

# ภาคผนวก ง

เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์

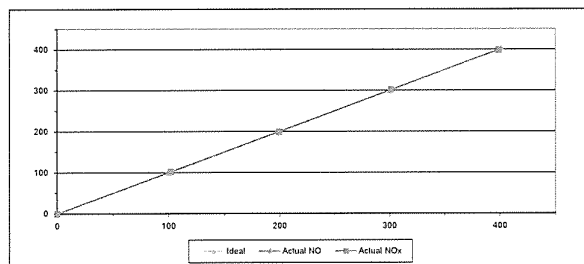




## MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	NV0ER3YH	Equipment ID	RYG_F80459
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.10	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.80	1.80	1.80
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.50	1.50	0.50
4	400.00	401.30	1.30	0.33	398.90	-1.10	-0.28
AVERAGE (%)				-0.06			0.39



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

Approved By  
  
(Mr. Sarayuth Jitranont)  
Assistant General Manager

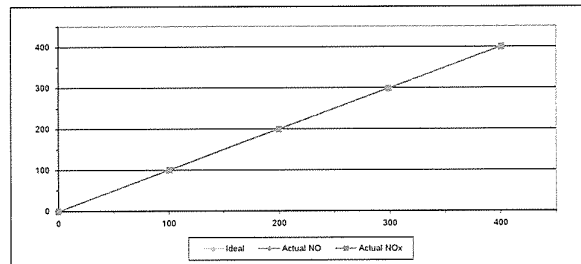
ALS Laboratory Group  
FORM NO. F-06-056 REVISION NO. 1 ISSUE DATE 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T2T8YRL	Equipment ID	RYG_F80457
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70	100.20	0.20	0.20
2	200.00	198.40	-1.60	-0.80	199.60	-0.40	-0.20
3	300.00	297.10	-2.90	-0.97	298.50	-1.50	-0.50
4	400.00	398.60	-1.40	-0.35	400.70	0.70	0.17
AVERAGE (%)				-0.74			-0.05



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

Approved By  
  
(Mr. Sarayuth Jitranont)  
Assistant General Manager

ALS Laboratory Group  
FORM NO. F-06-056 REVISION NO. 1 ISSUE DATE 02/04/12



J NAC Associates Co., Ltd.  
43/44 (1st floor) 101/102  
Bangkok 10110 Thailand  
Tel: +662-05511111  
Fax: +662-05511111  
E-mail: jnac@jnac.com  
Web site: www.jnac.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NAC 10110:2017  
CALIBRATION 0364

Approved measurement laboratory  
Calibration services department

Certificate Number  
CWS-004-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE	Cap anemometer Novelty Sensor: WS-02 Data logger: 200 WS-25L Sensor: WSD-AS101 Data logger: AS101
SERIAL NUMBER	RYG_F80328
ID NUMBER	Used item
CONVENTION AS-RECEIVED CUSTOMER	ALS Laboratory Group (Thailand) Co., Ltd. 104 Phatthanaburi 40, Phatthanaburi 90, Khwaeng Suan Luang, Thet Suan Luang, Bangkok 10250 Thailand
RECEIVED DATE	11 Aug 2023
MEASUREMENT DATE	18 Aug 2023
ISSUE DATE	21 Aug 2023
ENVIRONMENTAL CONDITIONS:	Ambient condition in the laboratory are as follow: Temperature: 23.0 ± 3.0 °C Relative Humidity: 55.0 ± 15.0 %RH Atmospheric Pressure: 1010 ± 10 hPa
PLACE OF CALIBRATION	Effel type wind tunnel of J NAC Associates Co., Ltd.
CALIBRATION CONDITIONS	Wind tunnel cross section area <sup>1</sup> : 900 cm <sup>2</sup> Win direction frontal area <sup>2</sup> : 100 cm <sup>2</sup> Diameter of mounting pipe <sup>3</sup> : 11 mm Blockage ratio of test object <sup>4</sup> : 0.11
Preconditioning	24 hours at ambient conditions
Measurement Condition	The average values during measurement are (24.3) °C, (64.3) %RH and (1009.4) hPa

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

Calibrated by  
Mr. Sarayuth Jitranont  
Mr. Jirawut Sakam



Approved signature  
Mr. Sarayuth Jitranont  
Calibration Department Manager

Remarks:  
<sup>1</sup> Nominal cross section area of the wind tunnel  
<sup>2</sup> Projected cross section area of the test object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio (%)

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



J NAC Associates Co., Ltd.  
43/44 (1st floor) 101/102  
Bangkok 10110 Thailand  
Tel: +662-05511111  
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Web site: www.jnac.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NAC 10110:2017  
CALIBRATION 0364

Approved measurement laboratory  
Calibration services department

Certificate Number  
CWS-004-66

## CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE	Wind Direction Sensor Novelty Sensor: WS-02 Data logger: 200 WS-25L Sensor: WSD-AS101 Data logger: AS101
SERIAL NUMBER	RYG_F80328
ID NUMBER	Used item
CONVENTION AS-RECEIVED CUSTOMER	ALS Laboratory Group (Thailand) Co., Ltd. 104 Phatthanaburi 40, Phatthanaburi 90, Khwaeng Suan Luang, Thet Suan Luang, Bangkok 10250 Thailand
RECEIVED DATE	11 Aug 2023
MEASUREMENT DATE	18 Aug 2023
ISSUE DATE	21 Aug 2023
ENVIRONMENTAL CONDITIONS:	Ambient condition in the laboratory are as follow: Temperature: 23.0 ± 3.0 °C Relative Humidity: 55.0 ± 15.0 %RH Atmospheric Pressure: 1010 ± 10 hPa
PLACE OF CALIBRATION	Effel-type wind tunnel of J NAC Associates Co., Ltd.
CALIBRATION CONDITION	Wind tunnel cross-section area <sup>1</sup> : 900 cm <sup>2</sup> Win direction frontal area <sup>2</sup> : 100 cm <sup>2</sup> Diameter of mounting pipe <sup>3</sup> : 11 mm Blockage ratio of test object <sup>4</sup> : 0.11
Preconditioning	24 hours at ambient conditions
Measurement Condition	The average values during measurement are (23.9) °C, (41.3) %RH and (1009.3) hPa

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

Calibrated by  
Mr. Sarayuth Jitranont  
Mr. Jirawut Sakam



Approved signature  
Mr. Sarayuth Jitranont  
Calibration Department Manager

Remarks:  
<sup>1</sup> Nominal cross section area of the wind tunnel  
<sup>2</sup> Projected cross section area of the test object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio (%)

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

Certificate Number  
CL-011-66

Page 2 of 2 Pages

#### MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	45.000	42	-3	1.0
	50.000	83	-3	1.0
	135.000	133	-2	1.0
	180.000	182	2	1.0
	225.000	225	4	1.0
	270.000	275	5	1.0
	315.000	320	5	1.0
	360.000	356	3	1.0

#### Remark:

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

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration



Accredited calibration laboratory  
ISO/IEC 17025:2017  
MSC-18078-1:2020  
CALIBRATION 0167

Air speed measurement laboratory  
Calibration services department

Certificate Number  
CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

#### MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor

Novajima

Sensor WS-02F

Data logger: 200 WS-250i

Sensor:

Data logger: A1567

RYG-150083

Used item

AIS laboratory group (Thailand) Co., Ltd.

104 Phrasathanakun 40, Phrasathanakun Rd. Khwaeng Suan Luang,

Khut Suan Luang, Bangkok 10250 Thailand

#### Calibration procedure:

The wind direction sensor was calibrated against standard rotary encoder, model: AX000120-00000, P.S. 100m, on same direction of 90°/1 type wind tunnel with 900 cm<sup>2</sup> cross test section area. The test is done based on ISO 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2012, and used as a calibration guideline.

#### Traceability:

This certificate provides a traceability of the measurement to recognize the national system of units (SI) through the NMV (National Metrology Institute of Thailand) via Certificate Number: CL-001-23.

#### Uncertainty of measurement:

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

#### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

#### PLACE OF CALIBRATION

Effel type wind tunnel of Janus Nee Associates Co., Ltd.

#### CALIBRATION CONDITION

Wind tunnel cross section area<sup>1</sup>: 900 cm<sup>2</sup>

Wind direction frontal area<sup>2</sup>: 129 cm<sup>2</sup>

Diameter of mounting pipe<sup>3</sup>: 4mm

Blockage ratio of test object<sup>4</sup>: 0.141 [-]

#### Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (24.1) °C, (54.3) %RH and (1015.2) hPa.

#### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

SC M. Sereen Thongkiet

(Mass Measurement Laboratory)

Approved signature:

Mr. Parinya Booncharern  
Calibration Department Manager

#### Remark:

<sup>1</sup> Inside cross section area of the wind tunnel

<sup>2</sup> Projected cross section area of the tested object include mounting pipe

<sup>3</sup> Diameter of mounting pipe

<sup>4</sup> Ratio "a/b"

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

Certificate Number  
CL-011-66

Page 2 of 2 Pages

#### MEASUREMENT RESULTS<sup>1</sup>

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

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.66
	90.000	85	-5	0.74
	135.000	133	-2	0.55
	180.000	180	0	0.74
	225.000	228	3	0.74
	270.000	273	3	0.68
	315.000	326	4	0.74

#### Remark:

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

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration

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



Accredited calibration laboratory  
ISO/IEC 17025:2017  
MSC-18078-1:2020  
CALIBRATION 0167

Air speed measurement laboratory  
Calibration services department

Certificate Number  
CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

#### MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Cup anemometer

Novajima

Sensor WS-02F

Data logger: 200 WS-250i

Sensor:

Data logger: A1567

RYG-150083

Used item

AIS laboratory group (Thailand) Co., Ltd.

104 Phrasathanakun 40, Phrasathanakun Rd. Khwaeng Suan Luang,

Khut Suan Luang, Bangkok 10250 Thailand

#### Calibration procedure:

The cup anemometer was calibrated against standard or velocity transducer, model: B15532 and pilot tube with anemometer differential pressure meter model: DP1550 in single calibration of Effel type wind tunnel with 900 cm<sup>2</sup> cross test section area. The test is done based on ISO 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2012, and used as a calibration guideline.

#### Traceability:

This certificate provides a traceability of the measurement to recognize the national system of units (SI) through the NMV (National Metrology Institute of Thailand) via Certificate Number: M10-001-21 and M10-006-22.

#### Uncertainty of measurement:

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

#### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

#### PLACE OF CALIBRATION

Effel type wind tunnel of Janus Nee Associates Co., Ltd.

#### CALIBRATION CONDITIONS

Wind tunnel cross section area<sup>1</sup>: 900 cm<sup>2</sup>

Wind direction frontal area<sup>2</sup>: 100 cm<sup>2</sup>

Diameter of mounting pipe<sup>3</sup>: 4mm

Blockage ratio of test object<sup>4</sup>: 0.111 [-]

#### Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (23.5) °C, (52.8) %RH and (1014.1) hPa.

#### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

SC M. Sereen Thongkiet

(Mass Measurement Laboratory)

Approved signature:

Mr. Parinya Booncharern  
Calibration Department Manager

#### Remark:

<sup>1</sup> Inside cross section area of the wind tunnel

<sup>2</sup> Projected cross section area of the tested object include mounting pipe

<sup>3</sup> Diameter of mounting pipe

<sup>4</sup> Ratio "a/b"

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

Certificate Number

CL-018-66

Page 2 of 2 Pages

**MEASUREMENT RESULTS<sup>1</sup>**

The cup anemometer, under Calibration (U/C) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure transducer which was installed at 40 mm and 200 mm respectively away from wind tunnel nozzle. U/C was initiated at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 18 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{cal}$ (m/s)	Error (m/s)	$U$ (m/s) (m/s)
0.583	23.50	23.45	0.8	-0.2	0.12
2.035	23.44	23.45	1.9	-0.1	0.16
3.049	23.50	23.45	3.5	-0.2	0.15
4.116	23.50	23.45	3.8	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.8	-0.1	0.18
7.07	23.40	23.45	7.0	-0.1	0.19
8.14	23.50	23.45	8.0	-0.2	0.19
9.10	23.40	23.45	9.6	0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.13	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.23
13.20	23.27	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.1	-0.1	0.24
15.34	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

**Remarks:**  
 Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.  
<sup>1</sup> Velocity in standard.  
<sup>2</sup> Velocity of line under Calibration.

**PHOTO OF CALIBRATION SET-UP**

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

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

Certificate Number

CL-018-66

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
Cup anemometer

**MANUFACTURER**  
Novamex

**MODEL/TYPE**  
Sensor: WS-23F  
Data logger: 200 WS 2516

**SERIAL NUMBER**  
Sensor: 150411  
Data logger: AS369

**ID NUMBER**  
REC: 150411

**CONDITION AS RECEIVED**  
Used item

**CUSTOMER**  
ALS laboratory group (Thailand) Co., Ltd.  
104 Phraethanulan 40, Phraethanulan Rd., Khwaeng San-Luang, Khet San-Luang, Bangkok 10250 Thailand

**RECEIVED DATE**  
27 Jan 2023

**MEASUREMENT DATE**  
10 Feb 2023

**ISSUE DATE**  
10 Feb 2023

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

**PLACE OF CALIBRATION**  
Jiffy-type wind tunnel of Jaranat Associates Co., Ltd.

**CALIBRATION CONDITIONS**  
 Wind tunnel cross section area<sup>1</sup>: 900 cm<sup>2</sup>  
 Win direction frontal area<sup>2</sup>: 130 cm<sup>2</sup>  
 Diameter of mounting post<sup>3</sup>: 6 mm  
 Release rate of test object<sup>4</sup>: 0.143 1/s

**Preconditioning**  
24 hours at ambient condition

**Measurement Condition**  
The average values during measurement are 23.9 °C, 44.8 %RH and 1010.31 hPa

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

**Calibrated by:**  
☒ Mr. Surasak Thuchaisri  
☐ Miss Jaranat Jaranat

**Remarks:**  
<sup>1</sup> Nozzle cross section area of the wind tunnel  
<sup>2</sup> Projected cross section area of the tested object include mounting post  
<sup>3</sup> Diameter of mounting post  
<sup>4</sup> Release rate

**Approved signature:**  
  
 Mr. Parinya Boonchirong  
 Calibration Department Manager

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

Certificate Number

CL-018-66

Page 2 of 2 Pages

**MEASUREMENT RESULTS<sup>1</sup>**

The cup anemometer, under Calibration (U/C) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure transducer which was installed at 40 mm and 200 mm respectively away from wind tunnel nozzle. U/C was initiated at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 18 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{cal}$ (m/s)	Error (m/s)	$U$ (m/s) (m/s)
0.583	23.60	23.55	0.8	-0.2	0.15
2.036	23.50	23.55	1.8	-0.2	0.16
3.044	23.50	23.55	2.5	-0.2	0.18
4.147	23.58	23.55	3.5	-0.3	0.19
5.00	23.50	23.55	4.8	-0.1	0.18
5.98	23.62	23.55	5.5	-0.1	0.18
7.04	23.28	23.55	7.0	0.0	0.18
8.16	23.54	23.55	8.0	-0.1	0.18
9.10	23.46	23.55	9.0	-0.1	0.19
10.07	23.50	23.55	10.0	-0.1	0.19
11.13	23.10	23.55	11.0	-0.2	0.20
12.13	23.50	23.55	12.1	-0.1	0.21
13.21	23.12	23.55	13.1	-0.3	0.22
14.25	23.35	23.55	14.0	-0.2	0.22
15.34	23.10	23.55	15.1	-0.2	0.26
16.29	23.20	23.55	16.0	-0.3	0.24

**Remarks:**  
 Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.  
<sup>1</sup> Velocity in standard.  
<sup>2</sup> Velocity of line under Calibration.

**PHOTO OF CALIBRATION SET-UP**

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

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

Certificate Number

CL-018-66

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
Wind Direction Sensor

**MANUFACTURER**  
Novamex

**MODEL/TYPE**  
Sensor: WS-021  
Data logger: 200 WS 2516

**SERIAL NUMBER**  
Sensor: 150411  
Data logger: AS369

**ID NUMBER**  
REC: 150411

**CONDITION AS RECEIVED**  
Used item

**CUSTOMER**  
ALS laboratory group (Thailand) Co., Ltd.  
104 Phraethanulan 40, Phraethanulan Rd., Khwaeng San-Luang, Khet San-Luang, Bangkok 10250 Thailand

**RECEIVED DATE**  
27 Jan 2023

**MEASUREMENT DATE**  
10 Feb 2023

**ISSUE DATE**  
10 Feb 2023

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

**PLACE OF CALIBRATION**  
Jiffy-type wind tunnel of Jaranat Associates Co., Ltd.

**CALIBRATION CONDITIONS**  
 Wind tunnel cross section area<sup>1</sup>: 900 cm<sup>2</sup>  
 Win direction frontal area<sup>2</sup>: 130 cm<sup>2</sup>  
 Diameter of mounting post<sup>3</sup>: 6 mm  
 Release rate of test object<sup>4</sup>: 0.143 1/s

**Preconditioning**  
24 hours at ambient condition

**Measurement Condition**  
The average values during measurement are 23.9 °C, 44.8 %RH and 1010.31 hPa

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

**Calibrated by:**  
☒ Mr. Surasak Thuchaisri  
☐ Miss Jaranat Jaranat

**Remarks:**  
<sup>1</sup> Nozzle cross section area of the wind tunnel  
<sup>2</sup> Projected cross section area of the tested object include mounting post  
<sup>3</sup> Diameter of mounting post  
<sup>4</sup> Release rate

**Approved signature:**  
  
 Mr. Parinya Boonchirong  
 Calibration Department Manager

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

# MEASUREMENT RESULTS<sup>3</sup>

The wind direction sensor was calibrated against standard rotary encoder by manual sun method. During calibration, the measurement was carried out at 45 intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 3 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	D <sub>True</sub>	D <sub>Obs</sub>	Error	U <sub>95(D)</sub>
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.00	0.000	0	0	0.50
	45.000	41	-4	0.50
	90.000	87	-3	0.50
	135.000	135	0	0.60
	180.000	180	0	0.70
	225.000	230	5	0.60
	270.000	275	5	0.50
	315.000	320	5	0.50

## Remarks:

Calibration results may vary for the tested circumstances and environmental conditions during which calibration took place.

