

## ภาคผนวก ง

### เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



#### รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Wind Speed / Wind Direction	RYG F50411		29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	RYG F50085		8-Oct-21	8-Apr-23	18
Ambient	Wind Speed / Wind Direction	RYG F50329		31-Jan-22	29-Jul-23	18
Ambient	n-Hexane	Field Rotameter	RYG F50199	1-Oct-22	1-Jan-23	3
Noise	Leq 24 hrs	GC-FID	BKQ EN0126	21-Oct-21	21-Apr-23	18
Noise	Leq 24 hrs	Sound Calibrator	RYG F50213	26-Apr-22	26-Apr-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG F50390	18-Oct-22	18-Oct-23	12
Noise	Leq 12 hrs	Sound Calibrator	RYG F50213	26-Apr-22	26-Apr-23	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50387	13-Sep-21	13-Sep-22	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50388	13-Sep-21	13-Sep-22	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50389	13-Sep-21	13-Sep-22	12
Noise	Leq 12 hrs	Sound Calibrator	RYG F50215	31-Aug-22	31-Aug-23	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50434	21-Jan-22	21-Jan-23	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50433	21-Jan-22	21-Jan-23	12
Noise	Leq 12 hrs	Sound Level Meter	RYG F50432	21-Jan-22	21-Jan-23	12
Noise	Octave Band	Sound Calibrator	RYG F50213	26-Apr-22	26-Apr-23	12
Noise	Octave Band	Sound Level Meter	RYG F50387	13-Sep-21	13-Sep-22	12
Noise	Octave Band	Sound Level Meter	RYG F50388	13-Sep-21	13-Sep-22	12
Noise	Octave Band	Sound Level Meter	RYG F50389	13-Sep-21	13-Sep-22	12
Noise	Octave Band	Sound Calibrator	RYG F50215	31-Aug-22	31-Aug-23	12
Noise	Octave Band	Sound Level Meter	RYG F50434	21-Jan-22	21-Jan-23	12
Noise	Octave Band	Sound Level Meter	RYG F50433	21-Jan-22	21-Jan-23	12
Noise	Octave Band	Sound Level Meter	RYG F50432	21-Jan-22	21-Jan-23	12
Noise	Noise Dose, TWA	Dose Badge Reader	RYG F50212	1-Dec-21	1-Dec-22	12
Noise	Noise Dose, TWA	Dose Badge Reader	RYG F50497	1-Oct-22	7-Oct-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50523	7-Mar-22	7-Mar-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50522	7-Mar-22	7-Mar-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50558	16-Feb-22	16-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG F50559	28-Jan-22	28-Jan-23	12
Workplace	n-Hexane	Field Rotameter	RYG F50199	1-Jul-22	1-Oct-22	3
Workplace	n-Hexane	Field Rotameter	RYG F50199	1-Oct-22	1-Jan-23	3
Workplace	n-Hexane	GC-FID	BKQ EN0126	21-Oct-21	21-Apr-23	18
Workplace	Total Dust	Field Rotameter	RYG F50198	1-Jul-22	1-Oct-22	3
Workplace	Total Dust	Field Rotameter	RYG F50198	1-Oct-22	1-Jan-23	3
Workplace	Total Dust	Digital Balance	RYG EN0004	23-Mar-22	23-Mar-23	12
Rayong Lab	pH at 25 °C	pH meter	RYG EN0183	17-Mar-22	17-Mar-23	12
Rayong Lab	BOD	DO meter with Sensor	RYG EN0732	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	COD	Spectrophotometer	RYG EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Temperature	pH Meter	RYG F50420	14-Mar-22	14-Mar-23	12
Rayong Lab	n-Hexane	Gas Chromatography (MS)	BKQ EN0059	21-Jan-22	21-Dec-23	18
Rayong Lab	Chloride	pH DE Meter	RYG EN0152	23-Dec-21	23-Dec-22	12
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG EN0037	27-Sep-22	27-Mar-24	18

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Walthapra, Bangkokyai,Bangkok 10600 Thailand.  
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## CERTIFICATE OF CALIBRATION

Certificate No: WS-11072021  
Page 1 of 2 pages

**Measurement Item** : Cup anemometer with data logger.

**Manufacturer** : Data logger: Novalyne.  
Cup anemometer: Novalyne.

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

**Serial Number** : Data logger: A0369.  
Cup anemometer: -.

**ID No** : Data logger: RYG\_F50411.  
Cup anemometer: -.

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

**Test Conditions** : Wind tunnel: cross test section area: 900 cm<sup>2</sup>  
Anemometer frontal area: 100 cm<sup>2</sup>  
Diameter of mounting pipe: 3 mm  
Blockage ratio of test object: 0.111 [-]

**Test Conditions** : Air temperature: 24.3 ±0.8 °C  
Air pressure: 1009.3 ±0.4 hPa  
Relative air humidity: 58.6 ±3.5 %RH

**Calibration Procedure** : Calibration was carried out per on:  
ISO: 61400-12-1 ED1: 2008-Power Performance Measurements of Electricity Producing Wind Turbines  
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

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

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



Approved Signatory: Mr. Pinyakorn Poontharawat  
Technical Support and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-11072021  
Page 2 of 2 pages

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

V <sub>ref</sub> Reading m/s	V <sub>cup</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.084	1.9	-0.2	2.6
4.102	4.1	0.0	1.2
5.9	5.1	-0.1	0.97
8.03	8.0	0.0	0.73
10.02	10.1	0.1	0.63
11.99	12.2	0.2	0.62
13.98	14.3	0.3	0.62
15.9	16.3	0.3	0.62
18.0	18.4	0.4	0.65
20.0	20.1	0.1	0.67
22.0	22.1	0.1	0.51
24.1	24.1	0.1	0.63
26.1	26.1	0.0	0.84
5.164	5.1	-0.1	1.1
3.001	3.0	0.0	1.9
1.032	0.6	-0.2	5.4

## CERTIFICATE OF CALIBRATION

Certificate No: WD-11072021  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

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

Serial Number : Data logger: A5369.  
Wind direction sensor: -

ID No : Data logger: RY0\_F50411.  
Wind direction sensor: -

Customer : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanawan 40, Phatthanawan Rajkhuang Suan Luang, (Khai Suan) Luang, Bangkok 10250  
Thailand.

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

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

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

Traceability:  
The measurement results are traceable to the international system of units (SI) through Certificate No: DC553-07-0045.  
Certificate No: RW593/0044.

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



Approved Signatory: \_\_\_\_\_

Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-11072021  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.  
Calibration in the range of 0 ~ 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	180	0	3.0
6		225	225	226	1	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	180	0	3.0
14		225	225	226	1	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



## CERTIFICATE OF CALIBRATION

Certificate No: WS-01102021  
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novallux.  
Cup anemometer: Novallux.

Model/Type : Data logger: 200-WS-25DL.  
Cup anemometer: WS-02P

Serial Number : Data logger: A4985.  
Cup anemometer: -

ID No : Data logger: RY0\_F50085.  
Cup anemometer: -

Customer : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanawan 40, Phatthanawan Rajkhuang Suan Luang, (Khai Suan) Luang, Bangkok 10250  
Thailand.

Test Conditions : Wind tunnel, cross test section area : 900 cm<sup>2</sup>  
Anemometer frontal area : 100 cm<sup>2</sup>  
Diameter of mounting pipe : 30 mm  
Blockage ratio of test object : 0.111 %

Test Conditions : Air temperature : 24.0 ±0.5 °C  
Air pressure : 1026.1 ±0.4 hPa  
Relative air humidity : 58.1 ±3.5 %RH

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

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

Measurement Date : Oct 08, 2021.  
Issued Date : Oct 11, 2021.

Calibrated by:  
☒ Mr. Soravit Thacholad  
☐ Miss Orathai Wutavithayak



Approved Signatory: \_\_\_\_\_

Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-01102021  
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.  
Calibration in the range of 1 ~ 16 m/s at a calibration interval of 1 m/s.

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

V <sub>ref</sub> Reading m/s	V <sub>unc</sub> Reading m/s	Error (m/s)	Uncertainty (m/s)
2.049	1.9	-0.1	2.7
4.103	4.0	-0.1	1.3
6.01	6.0	0.0	1.1
8.01	8.0	0.0	0.99
9.99	10.0	0.0	1.0
11.99	12.1	0.1	0.64
13.98	14.1	0.1	0.55
16.02	16.2	0.2	0.40
18.03	18.2	0.2	0.78
19.99	19.1	-0.8	0.61
21.00	21.0	0.0	1.1
23.00	23.0	0.0	0.75
25.02	25.0	0.0	0.84
27.147	27.0	-0.1	0.98
29.274	29.0	-0.3	1.7
31.013	31.0	0.0	4.5

UUC\*: Unit Under Calibration

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

### Appendix 1: Instrumentations

NO.	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pist static	TESD INC.	De302145	Aug 07, 2021	MR-0034-21	0 ~ 30 m/s
2	Precision Differential Pressure Meter	Zorgab	DPW2500	Aug 07, 2021	MR-0034-21	0 ~ 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MR-0035-21	0 ~ 5 m/s
4	Temperature	Zorgab	039-THP	Mar 30, 2021	CL-0027-24	-30 ~ 70°C
5	Relative humidity	Zorgab	039-THP	Mar 30, 2021	RH-0023-2021	0 ~ 100 %RH
6	Atmospheric pressure	Zorgab	039-THP	Mar 30, 2021	BP-0103-2021	800 ~ 1100 hPa
7	Wind tunnel	EDSOM	MP3300	-	-	0 ~ 30 m/s

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





## CERTIFICATE OF CALIBRATION

Certificate No: WD-01102021  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 200-W9-25DL  
Wind direction sensor: WS-02P

Serial Number : Data logger: A4985  
Wind direction sensor: -

ID No : Data logger: RY0\_F80055  
Wind direction sensor: -

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

### Environmental Condition

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

### Measurement Method

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

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

### Traceability

The measurement results are traceable to the International system of units (SI) through Certificate No: CC563-07-0045, Certificate No: RWS64/0025.

Measurement Date : Oct.05, 2021.  
Issued Date : Oct 11, 2021.



Mr. Parinya Booncharoen,  
Technical Support  
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-01102021  
Pages 2 of 2 pages

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	46	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	135	0	3.0
5		180	180	182	2	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	135	0	3.0
13		180	180	182	2	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

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



### Performed by

☒ Mr. Sorawit Thachalad  
☐ Miss Chabral Wivattayaya

## CERTIFICATE OF CALIBRATION

Certificate No: WS-03012022  
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novallux.  
Cup anemometer: Novallux

Model/Type : Data logger: 200-W9-25LB  
Cup anemometer: WS-02P

Serial Number : Data logger: A5190  
Cup anemometer: -

ID No : Data logger: RY0\_F80329  
Cup anemometer: -

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

Test Conditions : Wind Tunnel cross test section area : 900 cm<sup>2</sup>  
Anemometer frontal area : 100 cm<sup>2</sup>  
Diameter of mounting pipe : 11 mm  
Blockage ratio of test object : 0.11 %

Test Conditions : Air temperature : 23.6 ±0.8 °C  
Air pressure : 1014.5 ±0.4 hPa  
Relative air humidity : 53.4 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on:  
ISO 91409-12-1 (Ed.1): 2005-Performance Measurements of Electricity Producing Wind Turbines  
MBSA/NET Anemometer Calibration Procedure - Version 2: 2009.

