGKOK 10250
TEL. 0-2717-0000-29 FAX. 0-2710-9-81



 Cert.No.: 23CH1088
Page.: 1 of 2

Certificate of Calibration

Equipment : Conductivity Meter
Manufacturer : Mettler Toledo
Model : S230
Serial No. : B241407147
ID No. : RYG_EN0029
Condition As-Received: Used Item
Received Date : 01 September 2023
Calibration Date : 04 September 2023
Reference : Z309-0010DSC-7
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
 616/10 Moo 5, T. Maenam Khu,
 A. Phukdaeng, Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In-house method :
 - CP-CH6, based on direct measurement by using certified reference material (CRM)

Calibrated by : Warakorn Lerngagrakul

Approved by : 
 Approved Signatory

(✓) Sathip Meangmai
 () Warakorn Lerngagrakul
 () Ponpan Palpim

Issue Date : 7 September 2023

The Uncertainties are for a confidence probability of approximately 95%

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 Approval of the head of Calibration Services 3: Equipment Calibration and Testing Services.

A 0058059


 Cert.No.: 23CH1088
 Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	231435	10 Apr 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
84,000 µS/cm	CPA Chem	885120	28 Mar 2024
1413.0 µS/cm	CPA Chem	913598	14 July 2024
12,880 mS/cm	CPA Chem	885123	28 Mar 2024

- Control Conductivity calibration solution temperature by Water bath (25.0 ± 0.1) °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 1413.0 µS/cm

Conductivity Electrode Serial No.: 5823251000

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
84,000 µS/cm	83.8 µS/cm	85.3 µS/cm	0.62 µS/cm	2.00
1413.0 µS/cm	1388 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12,880 mS/cm	12.41 mS/cm	12.63 mS/cm	0.086 mS/cm	2.00

Remark - UUC* = Unit Under Calibration

- Cell constant = 0.545371 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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a 1178950

Certificate of Calibration

Certificate No.: C29240011

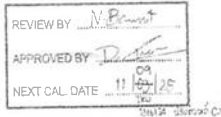
Page: 2 of 4

Represent to Certificate of Calibration No: C29240007

Equipment: Block Digestion Unit Certificate No: C29240011
Model: KT-20s Issued Date: 22 March 2024
Serial No. (or ID): 5720210009/5770200073 Job No.: WO-00020428
Manufacturer: Garhardt Page: 1 of 4
Condition: In Condition Digestion Block: 20 holes

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

Environment Condition: Temperature: 25 °C ± 0.7 °C
Humidity: 54 %RH ± 4.1 %RH
Voltage: 225 VAC ± 1.7 VAC



Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
(Wet Chemistry Lab)
616/10 Moo 5 T. Maenam Khu. A, Pluakdaeng, Rayong 21140, Thailand.

Calibration By: Mr. Thanathorn Phunook
Calibration Date: 11 March 2024
The Method used: In house method, base on by comparison with standard
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL) Certificate No. TC22/0080

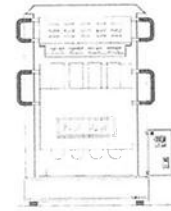
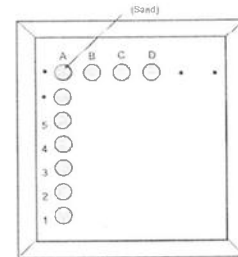


Fig. 1 Front view



Location of standard

Fig. 2 Digestion block

Definitions

Indicating Temperature: The average reading of a indicating device which forms the integral part of the Digestion block

Measured Temperature: The average reading of working standard at any positions or location.

(Mr. Thanathorn Phunook)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the international system of units (SI). It provides traceability of measurement to International System of Units (SI) maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL) Certificate No. TC22/0080.

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% in a determined in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested (or a batch or sample). The report shall not be reproduced except in full without any consent of DKSH Technology Limited.