Direction of rotation:

Direction of Clock Under Calibration:



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



## ROTA METER CALIBRATION RESULT JULY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Jul 23	Y = 1.2484x - 0.6741	0.9931
BKK_FS0579	03 Jul 23	Y = 1.0997x - 0.4918	1.0000
BKK_FS0583	01 Jul 23	Y = 1.0068x + 1.6459	0.9998
BKK_FS0584	01 Jul 23	Y = 0.9804x + 9.469	0.9999
BKK_FS0585	07 Jul 23	Y = 1.0248x + 0.8333	0.9996
BKK_FS0586	01 Jul 23	Y = 0.9907x + 11.074	1.0000
BKK_FS0587	07 Jul 23	Y = 0.986x + 17.77	0.9993
BKK_FS0588	01 Jul 23	Y = 0.9751x + 9.8452	0.9999
BKK_FS0589	03 Jul 23	Y = 1.0174x + 0.0381	1.0000
BKK_FS0590	01 Jul 23	Y = 1.0127x - 3.4333	1.0000
BKK_FS0591	03 Jul 23	Y = 1.0452x - 51.824	0.9998
BKK_FS0592	07 Jul 23	Y = 1.0003x + 14.344	1.0000
BKK_FS0593	01 Jul 23	Y = 1.0386x - 41.415	0.9997
BKK_FS0594	07 Jul 23	Y = 1.0025x + 6.32	0.9999
BKK_FS0595	01 Jul 23	Y = 1.0871x - 114.97	0.9985
BKK_FS0596	03 Jul 23	Y = 1.038x - 51.974	0.9993
BKK_FS0597	01 Jul 23	Y = 1.0059x - 9.9086	1.0000
BKK_FS1004	01 Jul 23	Y = 1.0186x + 6.731	0.9998
BKK_FS1005	01 Jul 23	Y = 0.9922x + 13.993	0.9970
BKK_FS1006	01 Jul 23	Y = 1.1747x - 3.1235	0.9991
BKK_FS1007	07 Jul 23	Y = 1.0737x + 0.8677	0.9997
BKK_FS1008	07 Jul 23	Y = 1.0446x + 1.2156	0.9999
BKK_FS1009	01 Jul 23	Y = 1.1044x - 0.8245	1.0000
BKK_FS1010	03 Jul 23	Y = 1.2271x - 2.0139	1.0000
BKK_FS1011	03 Jul 23	Y = 1.261x - 1.7003	1.0000
BKK_FS1012	03 Jul 23	Y = 0.9978x - 3.7238	0.9990
BKK_FS1013	03 Jul 23	Y = 1.0245x - 28.65	0.9999
BKK_FS1014	01 Jul 23	Y = 1.3135x - 7.0966	0.9961
BKK_FS1015	01 Jul 23	Y = 0.9802x + 3.8214	0.9999
BKK_FS1016	01 Jul 23	Y = 1.0726x - 85.581	0.9995
BKK_FS1020	01 Jul 23	Y = 1.1161x - 1.1986	1.0000
BKK_FS1021	01 Jul 23	Y = 0.9566x + 16.524	0.9987
BKK_FS1022	01 Jul 23	Y = 1.0712x - 89.51	0.9990
BKK_FS1023	01 Jul 23	Y = 1.3791x - 8.8721	0.9944
BKK_FS1024	01 Jul 23	Y = 0.9449x + 11.421	0.9993
BKK_FS1025	01 Jul 23	Y = 1.0477x - 41.116	1.0000
BKK_FS1026	01 Jul 23	Y = 1.3389x - 4.918	1.0000
BKK_FS1027	01 Jul 23	Y = 0.9852x + 1.5238	1.0000
BKK_FS1028	01 Jul 23	Y = 1.0281x - 19.897	0.9996



## ROTA METER CALIBRATION RESULT JULY 2023

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

Review By:

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By:

(Mr. Sarayuth Jitranont)

Assistant General Manager



## ROTA METER CALIBRATION RESULT OCTOBER 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	02 Oct 23	Y = 1.2862x - 1.2952	0.9963
BKK_FS0579	02 Oct 23	Y = 1.2546x + 0.0065	0.9946
BKK_FS0583	03 Oct 23	Y = 1.0773x - 2.4138	0.9989
BKK_FS0584	02 Oct 23	Y = 0.9787x + 12.569	0.9999
BKK_FS0585	18 Oct 23	Y = 1.0322x + 3.7767	0.9998
BKK_FS0586	02 Oct 23	Y = 0.9777x + 15.405	0.9997
BKK_FS0587	18 Oct 23	Y = 1.0175x + 14.717	0.9997
BKK_FS0589	03 Oct 23	Y = 1.0148x + 2.4143	1.0000
BKK_FS0590	03 Oct 23	Y = 1.0088x + 0.8429	1.0000
BKK_FS0591	02 Oct 23	Y = 1.0733x - 88.805	0.9989
BKK_FS0592	18 Oct 23	Y = 1.0037x + 10.388	1.0000
BKK_FS0593	02 Oct 23	Y = 1.0538x - 60.63	0.9996
BKK_FS0594	18 Oct 23	Y = 1.0052x + 5.3238	0.9999
BKK_FS0596	03 Oct 23	Y = 1.0449x - 48.241	0.9996
BKK_FS0597	03 Oct 23	Y = 1.0697x - 83.62	0.9994
BKK_FS1004	02 Oct 23	Y = 0.9855x + 14.75	0.9992
BKK_FS1005	02 Oct 23	Y = 1.02x + 1.7167	0.9996
BKK_FS1006	02 Oct 23	Y = 1.1762x - 3.5619	0.9999
BKK_FS1007	18 Oct 23	Y = 1.1405x + 2.6044	0.9993
BKK_FS1008	18 Oct 23	Y = 1.1267x + 4.8333	0.9991
BKK_FS1010	03 Oct 23	Y = 1.0027x + 2.5832	0.9986
BKK_FS1011	02 Oct 23	Y = 1.3811x - 6.2068	0.9998
BKK_FS1012	02 Oct 23	Y = 1.0017x + 0.9	1.0000
BKK_FS1013	02 Oct 23	Y = 1.0593x - 46.02	0.9994
BKK_FS1014	03 Oct 23	Y = 1.0961x - 1.6895	0.9983
BKK_FS1015	03 Oct 23	Y = 0.9979x + 6.2595	0.9993
BKK_FS1016	03 Oct 23	Y = 1.0683x - 82.491	0.9995
BKK_FS1017	06 Oct 23	Y = 0.9981x - 2.2235	0.9998
BKK_FS1018	06 Oct 23	Y = 0.9817x - 20.653	0.9999
BKK_FS1019	06 Oct 23	Y = 1.0152x - 64.485	0.9998
BKK_FS1020	02 Oct 23	Y = 1.2691x - 2.4721	0.9983
BKK_FS1021	02 Oct 23	Y = 1.0036x + 2.3286	0.9999
BKK_FS1022	02 Oct 23	Y = 1.0633x - 73.266	0.9990
BKK_FS1023	03 Oct 23	Y = 1.0879x - 1.0694	0.9984
BKK_FS1024	02 Oct 23	Y = 1.0035x + 1.4857	1.0000
BKK_FS1025	03 Oct 23	Y = 1.0556x - 58.597	0.9999
BKK_FS1026	02 Oct 23	Y = 1.2894x - 1.497	0.9970
BKK_FS1027	02 Oct 23	Y = 1.0032x + 1.5167	1.0000
BKK_FS1028	02 Oct 23	Y = 1.0433x - 30.012	0.9994



# ROTA METER CALIBRATION RESULT OCTOBER 2023

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

Review By:

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By:

(Mr. Sarayuth Jitranont)

Assistant General Manager

Page 2 of 2

RYG\_EN0004

Sartorius (Thailand) Co., Ltd.  
129 Nam 5 Road, Huaywang, Huaywang, Bangkok 10310  
Tel: +66 2643 8381-6 Fax: +66 2643 8387 e-mail: service.thailand@sartorius.com



SARTORIUS

NO:THS-TG-37033  
CALIBRATION 0426

# Certificate of Calibration

REVIEW BY: *[Signature]*  
APPROVED BY: *[Signature]*  
NEXT CAL DATE: 01/03/24

Model Number: MSE125P-100-DU Certificate No.: 23BCI0114  
Description: Semi-micro Balance Issued Date: Friday, March 03, 2023  
Serial Number: 0033108993 Reference No.: 204833  
ID No.: RYG\_EN0004  
Manufacturer: Sartorius Page No.: 1 of 3