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

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

### Calibrated by

☒ Mr. Sorawit Thachalad  
☐ Miss Chabral Wivattayaya



Approved Signatory: Mr. Parinya Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-03012022  
Page 2 of 2 Pages

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

V <sub>ref</sub> Reading m/s	V <sub>NAC</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.076	2.0	0.1	2.4
4.101	4.1	0.0	1.2
6.09	6.0	0.0	0.95
8.01	8.0	0.0	0.83
10.01	10.1	0.1	0.79
12.01	12.1	0.1	0.87
13.99	14.1	0.1	0.70
15.99	16.4	0.4	0.43
16.00	16.2	0.2	0.79
13.01	13.0	0.0	0.83
11.02	11.0	0.0	0.76
9.03	9.0	0.0	0.81
7.02	7.0	0.0	0.82
5.130	5.1	0.0	0.96
3.991	3.0	0.0	1.6
1.036	0.9	-0.1	4.5

### UUC's Unit Under Calibration

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

### Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pilot static	TESO INC.	00502145	Aug 07, 2021	MW-0034-01	5 - 30 m/s
2	Precision Differential Pressure Meter	Zorgie	DPN2500	Aug 07, 2021	MW-0034-01	5 - 30 m/s
3	Air velocity transducer (Ref. wind)	TSP INC.	8455-12	Aug 08, 2021	MW-0035-01	0 - 5 m/s
4	Temperature	Zorgie	SBH-T16P	March 30, 2021	CL-027-04	-30 - 70 °C
5	Relative humidity	Zorgie	DSH-T16P	March 30, 2021	RH-0303-0201	0 - 100 %RH
6	Atmospheric pressure	Zorgie	DSH-T16P	March 30, 2021	BP-0103-0201	800 - 1100 hPa
7	Wind tunnel	CSROM	MT3300	-	-	0 - 50 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-05012022  
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger: Novolyne  
: Wind direction sensor: Novolyne

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

Serial Number : Data logger: A5190  
: Wind direction sensor: -

ID No : Data logger: R00\_F03029  
: Wind direction sensor: -

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

### Environmental Conditions

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

### Measurement Method:

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

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

### Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: 021086014, Certificate No: KW854/0025.

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

### Performed by

☒ Mr. Sorwit Thachalad  
☐ Miss Orathai Waiwattayay



Approved Signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-05012022  
Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

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

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

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



## ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	01 Oct 22	Y = 1.0202x + 0.1976	1.0000
BKK_FS0579	01 Oct 22	Y = 1.0078x + 0.4789	0.9998
BKK_FS0583	01 Oct 22	Y = 1.016x + 0.3922	1.0000
BKK_FS0584	01 Oct 22	Y = 1.0036x + 2.2262	0.9997
BKK_FS0585	01 Oct 22	Y = 1.0189x - 5.6476	0.9997
BKK_FS0586	01 Oct 22	Y = 1.0095x - 1.1524	0.9995
BKK_FS0587	01 Oct 22	Y = 1.013x - 3.6619	0.9996
BKK_FS0588	01 Oct 22	Y = 1.0154x + 4.8357	0.9999
BKK_FS0589	01 Oct 22	Y = 0.9918x + 4.8069	0.9999
BKK_FS0590	01 Oct 22	Y = 1.0038x - 0.4857	0.9996
BKK_FS0591	01 Oct 22	Y = 0.9705x - 52.174	0.9986
BKK_FS0592	01 Oct 22	Y = 0.9646x - 37.642	0.9985
BKK_FS0593	01 Oct 22	Y = 0.9767x - 58.445	0.9988
BKK_FS0594	01 Oct 22	Y = 0.9902x - 62.87	0.9999
BKK_FS0595	01 Oct 22	Y = 1.0249x - 98.162	0.9999
BKK_FS0596	01 Oct 22	Y = 0.9843x - 26.806	0.9991
BKK_FS0597	01 Oct 22	Y = 0.9802x - 61.653	0.9978
BKK_FS1004	01 Oct 22	Y = 0.9762x + 11.724	0.9998
BKK_FS1005	01 Oct 22	Y = 1.0081x + 1.5143	1.0000
BKK_FS1006	01 Oct 22	Y = 1.098x - 2.9327	0.9999
BKK_FS1007	01 Oct 22	Y = 0.9917x + 1.6592	1.0000
BKK_FS1008	01 Oct 22	Y = 1.0132x + 0.7207	1.0000
BKK_FS1009	01 Oct 22	Y = 1.0132x + 1.1633	0.9960
BKK_FS1010	01 Oct 22	Y = 1.0033x + 0.5758	0.9999
BKK_FS1011	01 Oct 22	Y = 1.0234x + 0.1759	0.9996
BKK_FS1012	01 Oct 22	Y = 1.0106x - 2.0048	0.9997
BKK_FS1013	01 Oct 22	Y = 0.9677x - 35.851	0.9997
BKK_FS1014	01 Oct 22	Y = 1.0021x + 0.3148	0.9998
BKK_FS1015	01 Oct 22	Y = 0.9994x + 1.786	1.0000
BKK_FS1016	01 Oct 22	Y = 1.0105x - 80.256	0.9998
BKK_FS1017	01 Oct 22	Y = 0.9995x + 0.649	1.0000
BKK_FS1018	01 Oct 22	Y = 1.0011x + 1.1786	1.0000
BKK_FS1019	01 Oct 22	Y = 1.0023x - 68.424	0.9996
BKK_FS1020	01 Oct 22	Y = 1.0547x - 0.666	0.9998
BKK_FS1021	01 Oct 22	Y = 1.018x - 3.3286	0.9998
BKK_FS1022	01 Oct 22	Y = 0.9932x - 57.035	0.9986
BKK_FS1023	01 Oct 22	Y = 1.0094x + 0.0717	0.9999
BKK_FS1024	01 Oct 22	Y = 1.0042x + 0.4086	0.9997
BKK_FS1025	01 Oct 22	Y = 1.0132x - 88.507	0.9996



## ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1026	01 Oct 22	Y = 1.0018x + 1.0776	0.9997
BKK_FS1027	01 Oct 22	Y = 1.0053x + 0.231	0.9995
BKK_FS1028	01 Oct 22	Y = 0.9792x - 60.312	0.9982
BKK_FS1029	01 Oct 22	Y = 0.9935x + 0.8234	1.0000
BKK_FS1030	01 Oct 22	Y = 1.0039x + 0.515	0.9999
BKK_FS1031	01 Oct 22	Y = 1.009x - 79.295	0.9998
BKK_FS1039	01 Oct 22	Y = 0.9967x + 4.5048	0.9999
BKK_FS1040	01 Oct 22	Y = 0.9936x + 32.694	0.9998
BKK_FS1041	01 Oct 22	Y = 1.067x - 1.999	1.0000
BKK_FS1042	01 Oct 22	Y = 1.0019x + 2.1571	1.0000
BKK_FS1043	01 Oct 22	Y = 1.1569x - 96.479	0.8412
BKK_FS1044	01 Oct 22	Y = 1.0318x - 0.9374	0.9999
BKK_FS1161	01 Oct 22	Y = 1.0126x + 0.7738	0.9999
BKK_FS1162	01 Oct 22	Y = 0.9994x + 2.6357	0.9995
BKK_FS1163	01 Oct 22	Y = 0.977x - 55.03	0.9987
BKK_FS1164	01 Oct 22	Y = 0.9914x + 0.8427	0.9997
BKK_FS1165	01 Oct 22	Y = 0.9893x + 6.5919	0.9998
BKK_FS1166	01 Oct 22	Y = 1.0031x - 77.881	0.9996
BKK_FS1200	01 Oct 22	Y = 1.0313x - 0.4602	0.9995
BKK_FS1201	01 Oct 22	Y = 1.0045x + 0.15	0.9996
BKK_FS1202	01 Oct 22	Y = 0.9702x - 44.156	0.9994
RYG_FS0197	01 Oct 22	Y = 1.0039x - 0.179	0.9999
RYG_FS0198	01 Oct 22	Y = 0.9964x + 21.757	1.0000
RYG_FS0199	01 Oct 22	Y = 1.0577x - 1.7486	1.0000

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jitranont)

Assistant General Manager



## Certificate of System Qualification

GC-QQ

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

REVIEW BY: *Suchada T.*  
APPROVED BY: *Satyat M.*  
NEXT CAL DATE: 21 Apr 2023

## System Inspection and Basic Safety and Operation

Name: 7890  
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status  
Pass

## Inlet Pressure Decay

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

Overall Inlet Pressure Decay Test Status  
Pass

## Inlet Pressure Accuracy

Name: 7890  
Front SSL

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Setpoint Status: Pass

Setpoint Actual  
Inlet Pressure: 25.0 psi 24.9 psi  
Accuracy: 0.1 psi  
Agilent Recommended:  $\leq 1.2$

Overall Inlet Pressure Accuracy Test Status  
Pass

## Inlet Pressure Decay

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

Overall Inlet Pressure Decay Test Status  
Pass

## Inlet Pressure Accuracy

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

Overall Inlet Pressure Accuracy Test Status  
Pass

## Detector Flow Accuracy

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Name: 7890  
Front FID  
Setpoint Status: Pass  
Flow Type: Fuel  
Setpoint: 30.0 mL/min Measured Flow: 30.5 mL/min  
Accuracy: 0.5 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 3.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Oxidizer  
Setpoint: 400.0 mL/min Measured Flow: 394.0 mL/min  
Accuracy: 6.0 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 40.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.2 mL/min  
Accuracy: 0.8 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 2.5 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status  
Pass

## Detector Flow Accuracy

Name: 7890  
Back FID

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Setpoint Status: Pass  
Flow Type: Fuel  
Setpoint: 30.0 mL/min Measured Flow: 29.1 mL/min  
Accuracy: 0.9 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 3.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Oxidizer  
Setpoint: 400.0 mL/min Measured Flow: 397.3 mL/min  
Accuracy: 2.7 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 40.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.4 mL/min  
Accuracy: 0.6 mL/min  
Agilent Recommended:  $\leq 10.0$  % setpoint ( 2.5 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status  
Pass

## GC Oven Temperature Accuracy

Name: 7890

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**Setpoint Status:** Pass  
**Zone:** Oven  
**Setpoint/Actual**  
**Temperature:** 230.0 231.5 °C  
**Accuracy:** 1.5 °C  
**Agilent Recommended:**  $\geq 1.0$  % setpoint in K ( -5.0 °C )  
 $\leq 1.0$  % setpoint in K ( 5.0 °C )