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Certificate No.: C29240011

Page: 3 of 4

Calibration Results:

Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	401.5	21.5	1.5
A2				401.2	21.2	1.5
A3				398.1	18.1	1.5
A4				397.8	17.8	1.5
A5				395.1	15.1	1.5
B1				398.6	18.6	1.5
B2				398.1	18.1	1.5
B3				397.9	17.9	1.5
B4				391.6	11.6	1.5
B5				390.7	10.7	1.5
C1				395.3	15.3	1.5
C2				395.6	15.6	1.5
C3				392.9	12.9	1.5
C4				391.7	11.7	1.5
C5				390.3	10.3	1.5
D1				397.6	17.6	1.5
D2				395.6	15.6	1.5
D3				395.0	15.0	1.5
D4				394.2	14.2	1.5
D5				393.6	13.6	1.5

Certificate No.: C29240011

Page: 4 of 4

Calibration Results:

Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	382.5	17.5	1.5
A2				382.4	17.4	1.5
A3				382.1	17.1	1.5
A4				370.7	14.7	1.5
A5				378.3	13.3	1.5
B1				380.1	15.1	1.5
B2				380.1	15.1	1.5
B3				378.5	13.5	1.5
B4				375.3	13.3	1.5
B5				373.1	14.1	1.5
C1				380.1	15.1	1.5
C2				380.1	15.1	1.5
C3				378.9	13.9	1.5
C4				378.2	13.2	1.5
C5				377.3	12.3	1.5
D1				380.5	15.5	1.5
D2				380.6	15.6	1.5
D3				378.1	13.1	1.5
D4				378.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

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CAL-FM-C29-07 20 Jul 2022



ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00020429

ชนิดเครื่องมือ: Block Digestion Unit
รุ่น: KT-20s
หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
11 Mar 2024		11 Mar 2024		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1	สายไฟ	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2	การทำงานของ Main Switch	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3	การทำงานของ Selector Key	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4	การแสดงผล Display	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5	สภาพ Hole	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6	สภาพฝาปิด	ไม่มี
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	7	สภาพลิ้นเครื่อง	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8	สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	

ชื่อและนาม

Mr. Thanathorn Phunook
Service Engineer

Agilent Technologies ขอรับรองว่า
ใบตรวจสอบนี้จัดทำขึ้นโดย
ผู้ตรวจสอบที่ได้รับการฝึกอบรม
และได้รับอนุญาตให้ดำเนินการตรวจสอบ
และออกใบตรวจสอบได้ตามข้อกำหนด
ของ Agilent Technologies
Delivering Growth in Asia and Beyond

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Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY	<i>Not Sent</i>
APPROVED BY	<i>LLA</i>
NEXT CAL DATE	13-Jun-25

Agilent CrossLab Compliance Services

System ID: GM-7
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn 40, Pathanakarn Rd., Khwang Suan Luang, Khet Suan Luang, Bangkok.

Date: December 13, 2023 3:32:46 PM
EQP Name: AgilentRecommended, AgilentRecommended
EQP Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status
Pass

Inlet Pressure Accuracy

Name: 7890
Front: SSL
Setpoint Status: Pass
Setpoint: 25.0 psi
Actual: 25.0 psi
Accuracy: 0.0 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status
Pass

GC Oven Temperature Accuracy

Name: 7890

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Agilent CrossLab Compliance Services

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 230.0 232.3 °C
Accuracy: 2.3 °C
Agilent Recommended: >= -1.0 % setpoint in K { -5.0 °C }
<= 1.0 % setpoint in K { 5.0 °C }

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual
Temperature: 100.0 100.7 °C
Accuracy: 0.7 °C
Agilent Recommended: >= -1.0 % setpoint in K { -3.7 °C }
<= 1.0 % setpoint in K { 3.7 °C }

Overall GC Oven Temperature Accuracy Test Status
Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint/Average
Temperature: 100.0 100.4 °C
Stability: 0.0 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status
Pass

Log Amp

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Agilent CrossLab Compliance Services

Overall Log Amp Test Status Pass

RFPA

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass
Amu: 1050 m/z
Drift After Five Minutes: 2 mV
RFPV Voltage: 504 mV
Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status
Pass

Tune EI

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass
Filament: 1
Setpoint Status: Pass
Filament: 2