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

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

Calibrated By: Mr. Choncha Inthana Calibration Procedure No.: This calibration was conducted by  
Using in-house calibration procedure number (WI-003).  
Calibration Date: Wednesday, March 01, 2023 Based on UKAS LAB 14: 2015

Metrological data: Capacity: 120 g Readability: 0.00001 g  
Reasons for calibration: ☐ New installation ☐ Service / Repair ☒ Re-calibration / Maintenance  
Ambient Conditions: Temperature: 24.0 °C ± 5.0 °C  
Humidity: 63.0 % RH ± 10.0 % RH  
Pressure: ±

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

## Traceability:

Model Number	Description	Traceability	Certificate No	Due Date
YC0011-522-00	Sartorius weight set 1mg - 5000g E2 YC0011-522-00	SPC-RT	C02212555	14-Sep-2023
MHB-382SD	Humidity/Barenometer/Temp. Lubon MHB-382SD	DKSH	C18220444	5-Sep-2023

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

*[Signature]*  
Mr. Choncha Inthana (Technical Manager)

SOP FM 33 03 February 2022



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Tel: +66 2643 8381-6 Fax: +66 2643 8387 e-mail: service.thailand@sartorius.com

SARTORIUS

# Certificate of Calibration

Model Number: MSE125P-100-DU Certificate No.: 23BCI0114  
Description: Semi-micro Balance Issued Date: Friday, March 03, 2023  
Serial Number: 0033108993 Reference No.: 204833  
ID No.: RYG\_EN0004  
Manufacturer: Sartorius Page No.: 2 of 3

## Calibration Results: Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.	The eccentricity loading error is noticed by the difference between the result of the load, i.e. 1/5 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).
Nominal Value: (Low Load) 5.00001 g Tolerance: 0.000015 g	Nominal value: 50 g Tolerance: 0.00015 g
Nominal Value: (High Load) 50 g Tolerance: 0.00015 g	Difference: 1, 2, 3, 4, 5, 6
Standard Deviation: 0.000007	

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance 0.00004 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.01000	0.01000	0.00000	0.000026
0.1	0.10000	0.10000	0.00000	0.000026
1	1.00000	1.00000	0.00000	0.000026
2	2.00000	2.00000	0.00000	0.000026
5	5.00000	5.00001	+0.00001	0.000026
10	10.00000	10.00000	0.00000	0.000026
20	20.00000	20.00000	0.00000	0.000026
30	30.00000	30.00000	0.00000	0.000026
40	40.00000	40.00000	0.00000	0.000026
50	50.00000	50.00000	0.00000	0.000026

SOP FM 33 03 February 2022

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129 Nam 5 Road, Huaywang, Huaywang, Bangkok 10310  
Tel: +66 2643 8381-6 Fax: +66 2643 8387 e-mail: service.thailand@sartorius.com

SARTORIUS

# Certificate of Calibration

Model Number: MSE125P-100-DU Certificate No.: 23BCI0114  
Description: Semi-micro Balance Issued Date: Friday, March 03, 2023  
Serial Number: 0033108993 Reference No.: 204833  
ID No.: RYG\_EN0004  
Manufacturer: Sartorius Page No.: 3 of 3

## Calibration Results: Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.	The eccentricity loading error is noticed by the difference between the result of the load, i.e. 1/5 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).
Nominal Value: (Low Load) 100.0000 g Tolerance: 0.000015 g	Nominal value: 50 g Tolerance: 0.00015 g
Nominal Value: (High Load) 100 g Tolerance: 0.000015 g	Difference: 1, 2, 3, 4, 5, 6
Standard Deviation: 0.000003	

Linearity					
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.					
Tolerance		0.0001 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	
65	65.0000	65.0000	0.0000	0.00015	
70	70.0000	70.0000	0.0000	0.00015	
75	75.0000	75.0000	0.0000	0.00016	
80	80.0000	80.0000	0.0000	0.00017	
85	85.0001	85.0001	0.0000	0.00019	
90	90.0001	90.0001	0.0000	0.00018	
95	95.0001	95.0001	0.0000	0.00020	
100	100.0000	100.0000	0.0000	0.00024	
110	110.0000	110.0000	0.0000	0.00026	
120	120.0000	120.0000	0.0000	0.00026	

SOP FM 33 03 February 2022

End of Report

## Certificate of System Qualification

GC-02

System ID: CN11481066  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Soi 40 Phatthanekarn Rd Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250

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

CDS Logon Verification - GC

Logon: Saengutai Tarak

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front: SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: -0.1 psi /5 minutes

Agilent Recommended:  $\geq -2.0$  and  $\leq 0.5$ 

Date: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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## Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7860

Front: SSL

Setpoint Status: Pass

Setpoint: 25.0 psi

Actual: 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended:  $\leq 1.2$ 

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7860

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

Date: April 21, 2023 3:26:35 PM  
System ID: CN11481066

Page 2 / 23

Setpoint Status: Pass

Setpoint: 25.0 psi

Actual: 24.8 psi

Accuracy: 0.2 psi

Agilent Recommended:  $\leq 1.2$ 

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Front: FID

Setpoint Status: Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min

Measured Flow: 29.9 mL/min

Accuracy: 1.1 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: 400 mL/min

Accuracy: 0.0 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: 24.9 mL/min

Accuracy: 0.1 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.

Date: April 21, 2023 3:26:38 PM  
System ID: CN11481066

Page 3 / 23

## Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Back: FID

Setpoint Status: Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min

Measured Flow: 30.7 mL/min

Accuracy: 3.7 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: 399 mL/min

Accuracy: 1.0 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: 24.6 mL/min

Accuracy: 0.4 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: 7800

Date: April 21, 2023 3:26:36 PM  
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Setpoint Status: **Pass**

Zone: **Oven**

Temperature: **230.0** **230.6** °C

Accuracy: **0.6** °C

Agilent Recommended: **>= -1.0** % setpoint in K **( -5.0 °C )**  
**<= 1.0** % setpoint in K **( 5.0 °C )**

Setpoint Status: **Pass**

Zone: **Oven**

Temperature: **100.0** **100.9** °C

Accuracy: **0.9** °C

Agilent Recommended: **>= -1.0** % setpoint in K **( -3.7 °C )**  
**<= 1.0** % setpoint in K **( 3.7 °C )**

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: **7890**

Setpoint Status: **Pass**

Temperature: **100.0** **100.8833** °C

Stability: **0.1** °C

Agilent Recommended: **<= 0.5** °C

## Overall GC Oven Temperature Stability Test Status

Pass

## Scouting Run

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

Name: **7693A**

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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: **7690**

Setpoint Status: **Pass**

Base Signal: **22.7** pA

ASTM Noise: **0.06** pA

Drift: **0.05** pA/hr

Agilent Recommended: **<= 10.10** pA **<= 2.50** pA/hr

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

## Overall Noise and Drift Test Status

Pass

## Injection Precision

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

Name: **7693A**

Setpoint Status: **Pass**

Injection Volume on Column: **1.0** µL

Area RSD: **0.32** %

Retention Time RSD: **0.67** %

Agilent Recommended: **<= 3.00** % **<= 1.00** %

## Overall Injection Precision Test Status

Pass

## Signal to Noise

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

Name: **7890**

Setpoint Status: **Pass**

Signal to Noise: **721755**

Agilent Recommended: **>= 300000**

## Overall Signal to Noise Test Status

Pass

## Scouting Run

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

Name: **7693A**

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: **22.6** pA

ASTM Noise: **0.07** pA

Drift: **0.09** pA/hr

Agilent Recommended: **<= 10.10** pA **<= 2.50** pA/hr

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

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## Overall Noise and Drift Test Status

Pass

## Injection Precision

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

Name: **7693A**

Setpoint Status: **Pass**

Injection Volume on Column: **1.0** µL

Area RSD: **1.28** %

Retention Time RSD: **0.83** %

Agilent Recommended: **<= 3.00** % **<= 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: **2404398**

Agilent Recommended: **>= 300000**

## Overall Signal to Noise Test Status

Pass

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## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### System

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

#### Tested Combination1

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

#### Tested Combination2

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

#### Sampler 1

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN15360030
Firmware Revision	A.11.0.1
Vial Heater	Not installed

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#### Sampler 2

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16280128
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	G4512A
Serial Number	CN10340103
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10

#### Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
Oven Type	Standard

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#### Inlet 1

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

#### Inlet 2

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

#### Detector 1

Manufacturer	Agilent Technologies
Name	7890
Type	FID
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

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

### Details

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

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System ID: CN11461066

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User Name: saangultharak  
Host Name: LAPTOP-GQ2SK0GV  
System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