**Setpoint Status:** Pass  
**Zone:** Oven  
**Setpoint/Actual**  
**Temperature:** 100.0 100.5 °C  
**Accuracy:** 0.5 °C  
**Agilent Recommended:**  $\geq 1.0$  % setpoint in K ( -3.7 °C )  
 $\leq 1.0$  % setpoint in K ( 3.7 °C )

**Overall GC Oven Temperature Accuracy Test Status**  
Pass

#### GC Oven Temperature Stability

**Name:** 7890  
**Setpoint Status:** Pass  
**Setpoint/Average**  
**Temperature:** 100.0 100.4667 °C  
**Stability:** 0.1 °C  
**Agilent Recommended:**  $\leq 0.5$

**Overall GC Oven Temperature Stability Test Status**  
Pass

#### Scouting Run

**Tested Combination1** Front SSL / Front FID  
**Name:** 7890A

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

**Setpoint Status:** Completed

**Injection Volume on Column:** 1.0 µL

**Overall Scouting Run Status**  
Completed

#### Noise and Drift

**Tested Combination1** Front SSL / Front FID  
**Name:** 7890

**Setpoint Status:** Pass

**Base Signal:** 12.7 pA  
**ASTM Noise** 0.06 pA  
**Agilent Recommended:**  $\leq 0.10$   
**Status:** Pass  
**Drift** 0.10 pA/hr  
**Agilent Recommended:**  $\leq 2.50$   
**Status:** Pass

**Overall Noise and Drift Test Status**  
Pass

#### Injection Precision

**Tested Combination1** Front SSL / Front FID  
**Name:** 7893A

**Setpoint Status:** Pass

**Injection Volume on Column:** 1.0 µL

**Area RSD:** 0.42 %  
**Agilent Recommended:**  $\leq 3.00$   
**Retention Time RSD:** 0.16 %  
**Agilent Recommended:**  $\leq 1.00$

**Overall Injection Precision Test Status**  
Pass

#### Signal to Noise

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

**Tested Combination1** Front SSL / Front FID  
**Name:** 7890

**Setpoint Status:** Pass  
**Signal to Noise:** 1174861  
**Agilent Recommended:**  $\geq 300000$

**Overall Signal to Noise Test Status**  
Pass

#### Scouting Run

**Tested Combination2** Back SSL / Back FID  
**Name:** 7893A

**Setpoint Status:** Completed

**Injection Volume on Column:** 1.0 µL

**Overall Scouting Run Status**  
Completed

#### Noise and Drift

**Tested Combination2** Back SSL / Back FID  
**Name:** 7890

**Setpoint Status:** Pass

**Base Signal:** 10.4 pA  
**ASTM Noise** 0.05 pA  
**Agilent Recommended:**  $\leq 0.10$   
**Status:** Pass  
**Drift** 2.50 pA/hr  
**Agilent Recommended:**  $\leq 2.50$   
**Status:** Pass

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

**Overall Noise and Drift Test Status**  
Pass

#### Injection Precision

**Tested Combination2** Back SSL / Back FID  
**Name:** 7893A

**Setpoint Status:** Pass

**Injection Volume on Column:** 1.0 µL

**Area RSD:** 1.16 %  
**Agilent Recommended:**  $\leq 3.00$   
**Retention Time RSD:** 0.12 %  
**Agilent Recommended:**  $\leq 1.00$

**Overall Injection Precision Test Status**  
Pass

#### Signal to Noise

**Tested Combination2** Back SSL / Back FID  
**Name:** 7890

**Setpoint Status:** Pass

**Signal to Noise:** 805466  
**Agilent Recommended:**  $\geq 300000$

**Overall Signal to Noise Test Status**  
Pass

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

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### System

System ID	GC-6
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

#### Tested Combination1

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

#### Tested Combination2

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

#### Sampler 1

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

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#### Sampler 2

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

#### Sampler 3

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10

#### Mainframe 1

Manufacturer	Agilent Technologies
Name	7690
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
Component ID/Asset No.	GC-6
Oven Type	Standard

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#### Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

#### Inlet 2

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

#### Detector 1

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

#### Detector 2

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

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## Electronic Signature

### Purpose

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System ID: GC-6

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User Name: suriya.thongkham  
Hostname: ASDX00W7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## DQ GC ALS CN11461066 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 12:18:50 PM	Auth	SessionCreated	Session	None
October 20, 2021 12:18:50 PM	Start	Configuration	Session	None
October 20, 2021 12:18:50 PM	Auth	Entitlement	Licensing	User is Nonpaying and does not require an unlock code
October 20, 2021 12:24:51 PM	Auth	ExpLoaded	Session	EOP details for primary technician [OC] - File path: [ProtocolPathToGCConfig] and [GC.DI.51.egg], EOP File Name: [GC.DI.51.egg], EOP Name: [AgilentRecommended]
October 20, 2021 12:25:02 PM	End	Configuration	Session	None
October 20, 2021 12:25:09 PM	Start	Qualification	Session	QC
October 20, 2021 12:29:09 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	None
October 20, 2021 12:30:25 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	Run Count : 1
October 20, 2021 12:56:29 PM	Start	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 2.0 psi and <= 0.5 psi	None

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

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User Name: suriya.thongkham  
Hostname: ASDX00W7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## DQ GC ALS CN11461066 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:02:16 PM	End	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 2.0 psi and <= 0.5 psi	Run Count : 1
October 20, 2021 1:02:16 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 20, 2021 1:02:26 PM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
October 20, 2021 1:02:29 PM	Start	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 2.0 psi and <= 0.5 psi	None
October 20, 2021 1:04:21 PM	End	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 2.0 psi and <= 0.5 psi	Run Count : 1
October 20, 2021 1:07:53 PM	Start	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 20, 2021 1:08:11 PM	End	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
October 20, 2021 1:08:16 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:20:23 PM	Auth	Data	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:20:26 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1

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System ID: GC-6

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User Name: suriya.thongkham  
Hostname: ASDX00W7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## DQ GC ALS CN11461066 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:20:29 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:23:27 PM	Auth	Data	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:23:29 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:23:31 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:27:40 PM	Auth	Data	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:27:42 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:27:46 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:32:10 PM	Auth	Data	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:32:12 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:32:14 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:34:13 PM	Auth	Data	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry

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

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User Name: suriya.thongkham  
Hostname: ASDX00W7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## DQ GC ALS CN11461066 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:34:16 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:34:46 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 20, 2021 1:36:33 PM	Auth	Data	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 20, 2021 1:36:36 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 20, 2021 1:36:36 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	None
October 20, 2021 2:04:31 PM	Auth	Data	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 20, 2021 2:04:32 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Run Count : 1
October 20, 2021 2:04:34 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	None
October 20, 2021 2:10:47 PM	Auth	Data	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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

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User Name: suriya.thangkum  
Hostname: ASBKKW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC ALS CN11461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 2:10:49 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature Oven - S: 100.0°C - L: <= 1.0 AND <= 1.0 % setpoint in K	Run Count: 1
October 20, 2021 2:10:51 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C	None
October 20, 2021 2:31:38 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
October 20, 2021 2:31:41 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
October 20, 2021 2:31:44 PM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 20, 2021 2:43:06 PM	Audit	AccClosed	Session	None
October 21, 2021 9:18:58 AM	Audit	AccRestarted	Session	None
October 21, 2021 9:19:02 AM	Audit	SessionReleased	Session	None
October 21, 2021 9:19:09 AM	Start	Qualification	Session	GC
October 21, 2021 9:19:09 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:19:41 AM	Audit	AccClosed	Session	None

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

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User Name: suriya.thangkum  
Hostname: ASBKKW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC ALS CN11461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:20:08 AM	Audit	AccRestarted	Session	None
October 21, 2021 9:20:09 AM	Audit	SessionReleased	Session	None
October 21, 2021 9:20:13 AM	Start	Qualification	Session	GC
October 21, 2021 9:20:13 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:29:45 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-49-18\ISOTONS_F001.D\F1A.ch
October 21, 2021 9:30:05 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count: 1
October 21, 2021 9:30:08 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None
October 21, 2021 9:30:41 AM	Audit	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-49-18\ISOTONS_F001.D\F1A.ch
October 21, 2021 9:31:15 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1

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

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User Name: suriya.thangkum  
Hostname: ASBKKW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC ALS CN11461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:31:42 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
October 21, 2021 9:32:35 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F002.D\F1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F003.D\F1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F004.D\F1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F005.D\F1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F006.D\F1A.ch
October 21, 2021 9:32:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\NUPREC_F007.D\F1A.ch

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

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User Name: suriya.thangkum  
Hostname: ASBKKW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:46 AM

## GC ALS CN11461066 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:33:07 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:33:23 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 30000	None
October 21, 2021 9:34:01 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 30000	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-15-51-16\ISOTONS_F001.D\F1A.ch
October 21, 2021 9:34:15 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 30000	Run Count: 1
October 21, 2021 9:34:19 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	None
October 21, 2021 9:35:04 AM	Audit	Data	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Data file Path: C:\Chem32\10DATA\A00PV20\2100PV2021_F_2021-10-20-17-13-48\SCOUT_B001.D\F1D00.ch
October 21, 2021 9:35:27 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Run Count: 1
October 21, 2021 9:35:32 AM	Start	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None

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

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User Name: sanyas.thongkham  
Host Name: AS800K7915  
Print Date: October 21, 2021 10:05:46 AM  
System ID: GC-6

OG GC ALS CN1461566 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:06 AM	Auto	Data	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8001.D\FID20.ch
October 21, 2021 9:36:06 AM	End	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1
October 21, 2021 9:36:06 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8002.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8003.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8004.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8005.D\FID20.ch

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Date: October 21, 2021 10:05:46 AM  
System ID: GC-6

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User Name: sanyas.thongkham  
Host Name: AS800K7915  
Print Date: October 21, 2021 10:05:46 AM  
System ID: GC-6

OG GC ALS CN1461566 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8006.D\FID20.ch
October 21, 2021 9:36:57 AM	Auto	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8007.D\FID20.ch
October 21, 2021 9:36:57 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:36:57 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L - >= 300000	None
October 21, 2021 9:36:57 AM	Auto	Data	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L - >= 300000	Data File Path: C:\Chem32\1DATA\OGPV20\2100PV2021_B 2021-10-20 17-13-45\INUPREC_8001.D\FID20.ch
October 21, 2021 9:36:57 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L - >= 300000	Run Count: 1
October 21, 2021 9:36:57 AM	End	Qualification	Session	OG
October 21, 2021 9:36:57 AM	Start	Reporting	Session	None
October 21, 2021 10:04:15 AM	Auto	Reporting	Session	Report Generated Certificate

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Date: October 21, 2021 10:05:46 AM  
System ID: GC-6

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## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No.: ACC22013  
Pages : 1 of 3

### Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No.: 34178121  
ID No.: RYG\_FS0213

Condition As Found : GOOD

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

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

Received Date : 22 APRIL 2022  
Calibration Date : 26 APRIL 2022  
Date of Issue : 29 APRIL 2022



Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchumai  
( Thanakul Petchumai )

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.

## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

### Continuation of Calibration Certificate

Cert. No.: ACC22013  
Job No.: VC65AC0054  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

#### Calibration Method :

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

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

#### Condition of this result of calibration :

##### 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchumai



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

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurai



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

Cert. No. : ACL22237  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01173611 / 172173 / 74023  
ID No. : RYG FS0390

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 : 03 OCTOBER 2022  
Calibration Date : 18-19 OCTOBER 2022  
Date of Issue : 20 OCTOBER 2022



Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

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

QF-TS12-04-04-020664

T. Petchurai

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

T. Petchurai



## Continuation of Calibration Certificate

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
15.4

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	18.1
Flat	23.9

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.4	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.2	-0.2	-0.1	±5.0

QF-TS12-04-04-020664

T. Rth.

## Continuation of Calibration Certificate

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

T. Rth.

## Continuation of Calibration Certificate

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

T. Rth.

## Continuation of Calibration Certificate

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, 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	128.0	0.0	±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	-
One	136.4	135.4	-1.0	±3.0

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

QF-TS12-04-04-020664

T. Rth.



Continuation of Calibration Certificate

Cert. No. : ACL22237  
Job No. : VC65AC0088  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

*T. Petchurai*

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



Cert. No. : ACC22013  
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No. : 34178121  
ID No. : RYG\_FS0213

Condition As Found : GOOD

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

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

Received Date : 22 APRIL 2022  
Calibration Date : 26 APRIL 2022  
Date of Issue : 29 APRIL 2022



Calibrated by : Nathakorn Pisutpaisan

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

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Continuation of Calibration Certificate

Cert. No. : ACC22013  
Job No. : VC65AC0054  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

*T. Petchurai*

Continuation of Calibration Certificate

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

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

*T. Petchurai*



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21099  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01073608 / 172153 / 85748  
**ID No.:** RYG\_FS0387

**Condition As Found :** GOOD

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

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

**Received Date :** 01 SEPTEMBER 2021  
**Calibration Date :** 13-15 SEPTEMBER 2021  
**Date of Issue :** 16 SEPTEMBER 2021

REVIEW BY: *Nathakorn P.*  
APPROVED BY: *T. Petchuraj*  
NEXT CAL. DATE: 13/9/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchuraj*  
( Thanakul Petchuraj )

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

### Calibration Method :

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

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

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

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

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

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

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 3 of 8

### Summary of Measurement Result :

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 4 of 8

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value ( dB )
15.1

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	23.3

#### 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	0.7	0.7	0.7	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.9	-2.8	-2.8	±5.0

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Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.1	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.1	0.0	± 0.2

## 5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	94.1	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.1	0.0	± 0.1

## 6. Long - term stability

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

QF-TS12-04-04-020664

P. P. P.

Cert. No. : ACL21099  
Job No. : VC64AC0066  
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	132.9	-0.1	± 1.1
132.0	131.9	-0.1	± 1.1
131.0	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 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	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

P. P. P.

Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-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, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

P. P. P.

Cert. No. : ACL21099  
Job No. : VC64AC0066  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

P. P. P.



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL21100  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01173609 / 172170 / 74021  
**ID No.:** RYG FS0388

**Condition As Found :** GOOD

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

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

**Received Date :** 01 SEPTEMBER 2021  
**Calibration Date :** 13-15 SEPTEMBER 2021  
**Date of Issue :** 16 SEPTEMBER 2021

REVIEW BY: *Nathakorn P.*  
APPROVED BY: *T. Petchurai*  
NEXT CAL. DATE: 13/9/22

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL21100  
Job No. : VC64AC0066  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

### Calibration Method :

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

### Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21100  
Job No. : VC64AC0066  
Pages : 3 of 8

### Summary of Measurement Result :

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21100  
Job No. : VC64AC0066  
Pages : 4 of 8

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.1
Flat	23.9

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-0.7	-0.6	-0.6	±5.0

QF-TS12-04-04-020664



Cert. No. : ACL21100  
Job No. : VC64AC0066  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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Cert. No. : ACL21100  
Job No. : VC64AC0066  
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	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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Cert. No. : ACL21100  
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## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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Cert. No. : ACL21100  
Job No. : VC64AC0066  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL21101  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01173610 / 143485 / 22619  
**ID No.:** RYG\_FS0389

**Condition As Found :** GOOD

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

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

**Received Date :** 01 SEPTEMBER 2021  
**Calibration Date :** 13-15 SEPTEMBER 2021  
**Date of Issue :** 16 SEPTEMBER 2021

REVIEW BY: *Nathakorn P.*  
APPROVED BY: *[Signature]*  
NEXT CAL. DATE: 13/9/22

**Calibrated by :** Nathakorn Pisupaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

### Calibration Method :

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

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

### Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 3 of 8

### Summary of Measurement Result :

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 4 of 8

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
18.5

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

Frequency Weighting	Measured value (dB)
A-weight	13.1
C-weight	19.3
Flat	24.9

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.0	0.0	±1.5
1000	-0.2	-0.2	-0.1	±1.0
8000	-0.5	-0.4	-0.4	±5.0

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## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.2	-0.1	±2.0
125	-0.1	-0.1	-0.1	±1.5
250	0.0	-0.1	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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P.T.A.

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.2	0.2	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 1.1

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P.T.A.

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.9	-0.5	±3.0

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

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P.T.A.

## Continuation of Calibration Certificate

Cert. No. : ACL21101  
Job No. : VC64AC0066  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

P.T.A.



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Cert. No. : ACC22023  
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,  
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

**Location :** -  
**Ambient Temperature :** ( 23.0 ± 3 ) °C  
**Pressure :** ( 101.3 ± 3 ) kPa  
**Relative Humidity :** ( 50.0 ± 20 ) %  
**Received Date :** 22 AUGUST 2022  
**Calibration Date :** 31 AUGUST 2022  
**Date of Issue :** 02 SEPTEMBER 2022



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**   
( Thanakul Petchurai )

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC22023  
Job No. : VC65AC0077  
Pages : 2 of 3

**Calibration Procedure :** CP-AC-03

## Calibration Method :

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC22023  
Job No. : VC65AC0077  
Pages : 3 of 3

## Result of calibration :

### 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.04	0.04	0.14	0.40

### 2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.5	0.1	0.1	1.0

### 3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.70	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22057  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00296517 / 179120 / 87527  
**ID No.:** RYG\_FS0434

**Condition As Found :** GOOD

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

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

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



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**   
( Thanakul Petchurai )

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Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Pithan

Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

T. Pithan

Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

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

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.6	0.7	0.7	±5.0

QF-TS12-04-04-020664

T. Pithan

Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.1	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	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

T. Pithan



## Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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## Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	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 <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	± 3.0

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

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## Continuation of Calibration Certificate

Cert. No. : ACL22057  
Job No. : VC65AC0043  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

451-451/1 Sirinthon Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND  
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22056  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00296516 / 180412 / 88182  
ID No. : RYG-FS0433

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpoisan

Approved by :

( Thanakul Petchumai )

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QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 3 of 8

## Summary of Measurement Result :

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

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.8

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

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

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.7	0.7	0.7	±5.0

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664



Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 6 of 8

7. Level linearity on the reference level range

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

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T. P. T.

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

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T. P. T.

Cert. No. : ACL22056  
Job No. : VC65AC0043  
Pages : 8 of 8

11. Overload indication

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

QF-TS12-04-04-020664

T. P. T.

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



Cert. No. : ACL22055  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00296515 / 179119 / 87526  
ID No. : RYG\_FS0432

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %  
Received Date : 14 JANUARY 2022  
Calibration Date : 21-24 JANUARY 2022  
Date of Issue : 25 JANUARY 2022



Calibrated by : Nathakorn Pisutpaisan

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

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Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL_BP_05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

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

QF-TS12-04-04-020664

7. P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	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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7. P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	11.6
C-weight	17.7
Flat	23.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-0.2	-0.2	-0.2	±5.0

QF-TS12-04-04-020664

7. P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

7. P.L.A.



## Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	63.9	-0.1	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	38.9	-0.1	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	25.1	0.1	±1.1

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22055  
Job No. : VC65AC0043  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

## CERTIFICATE OF CALIBRATION

ISSUED BY: Cirrus Research plc  
DATE OF ISSUE: 02/12/21  
CERTIFICATE NUMBER: 166913Cirrus Research plc  
Acoustic House  
Bridlington Road  
Hunmanby  
North Yorkshire  
YO14 0PH  
United Kingdom

Page 1 of 1

Test engineer:  
Rebecca Thomas  
Electronically signed:

## doseBadge Reader

## Instrument

Manufacturer: Cirrus Research plc  
Model Number: RC:110A  
Serial Number: 76062  
Notes:

## Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 01 December 2021

## Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

REVIEWED: *Markon P.*  
APPROVED BY: *REB*  
NEXT CAL DATE: 1/12/22

## Calibration Results

	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
Initial	114.20	1000.9	0.35
Adjusted	113.99	1000.9	0.34
Uncertainty	± 0.11	± 0.14	± 0.10
Tolerances	± 0.60	± 2.00	± 4.00

## Environmental Conditions

Pressure: 98.75 kPa  
Temperature: 22.4 °C  
Humidity: 43.9 %

## Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k=2$ , providing a coverage probability of approximately 95%.



# CERTIFICATE OF CALIBRATION

ISSUED BY

Cirrus Research plc

DATE OF ISSUE

07 October 2022

CERTIFICATE NUMBER 181215

Cirrus Research plc  
Acoustic House  
Bridlington Road  
Humby Grove  
North Yorkshire  
YO14 0PH  
United Kingdom

Page 1 of 1

Test engineer:  
Nigel Smith  
Electronically signed:

## doseBadge Reader

### Instrument

Manufacturer: Cirrus Research plc  
Model Number: RC:110A

Serial Number: 92612  
Notes:

### Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 07 October 2022

### Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

### Calibration Results

Result	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
113.99	113.99	1004.5	0.47
Uncertainty	± 0.11	± 0.14	± 0.10
Tolerances	± 0.60	± 2.00	± 4.00

No adjustments were made during this calibration.