Overall Tune EI Test Status
Pass

Signal to Noise: EI

Tested Combination1 Front SSL / External SQ
Name: 5977A

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Source:	El - Extractor	Filament:	1
Setpoint Status:	Pass		
Signal to Noise:	11318		
Agilent Recommended:	≥ 1200		
Source:	El - Extractor	Filament:	2
Setpoint Status:	Pass		
Signal to Noise:	16568		
Agilent Recommended:	≥ 1200		

Overall Signal to Noise El Test Status

Pass

NOTE: This test has 0 comment(s) and 6 deviation(s) are available in the Attachments section.

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Instrument Details**Purpose**

This section describes the as found system configuration.

Details

System:	
System ID	GM-7
Manufacturer	Agilent Technologies
Name	7690
Testkit Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN14133181
Firmware Revision	B.02.03
Oven Type	Standard

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Inlet 1	
Manufacturer	Agilent Technologies
Name	7690
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	SQ
Name	5977A
Serial Number	US1415M209
Firmware Revision	5977 6.00.21
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
MS El Source 1	
Manufacturer	Agilent Technologies
Source Type	El - Extractor
Number of filaments	2

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Electronic Signature**Purpose**

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

Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	December 13, 2023
Reason for Signature:	Executed protocol and published the 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

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: supasak.nimsangtham
Report Generated by Hostname: ASBKXW492
Print Date: December 13, 2023 3:32:47 PM
System ID: GM-7

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 10:22:24 AM	Audit	Session Created	Session	None
December 13, 2023 10:22:28 AM	Start	Configuration	Session	None
December 13, 2023 10:22:34 AM	Audit	Enrollment	License	User is Field Engineer and does not require an unlock code
December 13, 2023 10:23:53 AM	Audit	Exploaded	Session	EQP details for primary technique [G1] - File path: [ProtocolPack\G1\Conf\G1.ms02 50°C\02 50 rep], EQP File Name: [G1 02 50 e-9], EQP Name: [Agilent Recommended] Protocol Review: [G1 02 50] EQP details for hybridized technique [G2Ab] - File path: [ProtocolPack\G2Ab\Conf\G2.ms02 50°C\02 50 e-9], EQP File Name: [G2Ab 02 50 rep], EQP Name: [Agilent Recommended]
December 13, 2023 10:23:56 AM	End	Configuration	Session	None
December 13, 2023 10:23:59 AM	Start	Qualification	Session	OQ
December 13, 2023 10:23:59 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7590 - Qualitative Test - No setpoints associated	None

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: supasak.nimsangtham
Report Generated by Hostname: ASBKXW492
Print Date: December 13, 2023 3:32:47 PM
System ID: GM-7

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 10:24:10 AM	End	Execution	System Inspection and Basic Safety and Operation - 7590 - Qualitative Test - No setpoints associated	Run Count: 1
December 13, 2023 10:24:11 AM	Start	Execution	Inlet Pressure Accuracy - Front SSI - Pressure Controlled Inlet - 25.0 psi - L <= 1.2 psi	None
December 13, 2023 10:24:15 AM	End	Execution	Inlet Pressure Accuracy - Front SSI - Pressure Controlled Inlet - 25.0 psi - L <= 1.2 psi	Run Count: 1
December 13, 2023 10:24:17 AM	Start	Execution	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 250.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	None
December 13, 2023 10:24:23 AM	Audit	Data	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 250.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
December 13, 2023 10:24:11 AM	End	Execution	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 250.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
December 13, 2023 10:24:12 AM	Start	Execution	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 100.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	None
December 13, 2023 10:24:58 AM	Audit	Data	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 100.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
December 13, 2023 10:24:59 AM	End	Execution	GC Oven Temperature Accuracy - 7590 - Temperature Oven - 5: 100.0°C - L <= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: supasak.nimsangtham
Report Generated by Hostname: ASBKXW492
Print Date: December 13, 2023 3:32:47 PM
System ID: GM-7