## GC4\_BKH\_ENH127\_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:21:06 AM	Start	Session/Check	Session	None
April 21, 2023 11:21:06 AM	Start	Configuration	Session	None
April 21, 2023 11:21:06 AM	Start	Entitlement	Licensing	User is Nonpaying and does not require entitlement
April 21, 2023 11:22:34 AM	Start	EqLoaded	Session	EQP details for primary Hydrogen (H2) - Fix path: (Protocol)Pact/QC/Config/Int02.SI(05.02.30.m3) EQP File Name: (QC.02.SI.asa), EQP Name: (AgilentRecommend2).Photo cal Revision: (GC.02.35)
April 21, 2023 11:33:06 AM	End	Configuration	Session	None
April 21, 2023 11:32:14 AM	Start	Qualification	Session	OO
April 21, 2023 11:32:14 AM	Start	Execution	CD5 Logon Verification - GC - Qualitative Test	None
April 21, 2023 11:32:14 AM	End	Execution	CD5 Logon Verification - GC - Qualitative Test	Run Count: 1
April 21, 2023 11:33:16 AM	Start	Execution	System Inspection and Back Safety and Operation - 7890 - Qualitative Test - No response associated	None
April 21, 2023 11:33:35 AM	End	Execution	System Inspection and Back Safety and Operation - 7890 - Qualitative Test - No response associated	Run Count: 1
April 21, 2023 11:23:37 AM	Start	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 0.0 psi and <= 0.5 psi	None

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

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User Name: saangultharak  
Host Name: LAPTOP-GQ2SK0GV  
System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

## GC4\_BKH\_ENH127\_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:24:01 AM	End	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 0.0 psi and <= 0.5 psi	Run Count: 1
April 21, 2023 11:24:04 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
April 21, 2023 11:24:09 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
April 21, 2023 11:24:11 AM	Start	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 0.0 psi and <= 0.5 psi	None
April 21, 2023 11:24:15 AM	End	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= 0.0 psi and <= 0.5 psi	Run Count: 1
April 21, 2023 11:24:51 AM	End	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
April 21, 2023 11:24:53 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:20 AM	Start	Data	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:25 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1

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Date: April 21, 2023 3:26:38 PM  
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User Name: saangultharak  
Host Name: LAPTOP-GQ2SK0GV  
System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

## GC4\_BKH\_ENH127\_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:25:23 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:25:43 AM	Start	Data	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:42 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:25:44 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:01 AM	Start	Data	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:04 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:05 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:19 AM	Start	Data	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:22 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:24 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:26:38 AM	Start	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: April 21, 2023 3:26:38 PM  
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User Name: saangultharak  
Host Name: LAPTOP-GQ2SK0GV  
System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

## GC4\_BKH\_ENH127\_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:26:43 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:26:45 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
April 21, 2023 11:27:01 AM	Start	Data	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
April 21, 2023 11:27:05 AM	End	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
April 21, 2023 11:27:07 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature (Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0% setpoint in K	None
April 21, 2023 11:27:33 AM	Start	Data	GC Oven Temperature Accuracy - 7890 - Temperature (Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0% setpoint in K	Manual Data Entry
April 21, 2023 11:27:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature (Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0% setpoint in K	Run Count: 1
April 21, 2023 11:27:37 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature (Oven - S: 190.0°C - L: >= +1.0 AND <= 1.0% setpoint in K	None
April 21, 2023 11:27:54 AM	Start	Data	GC Oven Temperature Accuracy - 7890 - Temperature (Oven - S: 190.0°C - L: >= +1.0 AND <= 1.0% setpoint in K	Manual Data Entry

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User Name: seungghal.tarak  
Hostname: LAPTOP-GQ35KQWV

System ID: CN11461066  
Print Date: April 21, 2023 3:26:43 PM

## GC-6\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:27:57 AM	End	Execution	GC Oven Temperature Accuracy - 7530 - Temperature Oven - S: 102.0°C - L: > +1.0 AND <+ 1.0 % setpoint in K	Run Count: 1
April 21, 2023 11:27:59 AM	Start	Execution	GC Oven Temperature Stability - 7802 - Temperature - Oven - S: 100.0°C - L: <+ 0.5°C	None
April 21, 2023 11:28:07 AM	Audit	Data	GC Oven Temperature Stability - 7802 - Temperature - Oven - S: 100.0°C - L: <+ 0.5°C	Manual Data Entry
April 21, 2023 11:28:19 AM	End	Execution	GC Oven Temperature Stability - 7802 - Temperature - Oven - S: 100.0°C - L: <+ 0.5°C	Run Count: 1
April 21, 2023 11:29:19 AM	Start	Preparation	GC Solving Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:30:27 AM	Audit	Data	GC Solving Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:31:04 AM	End	Execution	GC Solving Run - Injection Tower, Front SSI, Front FID - Part of System Preparation - No limits associated	Run Count: 1
April 21, 2023 11:31:07 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <+ 0.10 pA - L (Drift) <+ 2.50 pA/hour	None

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User Name: seungghal.tarak  
Hostname: LAPTOP-GQ35KQWV

System ID: CN11461066  
Print Date: April 21, 2023 3:26:43 PM

## GC-6\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:31:43 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:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:32:00 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <+ 0.10 pA - L (Drift) <+ 2.50 pA/hour	Run Count: 1
April 21, 2023 11:32:03 AM	Start	Execution	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	None
April 21, 2023 11:32:23 AM	Start	Execution	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	None
April 21, 2023 11:32:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch

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User Name: seungghal.tarak  
Hostname: LAPTOP-GQ35KQWV

System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

## GC-6\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:33:58 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:35:00 AM	End	Execution	Injection Precision - Injection Tower, Front SSI, Front FID - GC - L (Area) <+ 3.00% - L (Ret. Time) <+ 1.00%	Run Count: 1
April 21, 2023 11:35:04 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSI, Back FID - Detector FID - L >+ 30000	None

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

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User Name: seungghal.tarak  
Hostname: LAPTOP-GQ35KQWV

System ID: CN11461066  
Print Date: April 21, 2023 3:26:43 PM

## GC-6\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:35:28 AM	Audit	Data	Signal to Noise - Injection Tower, Back SSI, Back FID - Detector FID - L >+ 30000	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:36:09 AM	End	Execution	Signal to Noise - Injection Tower, Back SSI, Back FID - Detector FID - L >+ 30000	Run Count: 1
April 21, 2023 11:36:03 AM	Start	Execution	GC Solving Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:36:36 AM	Audit	Data	GC Solving Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	Data File Path: C:\Users\Public\Documents\CrossLab\GC-6_BKK_EN0127_ALS_2023-04-20_14-36-08\FID1.D\FID1A.ch
April 21, 2023 11:37:59 AM	End	Execution	GC Solving Run - Injection Tower, Back SSI, Back FID - Part of System Preparation - No limits associated	Run Count: 1
April 21, 2023 11:37:52 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: April 21, 2023 3:26:38 PM  
System ID: CN11461066

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User Name: saengthaiarak  
Hostname: LAPTOP-Q255KGMV

System ID: CN1461066  
Print Date: April 21, 2023 3:26:43 PM

## GC4\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:38:55 AM	Auto	Date	Noise and Drift - Back FID -> Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:38:55 AM	End	Execution	Noise and Drift - Back FID -> Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1
April 21, 2023 11:38:55 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None
April 21, 2023 11:38:55 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None
April 21, 2023 11:40:17 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:40:17 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D

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Date: April 21, 2023 3:26:38 PM  
System ID: CN1461066

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User Name: saengthaiarak  
Hostname: LAPTOP-Q255KGMV

System ID: CN1461066  
Print Date: April 21, 2023 3:26:43 PM

## GC4\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:40:17 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:40:17 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:40:21 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:40:21 AM	Auto	Date	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:41:29 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID -> GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Run Count: 1
April 21, 2023 11:41:33 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID -> Detector FID - L <= 300000	None

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Date: April 21, 2023 3:26:38 PM  
System ID: CN1461066

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User Name: saengthaiarak  
Hostname: LAPTOP-Q255KGMV

System ID: CN1461066  
Print Date: April 21, 2023 3:26:43 PM

## GC4\_BKK\_EN0127\_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:42:22 AM	Auto	Date	Signal to Noise - Injection Tower, Back SSL, Back FID -> Detector FID - L <= 300000	Data File Path: C:\Users\PuK\Documents\CrossLab\GC4_BKK_EN0127_ALS_2023-04-20\GC4_2023_Fra 2023-04-20_14-35-05\GC4_2023_Fra 2023-04-20_14-35-05.D\FID.D\FID.D
April 21, 2023 11:42:50 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID -> Detector FID - L <= 300000	Run Count: 1
April 21, 2023 11:42:53 AM	End	Qualification	Session	GO
April 21, 2023 11:42:53 AM	Start	Reporting	Session	None
April 21, 2023 12:01:47 PM	Auto	AcqDisc2	Session	None
April 21, 2023 12:06:07 PM	Auto	AcqRestarted	Session	None
April 21, 2023 12:16:10 PM	Auto	SessionReleased	Session	None
April 21, 2023 12:16:31 PM	Start	Qualification	Session	GO
April 21, 2023 12:20:59 PM	Auto	AcqRestarted	Session	None
April 21, 2023 12:21:00 PM	Auto	SessionReleased	Session	None
April 21, 2023 12:21:07 PM	Start	Qualification	Session	GO
April 21, 2023 12:25:45 PM	Auto	Reporting	Session	Report Generated: Certificate

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Date: April 21, 2023 3:26:38 PM  
System ID: CN1461066