### Environmental Conditions

Pressure: 100.27 kPa  
Temperature: 23.8 °C  
Humidity: 45.3 %

### Notes

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# CERTIFICATE OF CALIBRATION

Certificate No.: CL-042.65  
Page 1 of 2

Equipment Name: Digital thermometer with RTD  
Manufacturer: DeltaOHM  
Model: HD32.2  
Serial No: 20032243  
ID No: RYG\_FS0523

### Customer

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

Received date: 25 FEB 2022  
Calibration date: 7 MAR 2022  
Issue date: 10 MAR 2022

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 25 Mar 2022  
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 04 June 2022

### Calibration Condition

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

### Calibration Procedure

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

### Traceability

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

REVIEW BY

APPROVED BY

NEXT CAL DATE

Calibrated by  
Mr. Sorawit Thachaisad  
Miss Orathai Wiatwattaya



Approved Signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate No.: CL-042.65  
Page 2 of 2

### Result of Calibration:

☒ Without Adjustment ☐ With Adjustment

### Calibration Range:

20 - 40 °C

### Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 21001219.  
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.050	20.0	-0.1	0.099
30	25.047	25.0	0.0	0.099
30	30.034	30.0	0.0	0.099
30	35.021	35.0	0.0	0.099
30	40.005	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001786.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.058	20.2	0.1	0.099
70	25.045	25.1	0.1	0.099
70	30.032	30.0	0.0	0.099
70	35.021	34.9	-0.1	0.099
70	40.001	39.7	-0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001243.  
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.0	-0.1	0.099
110	25.047	25.0	0.0	0.099
110	30.032	30.0	0.0	0.099
110	35.016	35.0	0.0	0.099
110	40.007	40.0	0.0	0.099

### UUC\* = Unit Under Calibration

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

★ End of Certificate ★



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# CERTIFICATE OF CALIBRATION

Certificate No.: CL-041.65  
Page 1 of 2

Equipment Name: Digital thermometer with RTD  
Manufacturer: DeltaOHM  
Model: HD32.2  
Serial No: 20032242  
ID No: RYG\_FS0522

### Customer

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

Received date: 25 FEB 2022  
Calibration date: 7 MAR 2022  
Issue date: 10 MAR 2022

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 25 Mar 2022  
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 04 June 2022

### Calibration Condition

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

### Calibration Procedure

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

### Traceability

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

REVIEW BY

APPROVED BY

NEXT CAL DATE

Calibrated by  
Mr. Sorawit Thachaisad  
Miss Orathai Wiatwattaya



Approved Signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate No.: CL-041-65  
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 21001206.  
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.058	20.0	-0.1	0.099
30	25.049	25.0	0.0	0.099
30	30.045	30.0	0.0	0.099
30	35.020	35.0	0.0	0.099
30	39.999	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001796.  
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.058	20.2	1.0	0.099
70	25.049	25.0	0.0	0.099
70	30.032	29.7	-0.3	0.099
70	35.011	34.6	-0.4	0.099
70	40.000	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001250.  
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.058	20.0	-0.1	0.099
110	25.048	25.0	0.0	0.099
110	30.031	30.0	0.0	0.099
110	35.020	35.0	0.0	0.099
110	40.000	40.0	0.0	0.099

UUC\*: Unit Under Calibration

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



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## CERTIFICATE OF CALIBRATION

Certificate No.: CL-021-65  
Page 1 of 2

Equipment Name: Heat Stress Monitor with Sensor  
Manufacturer: DeltaOHM  
Model: HD32.2  
Serial No: 18018313  
ID No: RYG\_FS0358

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

Received date: 10 JAN 2022  
Calibration date: 16 FEB 2022  
Issue date: 17 FEB 2022

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 25 Mar 2022  
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 04 June 2022

### Calibration Condition

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

### Calibration Procedure

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

### Traceability

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

REVIEW BY	<i>Manon P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	16/2/23

Calibrated by  
☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



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

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Certificate No.: CL-021-65  
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021467.  
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.048	20.1	0.1	0.099
30	25.050	25.1	0.1	0.099
30	30.036	30.1	0.1	0.099
30	35.027	35.1	0.1	0.099
30	40.024	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021270.  
Dimension: Diameter 8 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.048	20.0	0.0	0.099
70	24.993	25.1	0.1	0.099
70	29.932	29.9	0.0	0.099
70	34.848	34.4	-0.1	0.099
70	39.819	39.6	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020497.  
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.045	20.1	0.1	0.099
110	25.050	25.1	0.1	0.099
110	30.037	30.1	0.1	0.099
110	35.026	35.1	0.1	0.099
110	40.023	40.1	0.1	0.099

UUC\*: Unit Under Calibration

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



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## CERTIFICATE OF CALIBRATION

Certificate No.: CL-005-65  
Page 1 of 2

Equipment Name: Heat Stress Monitor with Sensor  
Manufacturer: DeltaOHM  
Model: HD32.2  
Serial No: 18018314  
ID No: RYG\_FS0359

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

Received date: 12 JAN 2022  
Calibration date: 24 JAN 2022  
Issue date: 25 JAN 2022

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 25 Mar 2022  
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 04 June 2022

### Calibration Condition

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

### Calibration Procedure

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

### Traceability

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

REVIEW BY	<i>Manon P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	24/1/23

Calibrated by  
☐ Mr. Sorawit Thachalad  
☒ Miss Orathai Wiwatwittaya



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

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Certificate No.: CL-005-65  
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021465.  
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.050	20.0	0.0	0.099
30	25.039	25.0	0.0	0.099
30	30.030	30.0	0.0	0.099
30	35.025	34.9	-0.1	0.099
30	40.019	39.9	-0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021262.  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.049	20.1	0.1	0.099
70	24.965	24.8	-0.2	0.099
70	29.925	29.7	-0.2	0.099
70	34.889	34.5	-0.4	0.099
70	39.850	39.4	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20008280.  
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.050	20.0	0.0	0.099
110	25.039	25.0	0.0	0.099
110	30.030	30.0	0.0	0.099
110	35.025	35.1	0.1	0.099
110	40.019	40.1	0.1	0.099

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



## ROTA METER CALIBRATION RESULT JULY 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	01 Jul 22	$Y = 1.0202x + 0.1976$	1.0000
BKK_FS0579	01 Jul 22	$Y = 1.0078x + 0.4789$	0.9998
BKK_FS0583	01 Jul 22	$Y = 1.016x + 0.3922$	1.0000
BKK_FS0584	01 Jul 22	$Y = 1.0036x + 2.2262$	0.9997
BKK_FS0585	01 Jul 22	$Y = 1.0189x - 5.6476$	0.9997
BKK_FS0586	01 Jul 22	$Y = 1.0095x - 1.1524$	0.9995
BKK_FS0587	01 Jul 22	$Y = 1.013x - 3.6619$	0.9996
BKK_FS0588	01 Jul 22	$Y = 1.0154x + 4.8357$	0.9999
BKK_FS0589	01 Jul 22	$Y = 0.9918x + 4.8069$	0.9999
BKK_FS0590	01 Jul 22	$Y = 1.0038x - 0.4857$	0.9996
BKK_FS0591	01 Jul 22	$Y = 0.9705x - 52.174$	0.9986
BKK_FS0592	01 Jul 22	$Y = 0.9646x - 37.642$	0.9985
BKK_FS0593	01 Jul 22	$Y = 0.9767x - 58.445$	0.9988
BKK_FS0594	01 Jul 22	$Y = 0.9902x - 62.87$	0.9999
BKK_FS0595	01 Jul 22	$Y = 1.0249x - 98.162$	0.9999
BKK_FS0596	01 Jul 22	$Y = 0.9843x - 26.806$	0.9991
BKK_FS0597	01 Jul 22	$Y = 0.9802x - 61.653$	0.9978
BKK_FS1004	01 Jul 22	$Y = 0.9696x + 17.69$	0.9990
BKK_FS1005	01 Jul 22	$Y = 1.0092x + 2.4571$	0.9999
BKK_FS1006	01 Jul 22	$Y = 1.168x - 5.566$	0.9997
BKK_FS1007	01 Jul 22	$Y = 0.9917x + 1.6592$	1.0000
BKK_FS1008	01 Jul 22	$Y = 1.0132x + 0.7207$	1.0000
BKK_FS1009	01 Jul 22	$Y = 1.0132x + 1.1633$	0.9960
BKK_FS1010	01 Jul 22	$Y = 1.0033x + 0.5758$	0.9999
BKK_FS1011	01 Jul 22	$Y = 1.0234x + 0.1759$	0.9996
BKK_FS1012	01 Jul 22	$Y = 1.0106x - 2.0048$	0.9997
BKK_FS1013	01 Jul 22	$Y = 0.9677x - 35.851$	0.9997
BKK_FS1014	01 Jul 22	$Y = 1.0021x + 0.3148$	0.9998
BKK_FS1015	01 Jul 22	$Y = 0.9994x + 1.786$	1.0000
BKK_FS1016	01 Jul 22	$Y = 1.0105x - 80.256$	0.9998
BKK_FS1017	01 Jul 22	$Y = 0.9995x + 0.649$	1.0000
BKK_FS1018	01 Jul 22	$Y = 1.0011x + 1.1786$	1.0000
BKK_FS1019	01 Jul 22	$Y = 1.0023x - 68.424$	0.9996
BKK_FS1020	01 Jul 22	$Y = 1.0547x - 0.666$	0.9998
BKK_FS1021	01 Jul 22	$Y = 1.018x - 3.3286$	0.9998
BKK_FS1022	01 Jul 22	$Y = 0.9932x - 57.035$	0.9986
BKK_FS1023	01 Jul 22	$Y = 1.0094x + 0.0717$	0.9999
BKK_FS1024	01 Jul 22	$Y = 1.0042x + 0.4086$	0.9997
BKK_FS1025	01 Jul 22	$Y = 1.0132x - 88.507$	0.9996

Page 1 of 2

ALS Laboratory Group



## ROTA METER CALIBRATION RESULT JULY 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1026	01 Jul 22	$Y = 1.0018x + 1.0776$	0.9997
BKK_FS1027	01 Jul 22	$Y = 1.0053x + 0.231$	0.9995
BKK_FS1028	01 Jul 22	$Y = 0.9792x - 60.312$	0.9982
BKK_FS1029	01 Jul 22	$Y = 0.9935x + 0.8234$	1.0000
BKK_FS1030	01 Jul 22	$Y = 1.0039x + 0.515$	0.9999
BKK_FS1031	01 Jul 22	$Y = 1.009x - 79.295$	0.9998
BKK_FS1039	01 Jul 22	$Y = 0.9879x + 7.3524$	0.9996
BKK_FS1040	01 Jul 22	$Y = 0.9704x + 88.336$	0.9987
BKK_FS1041	01 Jul 22	$Y = 1.0645x - 1.7878$	0.9999
BKK_FS1042	01 Jul 22	$Y = 0.9983x + 3.6262$	0.9998
BKK_FS1043	01 Jul 22	$Y = 1.0069x - 6.9619$	1.0000
BKK_FS1044	01 Jul 22	$Y = 1.0355x - 0.6214$	0.9997
BKK_FS1161	01 Jul 22	$Y = 1.0126x + 0.7738$	0.9999
BKK_FS1162	01 Jul 22	$Y = 0.9994x + 2.6357$	0.9995
BKK_FS1163	01 Jul 22	$Y = 0.977x - 55.03$	0.9987
BKK_FS1164	01 Jul 22	$Y = 0.9914x + 0.8427$	0.9997
BKK_FS1165	01 Jul 22	$Y = 0.9893x + 6.5919$	0.9998
BKK_FS1166	01 Jul 22	$Y = 1.0031x - 77.881$	0.9996
BKK_FS1200	01 Jul 22	$Y = 1.0313x - 0.4602$	0.9995
BKK_FS1201	01 Jul 22	$Y = 1.0045x + 0.15$	0.9996
BKK_FS1202	01 Jul 22	$Y = 0.9702x - 44.156$	0.9994
RYG_FS0197	01 Jul 22	$Y = 1.0039x - 0.179$	0.9999
RYG_FS0198	01 Jul 22	$Y = 0.9971x + 16.648$	0.9999
RYG_FS0199	01 Jul 22	$Y = 1.0832x - 2.6367$	1.0000