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 10:34:00 AM	Start	Execution	GC Oven Temperature Stability - 7590 - Temperature Oven - 5: 100.0°C - L <= 0.5°C	None
December 13, 2023 10:35:27 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSI, SQ - Source: EI - Extractor using Flament 1 - L <= 1200	None
December 13, 2023 10:35:29 AM	Start	Execution	GC Oven Temperature Stability - 7590 - Temperature Oven - 5: 100.0°C - L <= 0.5°C	None
December 13, 2023 10:35:19 AM	Audit	Data	GC Oven Temperature Stability - 7590 - Temperature Oven - 5: 100.0°C - L <= 0.5°C	Manual Data Entry
December 13, 2023 10:35:12 AM	End	Execution	GC Oven Temperature Stability - 7590 - Temperature Oven - 5: 100.0°C - L <= 0.5°C	Run Count: 1
December 13, 2023 10:36:15 AM	Start	Execution	Lag Amp - 5977A SQ - Source: EI - Extractor	None
December 13, 2023 10:36:42 AM	End	Execution	Lag Amp - 5977A SQ - Source: EI - Extractor	Run Count: 1
December 13, 2023 10:36:43 AM	Start	Execution	RPPA - 5977A SQ - Source: EI - Extractor	None
December 13, 2023 11:04:44 AM	End	Execution	RPPA - 5977A SQ - Source: EI - Extractor	Run Count: 1
December 13, 2023 11:04:45 AM	Start	Execution	Turn EI - 5977A SQ - Source: EI - Extractor Flament 1 (Qualitative - No setpoints associated)	None
December 13, 2023 11:32:36 AM	End	Execution	Turn EI - 5977A SQ - Source: EI - Extractor Flament 1 (Qualitative - No setpoints associated)	Run Count: 1

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: supasak.nimsangtham
Report Generated by Hostname: ASBKXW492
Print Date: December 13, 2023 3:32:47 PM
System ID: GM-7

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 11:32:38 AM	Start	Execution	Turn EI - 5977A SQ - Source: EI - Extractor Flament 2 (Qualitative - No setpoints associated)	None
December 13, 2023 11:33:06 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSI, SQ - Source: EI - Extractor using Flament 1 - L <= 1200	None
December 13, 2023 11:43:35 AM	Start	Execution	Turn EI - 5977A SQ - Source: EI - Extractor Flament 2 (Qualitative - No setpoints associated)	None
December 13, 2023 11:43:42 AM	End	Execution	Turn EI - 5977A SQ - Source: EI - Extractor Flament 2 (Qualitative - No setpoints associated)	Run Count: 1
December 13, 2023 11:48:43 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSI, SQ - Source: EI - Extractor using Flament 1 - L <= 1200	None
December 13, 2023 11:49:48 AM	Audit	Aborted	Session	None
December 13, 2023 12:36:39 PM	Audit	Forced Restart	Session	None
December 13, 2023 12:36:40 PM	Audit	Session Relocated	Session	None
December 13, 2023 12:36:42 PM	Start	Qualification	Session	OQ
December 13, 2023 12:36:42 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSI, SQ - Source: EI - Extractor using Flament 1 - L <= 1200	None

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: eugene.kim@agilent.com
Report Generated by Hostname: ASDKQW492
System ID: GM-7
Print Date: December 13, 2023 3:32:47 PM

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 12:37:32 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F1.D
December 13, 2023 12:38:18 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Run Count: 1
December 13, 2023 12:39:51 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Deviation filed for Run Count: 1
December 13, 2023 12:39:51 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	None
December 13, 2023 12:40:15 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F1.D
December 13, 2023 12:42:00 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Run Count: 2
December 13, 2023 12:42:55 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 12:43:43 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F2.D

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: eugene.kim@agilent.com
Report Generated by Hostname: ASDKQW492
System ID: GM-7
Print Date: December 13, 2023 3:32:47 PM

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 12:43:54 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Run Count: 1
December 13, 2023 1:34:41 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Deviation filed for Run Count: 2
December 13, 2023 1:54:41 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	None
December 13, 2023 1:54:50 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F1.D
December 13, 2023 1:56:22 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Run Count: 3
December 13, 2023 1:56:50 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Deviation filed for Run Count: 3
December 13, 2023 1:58:30 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	None
December 13, 2023 2:14:32 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F1.D