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# SITHIPHORN 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@sithiphorn.com http://www.sithiphorn.com



NSC-TISI-TIS 17025  
CALIBRATION 0354  
Cert. No.: ACC23809  
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 : 24 JANUARY 2023  
Calibration Date : 26 JANUARY 2023  
Date of Issue : 27 JANUARY 2023

Calibrated by : Nadehom Pinitpassan

Approved by :   
( Thunakul Petchurai )

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

Continuation of Calibration Certificate

Cert. No. : ACC23009  
Job No. : VC66AC0031  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	FEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	FEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	FEL.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. Petchur

Continuation of Calibration Certificate

Cert. No. : ACC23009  
Job No. : VC66AC0031  
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.16	0.16	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1000	1003.2	0.3	0.1	1.0

3. Total distortion

Measured value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1.97	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

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



Cert. No. : ACL23043  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preampifier NH-24  
Serial No. : 0090072 / 188465 / 01734  
ID No. : RYG FS0493

Condition As Found : GOOD

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

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

Received Date : 06 JANUARY 2023  
Calibration Date : 13-18 JANUARY 2023  
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisarn

Approved by :

T. Petchur  
( Thanakul Petchur )

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	FEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	FEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	FEL.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. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 3 of 8

## Summary of Measurement Result :

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

QI-TS12-04-04-020064

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	22.9

## 3. Acoustical signal tests of frequency weightings

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

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

QI-TS12-04-04-020064

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QI-TS12-04-04-020064

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

QI-TS12-04-04-020064

Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, T <sub>b</sub> (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
SFL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

QT-TS12-04-04-020604

T. Petchum

Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	SIM Display at initial (dB)	SIM 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

QT-TS12-04-04-020604

T. Petchum

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

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



Cert. No. : ACL22183  
Pages : 1 of 8

Calibration Certificate

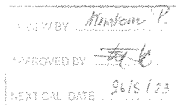
Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01072423 / 169513 / 73684  
ID No. : RYG.FS0386

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 25.0 ± 3 ) °C  
Pressure : ( 101.3 ± 2 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 22 AUGUST 2022  
Calibration Date : 26-31 AUGUST 2022  
Date of Issue : 02 SEPTEMBER 2022



Calibrated by : Nithakorn Pisutpaisan

Approved by : T. Petchum  
( Thanakul Petchum )

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QT-TS12-04-04-020604

SITHIPORN SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC66AC0077  
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

QT-TS12-04-04-020604

T. Petchum



## Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC65AC0077  
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	12.6
C - weight	18.6
Flat	24.5

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.3	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.5	1.5	1.6	±5.0

QF-1812-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC65AC0077  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±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
Leg	94.0	0.0	± 0.1

## 6. Long - term stability

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

QF-1812-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC65AC0077  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

QF-1812-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC65AC0077  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
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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Continuation of Calibration Certificate

Cert. No. : ACL22183  
Job No. : VC65AC0077  
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	127.0	127.0	0.0	±0.3

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

End of Calibration Certificate

QI-TS12-04-04-020604

551-451/1 Sathorn Rd, Banglumru, Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2431-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22235  
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\_TS0388

Condition As Found : GOOD

Customer : ALS 1 LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHUANG PHATTHANAKAN, KHEE SUAN TUANG,  
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 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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	MY53202742	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	MY60034273	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-42KA1	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).

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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

QI-TS12-04-04-020604

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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 )
15.1

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	18.0
Flat	23.7

3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.6	-0.5	-0.5	±5.0

QF-TS12-04-04-020664

T. Pich

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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	-0.1	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

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T. Pich

Continuation of Calibration Certificate

Cert. No. : ACL22235  
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	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
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. Pich

Continuation of Calibration Certificate

Cert. No. : ACL23235  
Job No. : VC66AC0088  
Pages : 8 of 8

11. Overload indication

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

QT-TS12-04-04-020664

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



Cert. No. : ACL23078  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NI-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, KHUET SUAN I UANG,  
BANGKOK, 10250 THAILAND.

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

Received Date : 24 JANUARY 2023  
Calibration Date : 25-26 JANUARY 2023  
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pichupaisan

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

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

QT-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220070	EEL-BP_05/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	LF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	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),

QT-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 3 of 8

Summary of Measurement Result :

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

QT-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.6

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

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

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.4	-0.3	-0.3	±5.0

QF-1512-04-04-020664

T. Petch...

## Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-1512-04-04-020664

T. Petch...

## Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 6 of 8

## 7. Level linearity on the reference level range

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

QF-1512-04-04-020664

T. Petch...

## Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	136.2	-0.2	±3.0

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

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T. Petch...

Continuation of Calibration Certificate

Cert. No. : ACL23078  
Job No. : VC66AC0031  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

451-451/11 Sindhon Rd., Banglamru, Bangkok 10700 THAILAND  
Tel:0-2433-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23323  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 + Preamplifier NH-24  
Serial No. : 00873057 / 171591 / 73333  
ID No. : RYG\_F56381

Condition As Found : GOOD

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

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

Received Date : 11 OCTOBER 2023  
Calibration Date : 19-20 OCTOBER 2023  
Date of Issue : 24 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurai*  
( Thannakul Petchurai )

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QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53720076	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

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

QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter.

will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
Pages : 4 of 8

## Result of calibration:

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limits ( dB )
93.9 (93.92)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
15.8

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

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

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.5	0.6	0.6	± 5.0

QH-TS12-04-04-020664

T. Petchan

## Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

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T. Petchan

## Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

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T. Petchan

## Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
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	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±3.0

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

QH-TS12-04-04-020664

T. Petchan

Continuation of Calibration Certificate

Cert. No. : ACL23323  
Job No. : VC67AC0011  
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

QT-TS12-04-04-020664

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



Cert. No. : ACL23079  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00296516 / IS0412 / R8182  
ID No. : RYG\_FS0433

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 46, PHATTHANAKAN ROAD,  
KHUANG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %  
Received Date : 24 JANUARY 2023  
Calibration Date : 25-26 JANUARY 2023  
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisapaisan

Approved by : T. Petchurai  
( Thanakul Petchurai )

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other than in full, except with the prior written approval of the head of Calibration Laboratory.

QT-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_040265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_030285	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL-BP_050265	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-42KA1	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).

QT-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 3 of 8

Summary of Measurement Result :

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.5
Flat	23.3

## 3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 dB

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
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	29.8	-0.2	± 1.1
29.0	28.8	-0.2	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 8 of 8

## 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.5	89.7	0.2	±1.5

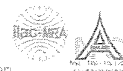
## 12. High level stability

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A-weight	137.0	137.0	0.0	±0.5

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

QT-TS12-05-04-00664

63/14-16,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.  
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Tel: (66) 02 8680812/13 Fax: (66) 02 8680860 www.jrnatco.com

## CERTIFICATE OF CALIBRATION

Certificate No. : CL-047-01  
Page 3 of 7Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15006126  
ID No: RYG\_FS022ECustomer:  
Name: AIS Laboratory Group (Thailand) Co., Ltd.  
Address: 104 Phoththamkarn Rd, Phoththamkarn Rd,  
Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 ThailandReceived date: 21 Feb 2023  
Calibration date: 27 Feb 2023  
Issue date: 28 Feb 2023Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-160 A500  
Serial No: 667682-09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DII-1000-A MK  
II, Serial No: 671407-00091, Due date: 22 Jun 2023Calibration Condition  
Temperature: (23±0.1)°C  
Relative Humidity: (65±1)%Calibration Procedure  
The temperature calibration was done by In-House  
calibration method as WI-CI-001 according to  
comparison method with standard digital temperature  
indicator and standard temperature probe. The  
temperature scale use was based on ITS-90.Traceability  
The measurement results are traceable to the  
international system of units (SI) through National  
Institute of Metrology (Thailand) (NIMT) Certificate  
number: TT-0034-22, Certificate number: ER-0092-  
22Calibrated by  
J. Mr. Sarawat Thachalad  
P. Ms. Jitraporn LertsompholApproved Signatory  
Mr. Panyia Boemcharoen  
Calibration Department ManagerTHIS CERTIFICATE MAY NOT BE REPRODUCED EXCEPT BY FULL WRITTEN PERMISSION FOR REPRODUCTION HAS  
BEEN OBTAINED IN WRITING FROM THE LABORATORY63/14-16,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.  
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Tel: (66) 02 8680812/13 Fax: (66) 02 8680860 www.jrnatco.comCertificate No. : CL-047-01  
Page 2 of 2Result of Calibration: ☒ Without Adjustment ☐ With AdjustmentCalibration Range: 20 ~ 40 °C  
Function:Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15015941  
Dimension: Diameter 14 mm, Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.052	20.0	0.1	0.099
60	25.052	25.0	0.1	0.099
60	30.055	30.0	0.1	0.099
60	35.049	35.0	0.0	0.099
60	40.041	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3201.2 S/N: 15015944  
Dimension: Diameter 14 mm, Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.052	20.0	0.1	0.099
70	25.056	25.0	0.1	0.099
70	30.055	29.9	0.2	0.099
70	35.048	34.6	0.3	0.099
70	40.041	39.7	0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3201.2 S/N: 20006982  
Dimension: Diameter 8 mm, Length 170 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.052	20.0	0.1	0.099
110	25.056	25.1	0.0	0.099
110	30.055	30.1	0.0	0.099
110	35.046	35.1	0.1	0.099
110	40.041	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 \*