Review By:

(Mr. Wichan Choonharat)  
Enviro Field Services Manager

Approved By:

(Mr. Sarayuth Jittrantont)  
Assistant General Manager

RYG\_EN0004



**PENTA**  
CALIBRATION

**PENTA CALIBRATION CO., LTD.**  
66/124 The Connect 33 Village Kanchanaphisek Road  
Dokmai Praveet Bangkok 10250  
Tel: +66 (0) 2059-9173  
www.pentalab.com

## Certificate of Calibration

Represent to Certificate of Calibration, PTC/07/22104

Certificate No.: PTC/07/22104 Page: 1 of 3  
Equipment: Digital Balance Condition: Normal  
Manufacturer: Sartorius Serial No: 33108993  
Model: MSE125P-100-DU ID No: RYG\_EN0004  
Type of Balance: Single interval

Customer: ALS Laboratory Group (Thailand) Co., Ltd.  
616/10 Moo 5 T.Maenamkoo, A.Piukdaeng,  
Rayong 21140, Thailand

Environment Condition: Temperature 23.9 °C ± 0.3 °C  
Humidity 58.1 %RH ± 4.4 %RH  
Air density 1.17 kg/m<sup>3</sup>

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd.  
616/10 Moo 5 T.Maenamkoo, A.Piukdaeng,  
Rayong 21140, Thailand

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

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

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroj Metakul

REVIEW BY:

APPROVED BY:

NEXT CAL. DATE: 09/09/23



Approved By:

(Mr. Keattisak Kerdto)  
Laboratory Manager

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

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

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

Represent to Certificate of Calibration ,PTC/07/22104

Certificate No.: PTC/07/22104

Page: 2 of 3

### Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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

				Eccentricity test                      50                      (g)	
		Position (g)			
1	2	3	4	5	
0.00000	-0.00004	-0.00001	0.00000	0.00001	
Maximum deviation:				0.00004	

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

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

Nominal test value (g)	Standard Deviation
50	0.000007

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.000000	0.00000	0.00000	0.000020	2.65
0.01	0.010001	0.01000	0.00000	0.000022	2.17
0.05	0.050002	0.04999	0.00001	0.000022	2.17
0.1	0.099999	0.09999	0.00001	0.000022	2.17
0.5	0.500001	0.50001	-0.00001	0.000022	2.17
1	1.000004	0.99999	0.00001	0.000022	2.14
2	1.999999	1.99999	0.00001	0.000022	2.14
5	5.000015	4.99999	0.00002	0.000023	2.14
10	10.000004	10.00000	0.00000	0.000024	2.10
20	20.000029	20.00000	0.00003	0.000032	2.00
50	50.000043	49.99999	0.00005	0.000069	2.00

Note: Weight of adjust - (g)

PTC-FAC/07/02/2 Rev.2020

Represent to Certificate of Calibration ,PTC/07/22104

Certificate No.: PTC/07/22104

Page: 3 of 3

### Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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

				Eccentricity test      50      (g)																					
<table border="1"> <thead> <tr> <th colspan="5">Position (g)</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>0.0000</td> <td>0.0000</td> <td>0.0000</td> <td>0.0000</td> <td>0.0000</td> </tr> <tr> <td colspan="3">Maximum deviation:</td> <td colspan="2">0.0000</td> </tr> </tbody> </table>						Position (g)					1	2	3	4	5	0.0000	0.0000	0.0000	0.0000	0.0000	Maximum deviation:			0.0000	
Position (g)																									
1	2	3	4	5																					
0.0000	0.0000	0.0000	0.0000	0.0000																					
Maximum deviation:			0.0000																						

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

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

Nominal test value (g)	Standard Deviation
100	0.00000

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
65	65.00006	65.0000	0.0001	0.00013	2.00
70	70.00007	70.0000	0.0001	0.00013	2.00
75	75.00008	75.0000	0.0001	0.00014	2.00
80	80.00008	80.0000	0.0001	0.00014	2.00
85	85.00009	85.0000	0.0001	0.00015	2.00
90	90.00010	90.0000	0.0001	0.00015	2.00
95	95.00012	95.0000	0.0001	0.00016	2.00
100	100.00004	100.0000	0.0000	0.00014	2.00
110	110.00004	110.0000	0.0000	0.00015	2.00
120	120.00007	120.0000	0.0001	0.00016	2.00

Note: Weight of adjust - (g)

The End of Certificate

PTC-FAC/07/02/3 Rev.2020



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534/0 PATTANAKARN ROAD SOI 16, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3008-27 FAX: 0-2719-9484



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

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven Compact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received: Used Item  
Received Date : 16 March 2022  
Calibration Date : 17 March 2022  
Reference : 2203-0811DSC-4  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Rayong Branch  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakaeng, Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure :  
In - house method :  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagtrakul

Approved by :   
Approved Signatory

(✓) Malee Bulkrusa  
( ) Saitip Meangmai  
( ) Warakorn Lemgagtrakul

Issue Date : 22 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services

A 0037307



Cert.No.: 22CH405  
Page.: 2 of 3

### Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	21E2682	25 Aug 2022
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	788995	01 Jan 2024
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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

### Calibration Results

Function : mV Measurement

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

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

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

#### Calibration Results

Function: pH Measurement

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

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

#### Function: Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe:

- Model: InLab Expert Pro-ISM

- Serial No.: 1453404

Dimension of probe:

- Length: 120 mm.

- Diameter: 12 mm.

- Immersion Depth: 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor k
25.0	25.002	24.9	-0.102	0.13	2.00

Remark: - UUC\* = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL. 0-2717-3000-34 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No.: 22E986  
Page: 1 of 2

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenCompact S220  
Serial No.: C104059460  
ID No.: RYG\_EN0183  
Condition As-Received: Used Item  
Received Date: 16 March 2022  
Calibration Date: 21 March 2022

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Reference: 2203-0611DSC  
Ambient Temperature: ( 23  $\pm$  2 ) °C  
Relative Humidity: ( 50  $\pm$  10 ) %  
Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch  
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand

Procedure used: Calibration were conducted using in-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

#### Condition of this result of calibration

1.Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6440007	21E1444	07 May 2022

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



Calibrated by: Pongsagorn Boonyaporn  
Issue Date: 22 March 2022

Approved Signatory:   
( ) Phalinee Prabpaipal  
( ) Nuntawat Khanchai  
( ) Pornthippa Tameyakul

B 0284414



Cert. No.: 22E986  
Page: 2 of 2

#### Result of calibration:- (\*) Without adjustment ( ) After adjustment

Function: DC voltage measurement	Range:	2000 mV
Standard Value	UUC* Reading	Error
( mV )	( mV )	( mV )
-200.0000	-200.0	0.0
-150.0000	-150.0	0.0
-100.0000	-100.0	0.0
-50.0000	-50.0	0.0
0.0000	0.0	0.0
50.0000	50.0	0.0
100.0000	100.0	0.0
150.0000	150.0	0.0
200.0000	200.0	0.0
		Uncertainty ( $\pm$ $\mu$ V)
		72
		69
		65
		62
		58
		62
		65
		69
		72

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

\*UUC= Unit Under Calibration.

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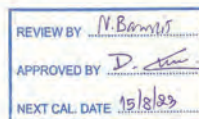


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TEL. 0-2717-3000 FAX. 0-2719-9484

## Certificate of Testing

Cert.No.: 22TW34  
Page: 1 of 2

Equipment: DO Meter  
Manufacturer: YSI  
Model: 5000-115V  
Serial No.: 15E102796  
ID No.: RYG\_EN0032  
Received Date: 11 February 2022  
Test Date: 14 February 2022  
Reference: 2202-0404DSC-4



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  $\pm$  5 ) °C  
Humidity ( 50  $\pm$  20 ) %  
Test Procedure: In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by: Walalak Sirinthean

Approved by:   
Approved Signatory

( ) Malee Butkruea  
( ) Saitip Meangmai  
( ) Warakorn Lemgsattrakul

Issue Date: 18 February 2022

B 0281285





Cert.No.: 22TW34  
Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.02	8.02	0.0084

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

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Saitip

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TEL: 0-2717-8000-27 FAX: 0-2719-9484



Cert. No.: 22LM12  
Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140, Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 11 February 2022  
Calibrated Date : 21 February 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
AC Line Voltage : (220 ± 22) V  
Calibrated by : Kunchit Promrat  
Approved by :   
( ) Ponthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%.

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A 0038008



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2202-0404DSC-5  
Procedure Used :-

Cert. No.: 22LM12  
Page.: 2 of 2

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 15E100464

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.00	45	20.001	19.88	-0.121	0.15	2.00

UUC\* : Unit Under Calibration

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

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Malee

a 1095714



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL: 0-2717-8000-27 FAX: 0-2719-9484



Cert. No.: 22TM317  
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)  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand  
BOD Room  
Location :  
Received Order : 22 April 2022  
Calibration Date : 22 April 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Man Pattanasongpaiboon  
Approved by :   
( ) Ponthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 3 May 2022

The Uncertainties are for a confidence probability of approximately 95%.