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: eugene.kim@agilent.com
Report Generated by Hostname: ASDKQW492
System ID: GM-7
Print Date: December 13, 2023 3:32:47 PM

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 2:15:03 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L >= 1200	Run Count: 4
December 13, 2023 2:28:07 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Deviation filed for Run Count: 4
December 13, 2023 2:28:07 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 2:29:00 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F2.D
December 13, 2023 2:29:41 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Run Count: 2
December 13, 2023 2:30:51 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Deviation filed for Run Count: 2
December 13, 2023 2:29:51 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 2:27:01 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F2.D

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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User Name: eugene.kim@agilent.com
Report Generated by Hostname: ASDKQW492
System ID: GM-7
Print Date: December 13, 2023 3:32:47 PM

GM-7-2023 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 2:27:42 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Run Count: 3
December 13, 2023 2:29:14 PM	Auto	Test/Unlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Deviation filed for Run Count: 3
December 13, 2023 2:28:14 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 2:34:02 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 2:41:26 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None
December 13, 2023 2:42:42 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Data File Path: D:\MassHunter\COMMS\data\10Q20230230_F2.D
December 13, 2023 2:44:32 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	Run Count: 4
December 13, 2023 2:44:36 PM	End	Qualification	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	OK
December 13, 2023 2:44:55 PM	Start	Reporting	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L >= 1200	None

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Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY Theresa B.
APPROVED BY Sally L. N.
NEXT CAL DATE 28/02/2028

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
December 13, 2023 1:01:22 PM	Auto	AccountClosed	Session	None
December 13, 2023 5:20:10 PM	Auto	AccountReopened	Session	None
December 13, 2023 3:25:10 PM	Auto	SessionRecreated	Session	None
December 13, 2023 3:06:13 PM	Start	Qualification	Session	QQ
December 13, 2023 3:31:33 PM	Auto	Reporting	Session	Report Generated Certificate
December 13, 2023 3:05:38 PM	Auto	Reporting	Session	Report Generated Report

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Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

Date: December 13, 2023 3:32:46 PM
System ID: GM-7

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Revision: A02, issued 21 January 2022
Document Number: 08014-90075
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Agilent 5100, 5110 Preventive Maintenance Checklist



Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer
- A Customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Ancient 5100, 5110 Preventive Maintenance Checklist



Important Customer Web Links

- ## Important Customer Web Links
- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
 - To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources/>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
 - The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
 - Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
 - Need to place a service call? Flexible Repair Options | Agilent



Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page.
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section.
- Ask the customer to sign the Service Verification section including the customer's and your signature.

Instrument Maintenance

System Information

- ☒ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	87010A / MY 15010005
Instrument System Site and Location	PLS Laboratory Group (Thailand) Co., LTD.

List System Component Product Numbers	List the Serial Numbers of each Component
1 87010A	MY 15010005
2 87010A	101544-0714
3 87010A - 80001	1001 - 00159
4	
5	
6	
7	
8	
9	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	Scrap/Spray OneWeb Conical Other
Spray Chamber	Cyclonic Single Pass Cyclonic Double Pass Other
Torch	Radial Dual View Other
Torch Type	One Piece Semi Detachable Fully Detachable Other
Injector Diameter	2.4mm 1.8mm 1.4mm 0.8mm Other
Injector Material	Quartz Ceramic Other

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Set instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes.
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☒ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Pre-PM

Clean and Inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polyhexamers purge filter.
- ☒ Replace the radial pre-optics window.
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☒ Replace high capacity air inlet dust filter element if installed.
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir.
- ☒ Remove, clean and re-install water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace if necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☐ Service not applicable
- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☒ Check the X-axis, theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☒ Pump Tubing Replacement: Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following instrument tests
- ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☒ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre-PM Sensitivity Check		Post-PM Sensitivity Check	
	Radial	Axial*	Radial	Axial*
Zn 213.857 nm SRRA	1511.1	3+46.3	1510.0	3421.8
Mn 257.610 nm SRBR	1354.1	1155.2-6	23+9.3	1799.3
Al 306.152 nm SBR	2.7	15.0	5.6	10.3
K 766.491 nm SBR	5.3	6+0	5.6	92.6