63/14-16,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.  
Wattana, Bangkoknoi, Bangkok 10600 Thailand  
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## CERTIFICATE OF CALIBRATION

Certificate No. : CL-017-01  
Page 1 of 2Equipment Name: Heat Stress Monitor  
Manufacturer: Delta OHM  
Model: HD32.2  
Serial No: 15008715  
ID No: RYG\_FS0220Customer:  
Name: AIS Laboratory Group (Thailand) Co., Ltd.  
Address: 104 Phoththamkarn Rd, Phoththamkarn Rd,  
Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 ThailandReceived date: 23 Jan 2023  
Calibration date: 03 Feb 2023  
Issue date: 05 Feb 2023Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-100 A500  
Serial No: 667682-09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DII-1000-A MK  
II, Serial No: 671407-00091, Due date: 22 July 2023Calibration Condition  
Temperature: (23±0.1)°C  
Relative Humidity: (65±1)%Calibration Procedure  
The temperature calibration was done by In-House  
calibration method as WI-CI-001 according to  
comparison method with standard digital temperature  
indicator and standard temperature probe. The  
temperature scale use was based on ITS-90.Traceability  
The measurement results are traceable to the  
international system of units (SI) through National  
Institute of Metrology (Thailand) (NIMT) Certificate  
number: TT-0034-22, Certificate number: ER-0092-  
22Calibrated by  
J. Mr. Sarawat Thachalad  
P. Ms. Jitraporn LertsompholApproved Signatory  
Mr. Panyia Boemcharoen  
Calibration Department ManagerTHIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT BY FULL WRITTEN PERMISSION FOR REPRODUCTION HAS  
BEEN OBTAINED IN WRITING FROM THE LABORATORY



63/14-15,67/35-36, Soi Petchkasem 7,7/1, Petchkasem Rd,  
Wattana, Bangkok, Bangkok 10650 Thailand  
Tel. (66) 02-6686812/13 Fax. (66) 02-6686860 www.jiraprasit.com



Cert.No. : CL 017 66  
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: HP301.2 S/N: 17022683.  
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.062	20.0	0.1	0.056
60	25.054	25.0	0.1	0.056
60	30.046	30.0	0.0	0.056
60	35.034	35.0	-0.1	0.16
60	40.018	39.5	0.1	0.056

Table 2: This equipment was connected with temperature probe Model: TP307.2 S/N: 15615507  
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.061	20.0	0.1	0.056
70	25.053	25.1	0.0	0.056
70	30.043	30.0	0.0	0.056
70	35.031	35.0	0.0	0.056
70	40.014	39.5	-0.1	0.056

Table 3: This equipment was connected with Glass thermometer probe Model: TP3276.2 S/N: 20019652  
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.061	20.0	-0.1	0.056
110	25.055	25.1	0.0	0.056
110	30.054	30.1	0.0	0.10
110	35.032	35.1	0.1	0.056
110	40.011	40.1	0.1	0.056

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND)-JAPAN  
CORPORATE SERVICES, EQUIPMENT CALIBRATION AND TESTING SERVICES  
SALUTATION KARN RUDHOM, 25, ANUANG, ANUANG, ANUANG, ANUANG  
TEL: 02-277-0000, FAX: 02-277-0001



Cert.No.: 22CH1733  
Page: 1 of 3

## Certificate of Calibration

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenExcellence  
Serial No.: BB34291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used item

Received Date: 21 December 2022  
Calibration Date: 22 December 2022  
Reference: 2212-0602D5C-1

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
618/10 Moo 5 T. Maenam Khu.  
A. Phakdeong Rayong 21140, Thailand

Ambient Temperature: (25 ± 2.5) °C  
Relative Humidity: (50 ± 10) %  
Calibration Procedure: In-house method

- GP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- GP-CH5 by comparison with standard thermometer

Calibrated by: Warakorn Lemgagtrakul

Approved by:   
Approved Signatory

( ) Malee Bulkruea  
( ) Sathip Meangmae  
( ) Warakorn Lemgagtrakul

Issue Date: 26 December 2022

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

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Approved by the Board of Corporate Services, Equipment Calibration and Testing Service

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Cert.No.: 22CH1733  
Page: 2 of 3

### Condition of this calibration result

#### 1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2763	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211308	27 Oct 2023

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

#### 2. Certified Reference Materials

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

#### Buffer Solution

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.006	CPA chem	826586	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826580	08 July 2023

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

### Calibration Results

Function: mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N: BB34291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.056	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 22CH1733  
Page: 3 of 3

### Calibration Results

Function: pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N: 1475516	4.006	4.011	185.2	0.0052	2.06
	6.987	6.987	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

### Function: Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe:

- Model: InLab Expert Pro-ISM  
- Serial No.: 1475516

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	25.001	24.9	-0.101	0.13	2.00

Remark: - UUC\* = Unit Under Calibration

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

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a 1141167

a 1141166



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3 EQUIPMENT CALIBRATION AND TESTING SERVICES  
534 PATTANAKARN ROAD SURIN SAENLANG, NIAENLUNG, BANGKOK 10250  
TEL: 0-2517-3999-24 FAX: 0-2514-9481



## Certificate of Calibration

Certificate No.: 22E4808  
Page: 1 of 2

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenExcellence  
Serial No.: 8834291443  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 21 December 2022  
Calibration Date: 22 December 2022  
Reference: 7012-05000SC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 55 ± 10 ) %

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except with the prior written approval of the head of  
Corporate Services 3 Equipment Calibration and Testing Services

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

Procedure used: Calibration was 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.	Exp. Date
1) Multi-Product Calibrator	5500A	6015011	22E1431	05 May 2023

2) The result of calibration was made on request at the point specified by customer

3) The certificate is valid only to the item calibrated on date and place of calibration

4) This Calibration is traceable to the International System of Unit maintained at:  
National Institute of Metrology Thailand (NIMT)

Calibrated by: Wutthareung Wongsukhikine  
Issue Date: 22 December 2022

Approved Signatory:

(Signature)  
: J. Nuntawit Khamech  
: J. Pongthapa Tanayakul

0304803



Cert. No.: 22E4808  
Page: 2 of 2

### Result of calibration: ( ) Without adjustment ( ) After adjustment

Function:	DC voltage measurement	Range:	2000	mV	
	Standard Value	UUC Reading	Error	Uncertainty	
	( mV )	( mV )	( mV )	( ± μV )	
	-200.0000	-200.0	0.0	72	
	-150.0000	-150.0	0.0	69	
	-100.0000	-100.0	0.0	65	
	-50.0000	-50.0	0.0	62	
	0.0000	0.0	0.0	58	
	50.0000	50.0	0.0	62	
	100.0000	100.0	0.0	65	
	150.0000	150.0	0.0	69	
	200.0000	199.9	-0.1	72	

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

\*UUC= Unit Under Calibration.

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1140616



## Certificate of Calibration

Equipment: SPECTROPHOTOMETER  
Model: DR8000  
Serial No. (or ID.): 1627645 (RYG\_EN0037)  
Manufacturer: HACH  
Condition: In Condition  
Customer: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Phrakdaeng, Rayong 21140, Thailand.  
Environment Condition: Temperature 23.9 °C ± 0.2  
Humidity 65.3 %RH ± 1.4  
Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch) (Wet Chemistry)  
616/10 Moo 5 T. Maenam Khu,  
A. Phrakdaeng, Rayong 21140, Thailand.  
Calibration By: Mr. Nattapat Rungruang  
Calibration Date: 18 September 2023  
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04  
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.