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0040735





Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2204-0146OC-1  
Page: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement.  
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument Model Serial No. Cert. No. Due Date  
1) Data Acquisition 34970A MY44031769 21LM12 02 Sep 2022

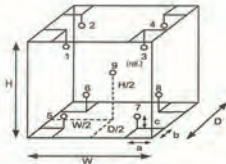
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( ° ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

Dimension of Chamber :

a = 10 cm D = 0.60 m  
b = 10 cm W = 1.0 m  
c = 10 cm H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	54	58
AC Supply ( Volt )	221	223

Position :	Ref. Std. ID No.:
1	9RTD-2/1
2	9RTD-2/2
3	9RTD-2/3
4	9RTD-2/4
5	9RTD-2/5
6	9RTD-2/6
7	9RTD-2/7
8	9RTD-2/8
9 (ref.)	9RTD-2/9

a 1106485



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2204-0146OC-1  
Page: 3 of 3

Result of Calibration :- ( ° ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Measured Temperature ( °C )								
Calibration Point ( °C )	Position							
20.0	1	2	3	4	5	6	7	8 (ref.)
	20.209	20.174	20.199	20.110	20.075	20.062	20.027	20.069

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

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

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

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

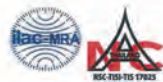
UUC\* : Unit Under Calibration

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

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

-o0o-

a 1106484



Certificate of Calibration

Equipment : SPECTROPHOTOMETER  
Model : DR8000  
Serial No. (or ID.): 1627845 (RYG\_EN0037)  
Manufacturer : HACH  
Condition : In Condition

Certificate No.: C06220464  
Issued Date: 27 September 2022  
Job No.: KSPR2212224  
Page: 1 of 3

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

REVIEW BY : N.B. BANG  
APPROVED BY : D. B. BANG  
NEXT CAL. DATE : 27/13/24

Environment Condition: Temperature 23.1 °C ±  
Humidity 65.4 %RH ±

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

Calibration By: Mr. Chattuphon Foithong  
Calibration Date: 27 September 2022

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

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

The standard for Wavelength Certificate No. 91418 and 91435  
The standard for Photometric Certificate No. 91441 and 101088  
The standard for Stray light Certificate No. 101041 and 101040  
The standard for Spectral resolution Certificate No. 101037

(Mr. Chattuphon Foithong)  
Person in charge

(Mr. Thalemgkiet Pongngarm)  
Authorized signatory

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

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

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

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CALFM-C06-13: 20 Jul 2022



Certificate No.: C06220464 Page 2 of 3

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of 81d at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.14
536.66	536.7	-0.04	0.14
637.98	638.3	-0.32	0.14
748.48	748.8	-0.32	0.14
807.03	807.4	-0.37	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5605	0.563	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6893	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9604	0.962	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

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Calibration Results:  
Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0080
	0.8609	0.861	-0.0001	0.0084
313 nm	0.0000	0.000	0.0000	0.0080
	0.2895	0.292	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6381	0.638	0.0001	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)	
260.67 +/- 0.11 nm	260.7	2.1	1.678	
391.94 +/- 0.11 nm	391.9	1.7	1.770	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength ( nm )	268.60	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance ( A)	0.4610	0.3176		
Absorbance ( A)	0.373	0.268		

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

The End of Certificate

DKSH Technology Limited  
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CALFM-C06-13: 20 Jul 2022

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
27 Sep 2022			27 Sep 2022		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิทช์ เปิด – ปิด 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. แรงดันไฟฟ้า (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"/>	656.1 นาโน 656.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. ขั้วไฟฟ้า ( 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. ฝาปิดกันละออง Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งขั้วไฟฟ้า (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความทึบที่ค่าสูง (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. ระบบท่อส่งยาและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพื่อสืบค้นหมายเลข :

Mr. Chattaphon Folthong  
Service Engineer

DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
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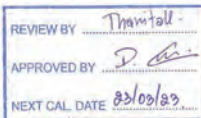
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## Certificate of Calibration

Represent to Certificate of Calibration PTC/07/22103

Certificate No.: PTC/07/22103 Page: 1 of 2  
Equipment: Digital Balance Condition: Normal  
Manufacturer: Sartorius Serial No: 26207038  
Model: MSE224S-100-DU ID No: RYG\_EN0002  
Type of Balance: Single Interval

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



Environment Condition: Temperature 23.9 °C ± 0.3 °C  
Humidity 58.1 %RH ± 4.4 %RH  
Air density 1.17 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.  
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,  
Rayong 21140, Thailand

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

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

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroj Metakul



Reviewed by  
(Mr. Kongsak Kalesri)

Approved By: (Mr. Keattisak Kerdlo)  
Laboratory Manager

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

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

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PTC-FM-C07-02: 2 Feb 2020



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Tel: +66 (0) 2059-9773  
www.pentacal.com

Represent to Certificate of Calibration PTC/07/22103

Certificate No.: PTC/07/22103

Page: 2 of 2

## Measurement Results:

Without Adjustment:

Function Calibration: Non Adjustment

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

Eccentricity test		100 (g)				
		Position (g)				
1	2	3	4	5		
0.0000	0.0000	-0.0002	0.0002	0.0002		
Maximum deviation:						0.0002

Repeatability Test: Weight to be 1/2 ≤ L<sub>1</sub> ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
20	0.000042
200	0.000027

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.000086	2.16
0.01	0.01000	0.0100	0.0000	0.00010	2.06
0.1	0.10000	0.1000	0.0000	0.00010	2.06
1	1.00000	1.0000	0.0000	0.00010	2.06
2	2.00000	1.9999	0.0001	0.00010	2.06
5	5.00001	5.0000	0.0000	0.00010	2.06
10	10.00000	10.0000	0.0000	0.00010	2.06
20	20.00003	19.9999	0.0001	0.00011	2.05
50	50.00004	49.9999	0.0001	0.00012	2.00
100	100.00004	100.0001	-0.0001	0.00017	2.00
200	200.00011	200.0000	0.0001	0.00027	2.00

Note: Weight of adjust (g)

The End of Certificate

PTC-FM-C07-02: 2 Feb 2020





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 19, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1517  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UFE 500  
Serial No. : GS11.1572  
ID No. : RYG\_EN0010  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : Oven Room  
Received Order : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0046908



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-2  
Procedure Used :-

Cert. No.: 22TM1517  
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	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

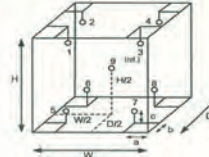
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	54	59
AC Supply ( Volt )	223	225

Ref. Std. ID No.: @ Calibration Point		
Position :	( 180 ) °C	( 104 ) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

Probe Installation Details : Dimension of Chamber :  
a = 5.0 cm D = 0.40 m  
b = 5.0 cm W = 0.56 m  
c = 5.0 cm H = 0.48 m  
Capacity = 0.11 m<sup>3</sup>

a 1132466



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM1517  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Measured Temperature ( °C )									
Calibration Point ( °C )	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243	179.605

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

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

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

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

UUC\* : Unit Under Calibration

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

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

-000-

a 1132465



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1492  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UM 400  
Serial No. : b495.0899  
ID No. : RYG\_EN0006  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140, Thailand  
Location : Oven Room  
Received Order : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Preecha Hiahb  
Approved by :   
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0046905





Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-1

Cert. No.: 22TM1492  
Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ).  
The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

**1. Reference standard instrument:-**

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

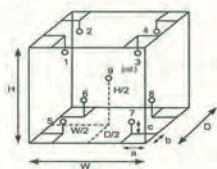
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



**Probe Installation Details :**

**Dimension of Chamber :**

a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
	Capacity = 0.053 m <sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	28	29
REL.Humid. ( % )	43	47
AC Supply ( Volt )	220	221

Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

a 1132473



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-1

Cert. No.: 22TM1492  
Page : 3 of 3

**Result of Calibration :-**

( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Measured Temperature ( °C )									
Calibration Point ( °C )	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

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

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

**Overall Variation :** The Difference of the maximum and minimum measured temperatures throughout observation UUC\* : Unit Under Calibration

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

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

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a 1132472

RYG\_EN0061



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5344 PATTANAKARN ROAD 50/18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3086-27 FAX: 0-2719-9484



Cert. No.: 22TM1491  
Page : 1 of 3

**Certificate of Calibration**

**Equipment :** Water Bath

**Manufacturer :** Memmert

**Model :** WNB22

**Serial No. :** L513.0648

**ID No. :** RYG\_EN0061

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

**Location :** Wet Chemistry Lab

**Received Order :** 20 October 2022

**Calibration Date :** 20 October 2022

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Preecha Hlahib

**Approved by :**   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0046906



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2210-0376OC-4

Cert. No.: 22TM1491  
Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

**1. Reference standard instrument:-**

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

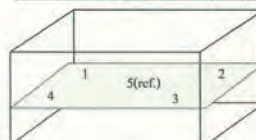
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

a 1132471





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2210-03760C-4  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM1491  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
85.0	0.12	0.081	0.18	2

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

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC\* : Unit Under Calibration

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

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

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a 1132470



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TEL. 0-2713-0800-27 FAX. 0-2719-9884



Cert.No.: 22CH1377  
Page: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2Go  
Serial No. : B531256371  
ID No. : RYG\_FS0420  
Condition As-Received : Used Item  
Received Date : 11 March 2022  
Calibration Date : 14 March 2022  
Reference : 2203-0495DSG-1  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
618/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In - House method  
- GP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by : Warakorn Lemgagatrakul

Approved by :   
Approved Signatory

( / ) Malee Bulkruea  
( ) Sathip Meangmal  
( ) Warakorn Lemgagatrakul

Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%.

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A 0039308



Cert. No.: 22CH1377  
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 61030049 130RC116 21E2682 25 Aug 2022  
This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. A13-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	766820	23 Sep 2023
pH 6.863	CPA chem	766822	04 Sep 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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

### Calibration Results

#### Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
	pH	mV	mV	pH	pH		
pH Meter	4.00	177.48	177	4.00	0.58	2.00	
S/N : B5312563/1	7.00	0.00	0	7.00	0.58	2.00	
	10.00	-177.48	-178	10.00	0.58	2.00	

#### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading ( mV )	Uncertainty of pH measurement ( ± )	Coverage factor k
pH Electrode	4.008	4.01	181	0.0079	2.00
S/N : 1311407	6.863	6.86	7	0.0093	2.00
	10.015	10.01	-171	0.0092	2.00

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

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a 1100595



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TEL. 0-2713-0800-27 FAX. 0-2719-9884



Cert. No.: 22LM1  
Page: 1 of 2

## Certificate of Calibration

Equipment : pH Meter with Sensor  
Manufacturer : Mettler Toledo  
Model : Seven2Go  
Serial No. : B531256371  
ID No. : RYG\_FS0420  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
618/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory

Received Order : 11 March 2022  
Calibrated Date : 15 March 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Malee Bulkruea

Approved by :   
Approved Signatory

( ) Penitilippa Tarnieyakul  
( / ) Suwit Injai

Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%.

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Equipment: pH Meter with Sensor  
Condition As-Received: Used Item  
Reference: 2203-0495DSC-2  
Cert. No.: 22LMA1  
Page: 2 of 2

Procedure Used :-  
Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.  
The temperature scale used was based on ITS-90.

Condition of this result of calibration  
1. Reference standard instrument:-  
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This certification is traceable to the International System of Unit.

Result of Calibration:- ( \* ) Without Adjustment  
Function: Temperature measurement.