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	PASS
Air Flow	PASS
Water Flow	PASS
Gas Flows	PASS
RF Generator	PASS
Camera Test	PASS
Optics Test	PASS
Nebulizer Test	PASS



Certificate No. T231676

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 22 September 2023
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.J
- Condition of calibrated item : good
Equipment Description :
Time Constant : 2 Hour 20 Minute At 95 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment :
() without adjustment (X) after adjustment

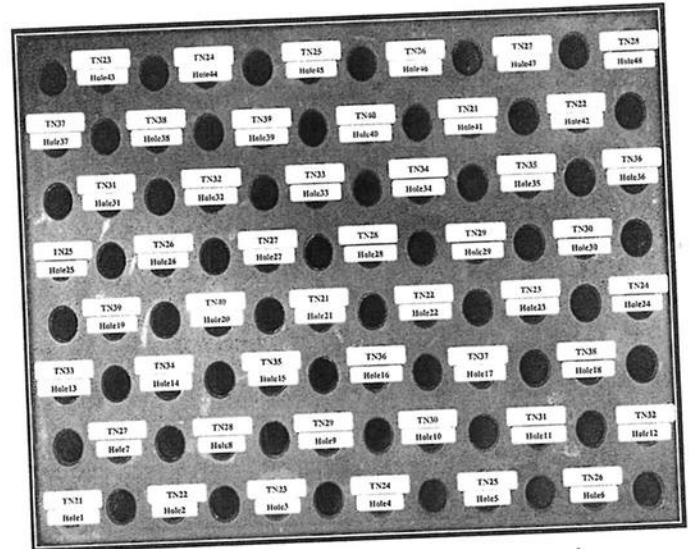
Approved By

FM-L13 108-30-05-57

Certificate No. T231676

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Calibration Report



FRONT CONTROL

Approved By

FM-L13 108-30-05-57



Certificate No T231676

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Calibration Report

Measurement Results		Average Standard Reading at each position (°C)						
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26	
R1 Hole1-Hole6								
CAL POINT	Max	95.01	94.41	95.20	95.41	94.31	95.17	
	Min	94.57	93.95	94.75	94.92	94.00	94.72	
	Average	94.79	94.18	94.93	95.17	94.26	94.95	
R2 Hole7-Hole12								
CAL POINT	Max	95.36	95.43	95.19	95.16	95.35	94.97	
	Min	94.94	94.95	94.72	94.71	94.80	94.57	
	Average	95.15	95.19	94.96	94.94	95.13	94.77	
R3 Hole13-Hole18								
CAL POINT	Max	95.37	95.50	95.22	95.21	95.33	95.31	
	Min	94.89	95.09	94.78	94.82	94.88	94.96	
	Average	95.18	95.30	95.00	95.02	95.11	95.13	
R4 Hole19-Hole24								
CAL POINT	Max	95.59	94.42	94.52	94.24	94.63	94.67	
	Min	95.21	94.06	94.13	93.88	94.28	94.27	
	Average	95.40	94.24	94.33	94.06	94.45	94.47	
R5 Hole25-Hole30								
CAL POINT	Max	95.19	95.26	92.93	95.30	95.14	95.03	
	Min	94.83	95.03	92.56	94.95	94.79	94.70	
	Average	95.01	95.20	92.75	95.12	94.96	94.87	
R6 Hole31-Hole36								
CAL POINT	Max	94.63	94.90	94.77	94.31	94.24	92.87	
	Min	94.24	94.55	94.44	93.98	93.92	93.56	
	Average	94.43	94.72	94.60	94.14	94.08	93.71	
R7 Hole37-Hole42								
CAL POINT	Max	94.30	94.44	94.04	93.81	91.89	95.35	
	Min	93.95	94.05	93.67	93.48	94.39	94.90	
	Average	94.13	94.24	93.86	93.65	94.64	95.12	
R8 Hole43-Hole48								
CAL POINT	Max	95.99	95.63	95.28	95.29	95.45	94.57	
	Min	95.57	95.15	94.82	94.84	94.99	94.48	
	Average	95.78	95.39	95.05	95.07	95.22	94.68	