This instrument was connected with temperature sensor, D/N: 1511407

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor #
25.0	100	25.009	25.4	0.391	0.16	2.00
30.0	100	30.008	30.5	0.492	0.16	2.00
40.0	100	39.997	40.6	0.603	0.16	2.00
50.0	100	49.997	50.6	0.603	0.16	2.00

UUC\* : Unit Under Calibration

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

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REVIEW BY: Mont Sout  
APPROVED BY: KL AI  
NEXT CAL. DATE: 01/12/23

### Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-7  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Pathanakarn rd., Khwang Suan Luang, Khet Suan Luang, Bangkok 10250

Date: June 21, 2022 2:04:12 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	Actual
Inlet Pressure: 25.0 psi	25.0 psi
Accuracy: 0.0 psi	0.0 psi
Agilent Recommended: <= 1.2	<= 1.2

Overall Inlet Pressure Accuracy Test Status  
Pass

GC Oven Temperature Accuracy

Name: 7890

Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual: 230.0 / 230.0 °C  
Temperature: 230.0 / 230.0 °C  
Accuracy: 0.0 °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: 100.0 / 100.4 °C  
Temperature: 100.0 / 100.4 °C  
Accuracy: 0.4 °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: 100.0 / 100.0333 °C  
Stability: 0.1 °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: June 21, 2022 2:04:12 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: 22 mV  
RFPA Voltage: 568 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: June 21, 2022 2:04:12 PM  
System ID: GM-7

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Source:	EI - Extractor	Filament:	1
Setpoint Status:	Pass		
Signal to Noise:	51283		
Agilent Recommended:	>= 1200		
Source:	EI - Extractor	Filament:	2
Setpoint Status:	Pass		
Signal to Noise:	7088		
Agilent Recommended:	>= 1200		

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

**Overall Signal to Noise EI Test Status**

Pass

Date: June 21, 2022 2:04:12 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	7890
Tested Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN14133181
Firmware Revision	B.02.03
Oven Type	Standard

Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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**Inlet 1**

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

**Detector 1**

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

**Mass Spectrometer 1**

Manufacturer	Agilent Technologies
Type	SQ
Name	5977A
Serial Number	US1415M209
Firmware Revision	5977 B.00.21
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

**MS EI Source 1**

Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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**Electronic Signature****Purpose**

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**Details**

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	June 21, 2022
Reason for Signature:	Executed protocol and published this original version of document

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: kupaak@mscimglobal  
Hostname: SCG115HEC  
System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:25:05 AM	Auth	SessionCreated	Session	None
June 21, 2022 10:25:05 AM	Start	Configuration	Session	None
June 21, 2022 10:25:05 AM	Auth	Enrollment	Licensing	User is Field Engineer and does not require an unlock code
June 21, 2022 10:25:26 AM	Auth	ExpLoaded	Session	EQP details for primary technique [G] - File path: [H:\Data\Pack\GC\Conf\qual\02.50\02.50.eqp] EQP File Name: [02.50.eqp] (EQP Name: [AgilentRecommended]) EQP details for hyphenated technique [G] - File path: [H:\Data\Pack\GC\Conf\qual\02.50\02.50.eqp] EQP File Name: [02.50.eqp] (EQP Name: [AgilentRecommended])
June 21, 2022 10:25:38 AM	End	Configuration	Session	None
June 21, 2022 10:25:43 AM	Start	Qualification	Session	QG
June 21, 2022 10:25:43 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7800 - Outflow Test - No septum associated	None
June 21, 2022 10:25:54 AM	End	Execution	System Inspection and Basic Safety and Operation - 7800 - Outflow Test - No septum associated	Run Count: 1

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: kupaak@mscimglobal  
Hostname: SCG115HEC  
System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:26:00 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
June 21, 2022 10:26:10 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
June 21, 2022 10:30:12 AM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % septum in K	None
June 21, 2022 10:34:09 AM	Auth	Data	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % septum in K	Manual Data Entry
June 21, 2022 10:34:16 AM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 230.0°C - L: >= 1.0 AND <= 1.0 % septum in K	Run Count: 1
June 21, 2022 10:34:11 AM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % septum in K	None
June 21, 2022 10:38:42 AM	Auth	Data	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % septum in K	Manual Data Entry
June 21, 2022 10:38:44 AM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % septum in K	Run Count: 1
June 21, 2022 10:38:46 AM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= 1.0 AND <= 1.0 % septum in K	None

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: kupaak@mscimglobal  
Hostname: SCG115HEC  
System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:01:00 AM	Auth	AppClosed	Session	None
June 21, 2022 11:01:47 AM	Auth	AppRestarted	Session	None
June 21, 2022 11:01:48 AM	Auth	SessionRestarted	Session	None
June 21, 2022 11:01:51 AM	Start	Qualification	Session	QG
June 21, 2022 11:01:51 AM	Start	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
June 21, 2022 11:03:14 AM	Auth	Data	DataManager	DataManager was in a data verification state that this user checks it out over.
June 21, 2022 11:04:19 AM	Auth	Data	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
June 21, 2022 11:04:32 AM	End	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
June 21, 2022 11:04:34 AM	Start	Execution	Log Amp - 5877A SQ - Source: EI - Extractor	None
June 21, 2022 11:04:34 AM	End	Execution	Log Amp - 5877A SQ - Source: EI - Extractor	Run Count: 1
June 21, 2022 11:04:37 AM	Start	Execution	RPPA - 5877A SQ - Source: EI - Extractor	None
June 21, 2022 11:07:49 AM	End	Execution	RPPA - 5877A SQ - Source: EI - Extractor	Run Count: 1
June 21, 2022 11:07:52 AM	Start	Execution	Tune EI - 5877A SQ - Source: EI - Extractor Filament 1 (Qualitative - No septum associated)	None

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System ID: GM-7

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User Name: kupaak@mscimglobal  
Hostname: SCG115HEC  
System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:08:35 AM	End	Execution	Tune EI - 5877A SQ - Source: EI - Extractor Filament 1 (Qualitative - No septum associated)	Run Count: 1
June 21, 2022 11:14:39 AM	Start	Execution	Tune EI - 5877A SQ - Source: EI - Extractor Filament 2 (Qualitative - No septum associated)	None
June 21, 2022 11:15:48 AM	End	Execution	Tune EI - 5877A SQ - Source: EI - Extractor Filament 2 (Qualitative - No septum associated)	Run Count: 1
June 21, 2022 11:18:49 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:17:05 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 11:17:15 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:28:09 AM	Auth	AppClosed	Session	None
June 21, 2022 12:30:20 PM	Auth	AppRestarted	Session	None
June 21, 2022 12:30:22 PM	Auth	SessionRestarted	Session	None
June 21, 2022 12:30:25 PM	Start	Qualification	Session	QG
June 21, 2022 12:30:25 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: supasak.komsoy@thairn  
Host Name: SC0115HNC

System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:57:07 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	None
June 21, 2022 12:57:58 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	None
June 21, 2022 12:58:54 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:59:24 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:59:59 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:42:04 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:42:17 PM	Auto	AcqClosed	Session	None
June 21, 2022 12:50:31 PM	Auto	AcqResumed	Session	None
June 21, 2022 12:53:33 PM	Auto	SessionResumed	Session	None
June 21, 2022 12:53:37 PM	Start	Qualification	Session	OQ
June 21, 2022 12:53:37 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	None

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User Name: supasak.komsoy@thairn  
Host Name: SC0115HNC

System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:34:48 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF1_001.D
June 21, 2022 12:50:29 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L1 => 1200	Run Count : 1
June 21, 2022 12:57:11 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	None
June 21, 2022 12:58:15 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:58:50 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:58:45 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:59:00 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:58:14 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D

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System ID: GM-7

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: supasak.komsoy@thairn  
Host Name: SC0115HNC

System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:59:45 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:40:16 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:40:45 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:41:09 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D
June 21, 2022 12:41:29 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Run Count : 1
June 21, 2022 12:42:50 PM	Auto	TestUnloaded	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Deviation Used for Run Count : 1
June 21, 2022 12:42:50 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	None
June 21, 2022 12:42:55 PM	Auto	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Data File Path : E:\ALSGM7_2022\SNF2_001.D

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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User Name: supasak.komsoy@thairn  
Host Name: SC0115HNC

System ID: GM-7  
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:42:46 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L1 => 1200	Run Count : 2
June 21, 2022 12:42:50 PM	End	Qualification	Session	OQ
June 21, 2022 12:42:50 PM	Start	Reporting	Session	None
June 21, 2022 12:45:17 PM	Auto	TestClosed	Session	None
June 21, 2022 1:57:47 PM	Auto	AcqResumed	Session	None
June 21, 2022 1:57:50 PM	Auto	SessionResumed	Session	None
June 21, 2022 1:57:56 PM	Start	Qualification	Session	OQ
June 21, 2022 2:02:42 PM	Auto	Reporting	Session	Report Generated : Complete

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Date: June 21, 2022 2:04:12 PM  
System ID: GM-7

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Cert.No.: 21CH1733  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No. : B834291445  
ID No. : RYG\_EN0152  
Condition As-Received: Used Item  
Received Date : 22 December 2021  
Calibration Date : 23 December 2021  
Reference : 2112-0636DSC-2  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5 T.Maenam Khu, A.Pluakaeng,  
Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :   
Approved Signatory

( / ) Malee Bukruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 24 December 2021

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services

A 0036356



Cert.No.: 21CH1733  
Page.: 2 of 3

### Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	21E2682	25 Aug 2022
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	761016	02 Aug 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

### Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
	pH	mV	mV	pH		
pH Meter	4.000	177.48	177.3	4.000	0.058	2.00
S/N.: B834291445	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

a 1087319



Cert.No.: 21CH1733  
Page.: 3 of 3

### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 1475518	4.008	4.011	180.6	0.0049	2.05
	6.982	6.984	5.3	0.0077	2.00
	10.015	10.014	-171.3	0.0065	2.00

### Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM

- Serial No. : 1475518

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.002	24.9	-0.102	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1087180



## Certificate of Calibration

Certificate No.: 21E4151  
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 : 22 December 2021  
Calibration Date : 28 December 2021

Reference : 2112-0636DSC-2  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
Ambient Temperature : ( 23 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
616/10 Moo 5 T.Maenam Khu, A.Pluakaeng, Rayong  
21140, Thailand

Procedure used : Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

### Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6440007	21E1444	07 May 2022

2. This result of calibration was made on requested at the point specified by customer.

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

4. This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Wuthareeporn Wongchutakane  
Issue Date : 07 January 2022

Approved Signatory :

( / ) Phalinee Prabpaipai  
( / ) Nuntawat Khamchai  
( / ) Pornthippa Tameyakul

B 0278122





Result of calibration :- ( \* ) Without adjustment ( ) After adjustment

Function: DC voltage measurement	Range: 2000	mV	
<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>
( mV )	( mV )	( mV )	( $\pm$ $\mu$ V )
-100.0000	-100.0	0.0	65
-50.0000	-50.0	0.0	62
0.0000	0.0	0.0	58
50.0000	50.0	0.0	62
100.0000	100.0	0.0	65
150.0000	150.0	0.0	69
200.0000	199.9	-0.1	72

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

\*UUC= Unit Under Calibration.

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