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Calibration Report

Measurement Results		Average Standard Reading at each position (°C)						
Calibration Point		TN21	TN22	TN23	TN24	TN25	TN26	
R1 Hole1-Hole6								
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44	105.27	
	Min	104.94	103.95	105.15	105.04	104.11	104.96	
	Average	105.09	104.13	105.29	105.15	104.28	105.12	
R2 Hole7-Hole12								
CAL POINT	Max	105.30	105.12	105.18	105.22	105.12	105.16	
	Min	105.11	104.92	104.96	105.00	104.92	104.97	
	Average	105.20	105.02	105.07	105.11	105.02	105.06	
R3 Hole13-Hole18								
CAL POINT	Max	105.27	105.63	105.02	104.80	104.69	105.19	
	Min	105.17	105.37	104.75	104.59	104.50	105.00	
	Average	105.27	105.50	104.88	104.69	104.60	105.09	
R4 Hole19-Hole24								
CAL POINT	Max	105.31	104.43	104.41	104.71	105.63	105.82	
	Min	105.08	104.22	106.15	104.41	105.37	105.56	
	Average	105.19	104.33	105.28	104.56	105.50	105.69	
R5 Hole25-Hole30								
CAL POINT	Max	104.95	106.26	103.34	105.78	105.59	105.87	
	Min	104.67	105.96	103.08	105.56	105.36	105.68	
	Average	104.81	106.11	103.21	105.67	105.48	105.77	
R6 Hole31-Hole36								
CAL POINT	Max	104.75	104.36	104.80	105.20	104.50	104.39	
	Min	104.54	104.63	104.59	105.00	104.32	104.18	
	Average	104.65	104.75	104.69	105.10	104.41	104.28	
R7 Hole37-Hole42								
CAL POINT	Max	104.30	104.90	104.85	104.65	104.85	104.85	
	Min	104.09	104.72	104.66	104.49	104.63	104.52	
	Average	104.19	104.81	104.75	104.57	104.76	104.68	
R8 Hole43-Hole48								
CAL POINT	Max	105.71	105.85	105.39	105.61	105.42	105.19	
	Min	105.45	105.61	105.14	105.27	105.18	104.94	
	Average	105.58	105.73	105.27	105.44	105.30	105.07	

Approved By

FM-L13 108-30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



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Certificate No. T231676

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Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min., Max	Average		
100.0	100.3, 100.5	100.4	0.26	0.81
107.0	107.0, 107.1	107.1	0.19	0.78

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By: _____

FM-L13 108/30-05-57

Certificate No. T232160

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling 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 : 29 November 2023

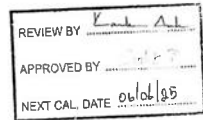
Calibrated By : Atiphong Rongrat (Technician)

Approved By : Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 09 JAN 2024

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 Metrology.



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Certificate No. T232160

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Calibration Report

Equipment : Chamber (Cooling Room)
Date of Calibration : 6 December 2023
Environment : Temperature : 23.4-24.9 °C
Line Voltage : 221.4-230.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. 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 shown below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244).

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 1 Hour 30 Minute At 3 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment () after adjustment

Approved By: _____

FM-L15 118/18-08-66



Metrology

SCI ECO Services Company Limited

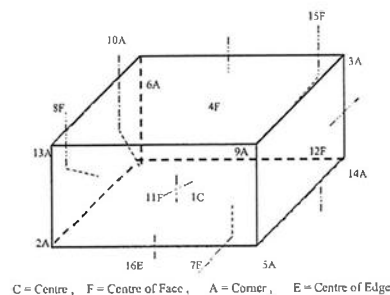
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Certificate No. T232160

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: _____

FM-L15 118/18-08-66