REVIEW BY: (Signature)  
APPROVED BY: (Signature)  
NEXT CAL DATE: 08/12/25

(Mr. Nattapat Rungruang)  
Person in charge

(Mr. Nidun Sritawan)  
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 standards 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 listed, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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CAL-FM-C05-15 12 Sep 2022



Certificate No.: C08230441 Page 2 of 3

### Calibration Results:

#### Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.3	0.31	0.13	
536.66	536.6	0.06	0.13	
637.98	638.3	-0.32	0.13	
748.48	748.7	-0.22	0.13	
807.03	807.4	-0.37	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.468	-0.0008	0.0045
	0.9488	0.946	0.0028	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2584	0.259	-0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2679	0.257	0.0009	0.0045
	0.4671	0.497	-0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

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CAL-FM-C05-15 12 Sep 2022



Certificate No.: C06230441 Page 3 of 3

### 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
	0.7355	0.737	-0.0015	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2864	0.290	-0.0038	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard cut-off	UUC Wavelength (nm)	UUC Transmission (%T)	Absorbance (A)	
260 G2 +/- 0.11 nm	266.6	1.3	1.886	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	BSW
Standard Wavelength ( nm )	268.65	266.69	1.38	2.00
UUC Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4566	0.2750		
Absorbance (A)	0.413	0.306		

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

The End of Certificate

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Thailand 10260  
Phone: +66 2275 9200 Email: info@dksh.com Website: www.dksh.com/thailand  
Delivering Growth - In Asia and Beyond

CAL-FM-GRE-15-12 Sep 2022



### ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
16 Sep 2023			18 Sep 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายในนอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Spectrophotometer					
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ลำหนวนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แสงอัลตราไวโอเลต (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	9.2 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็น (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	741.6 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่หลอดตัวอย่าง (Cuvet Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
pH Meter and Conductivity Meter					
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับการละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
Turbidimeter					
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการกรองตัวอย่างของเครื่อง (>= 2.5 ไมครอน 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"/>	

เงื่อนไข/ข้อแนะนำ: \*656.1nm=656.1nm

\*486.0nm=485.5nm

Mr.Nattapat Rungueang  
Service Engineer

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Thailand 10260  
Phone: +66 2275 9200 Email: info@dksh.com Website: www.dksh.com/thailand  
Delivering Growth - In Asia and Beyond

CAL-FM-R31-03: 20 Jul 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUAN LUANG BANGKOK 10250  
TEL 0-2717-3000 FAX 0-2719-9424

Cert.No.: 23TW165  
Page.: 1 of 2

### Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No : 15E102795  
ID No : RYG\_END032  
Received Date : 21 July 2023  
Test Date : 24 July 2023  
Reference : 2307-0713DSO-1  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5, T.Maenam Khu. A.Pluakdaeng,  
Rayong 21140, Thailand  
Laboratory Condition : Temperature (25 ± 5) °C  
Humidity (50 ± 20) %  
Test Procedure : In-house method : CP-CHB  
by Comparison Technique with Azide Modification Method  
Tested by : Walailak Sirithuan  
Approved by :   
Approved Signatory  
( ) Meelee Butkrues  
(✓) Seithip Maengmai  
( ) Werakom Lemagtrakul

Issue Date : 25 July 2023

U 0320211



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

### Condition of this result of calibration

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143784	140RC004	22MM50	20 Sep 2023

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %  
Dissolved Oxygen Probe No : IDE100404

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
54/1 PATTANAKARN ROAD NORTH MOUANG MAE, NONG BUA BANGKHOE DISTRICT  
TEL: 02577 4001-2 FAX: 02577 4004



Cert. No.: 23LM126  
Page: 1 of 2

## Certificate of Calibration

Equipment : DC Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102706  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu. A. Phraksaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 25 July 2023  
Calibration Date : 27 July 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Preedha Hathi

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Bulkruea  
(x) Suwit Imjai

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%  
(This certificate may not be reproduced or copied in full except as per the permission)  
Approved by the Board of Corporate Services & Equipment Calibration and Testing Services

4 0053616



Equipment : DC Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2307-0713DSC-2

Cert. No.: 23LM126  
Page: 2 of 2

### Procedure Used :-

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

### Condition of this result of calibration

#### 1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	21B0060	2211285	TPA	21 Oct 2023

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

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1226475367

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

UUC\* : Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
54/1 PATTANAKARN ROAD NORTH MOUANG MAE, NONG BUA BANGKHOE DISTRICT  
TEL: 02577 4001-2 FAX: 02577 4004



Cert. No.: 23TM992  
Page: 1 of 3

## Certificate of Calibration

Equipment : Low Temp. Incubator  
Manufacturer : Memmert  
Model : IPP750  
Serial No. : V818 0054  
ID No. : RYG\_EN0154  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
616/10 Moo 5 T. Maenam Khu. A. Phraksaeng, Rayong 21140 Thailand  
BOD Room  
Location :  
Received Order : 29 May 2023  
Calibration Date : 29 May 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Man Pattansongpaiboon

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Bulkruea  
(x) Suwit Imjai

Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%  
(This certificate may not be reproduced or copied in full except as per the permission)  
Approved by the Board of Corporate Services & Equipment Calibration and Testing Services

4 0054967



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0899OC-2

Cert. No.: 23TM992  
Page: 2 of 3

### Procedure Used :-

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

### Condition of this result of calibration

#### 1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

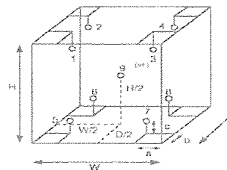
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

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



Probe Installation Details :  
a = 10 cm  
b = 10 cm  
c = 10 cm  
Dimension of Chamber :  
D = 0.60 m  
W = 1.0 m  
H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

Position	Ref. Std. ID No.
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	16-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

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Equipment : Low Temp. incubator  
 Condition As-Received : Used Item  
 Reference : 2305-0860CC-2  
 Result of Calibration : ( ° ) Without Adjustment  
 Function of UUC : Temperature Source  
 Fresh air setting : Close

Cert. No.: 23TM992  
 Page: 3 of 3

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

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (°C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.523	19.408	20.139	20.112	20.405	20.116	0.30

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

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

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RYG\_EN0002

Sartorius (Thailand) Co., Ltd.  
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
 Tel : +66 2643 6361-5, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

REVIEW BY: *Thantol*  
 APPROVED BY: *Thantol*  
 NEXT CAL DATE: 01/05/2024

Model Number : MSE224S-100-DU  
 Description : Analytical Balance  
 Serial Number : 0026207038  
 ID No : RYG\_EN0002  
 Manufacturer : Sartorius  
 Certificate No. : 23BCI0112  
 Issued Date : Friday, March 03, 2023  
 Reference No. : 204833  
 Page No. : 1 of 2

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

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

Calibrated By : Mr. Chenchai Inthana  
 Calibration Date : Wednesday, March 01, 2023  
 Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14, 2019

Metrological data :  
 Capacity : 220 g Readability : 0.0001 g  
 Reasons for calibration : ☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance  
 Equipment Condition : ☒ Good Operation ☐ Fair

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

Model Number	Description	Traceability	Certificate No.	Due Date
YC5011-522-00	Sartorius weight set 1mg - 5000g E2 YC5011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-362SD	Humidity/Balometer/Temp. Lutron MHB-362SD	DKSH	C19220444	5-Sep-2023

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

*Chenchai Inthana*  
 M/ Chenchai Inthana (Technical Manager)



SOP FM 32 03 February 2022

Sartorius (Thailand) Co., Ltd.  
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
 Tel : +66 2643 6361-5 Fax : +66 2643 6357, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU  
 Description : Analytical Balance  
 Serial Number : 0026207038  
 ID No : RYG\_EN0002  
 Manufacturer : Sartorius  
 Certificate No. : 23BCI0112  
 Issued Date : Friday, March 03, 2023  
 Reference No. : 204833  
 Page No. : 2 of 2

#### Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical results under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.					
Nominal Value (Low Load)	20.0000	199.9999	Nominal value	100	g
20 g	20.0000	200.0002	Tolerance	0.0004	g
Tolerance	20.0000	199.9999			
0.0001 g	20.0000	200.0000			
20.0000	20.0000	199.9999			
Nominal Value (High Load)	20.0000	199.9999			
200 g	199.9999	200.0000			
Tolerance	20.0000	200.0000			
0.0001 g	20.0000	199.9999			
20.0000	20.0000	199.9999			
Standard Deviation	0.00003	0.00003			

Linearity  
 The linearity is the ability of a weighing instrument to display nearly identical results under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express linearity quantitatively.

Tolerance 0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
50	50.0000	50.0000	0.0000	0.00014
100	100.0000	99.9999	-0.0001	0.00014
200	200.0000	200.0000	0.0000	0.00014

End of Report

SOP FM 32 03 February 2022

RYG\_EN0010



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
 301 TATTA NAKHON ROAD IN NAKHON RATCHASIMHA PROVINCE, THAILAND 30000  
 TEL: 0 2720 5867-7 FAX: 0 2720 6841



Cert. No.: 23TM1517  
 Page: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven  
 Manufacturer : Memmert  
 Model : UFE 500  
 Serial No. : G511.1572  
 ID No. : RYG\_EN0010  
 Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
 616/10 Moo 5 T. Maenam Khu. A. Pluekdaeng, Rayong 21140 Thailand  
 Location : Oven Room  
 Received Order : 20 October 2022  
 Calibration Date : 20 October 2022  
 Ambient Temperature : ( 28 ± 1 ) °C  
 Relative Humidity : ( 50 ± 30 ) %  
 Calibrated by : Man Pattanasongpaisoon

REVIEW BY: *Thantol*  
 APPROVED BY: *Thantol*  
 NEXT CAL DATE: 30/09/2024

Approved by : *Thantol*  
 Approved Signatory

( ) Pornthippa Tameysakul  
 ( ) Males Butkruas  
 ( ) Suwit Injai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95 %

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 Sartorius (Thailand) Co., Ltd.

A 0046908



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-2  
 Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) 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	34872A	MY49023832	22LM07	28 Jul 2023

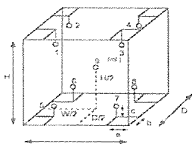
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



#### Probe Installation Details : 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>	

Environment during calibration		
	Beginning	Finished
Temp ( °C )	25	25
REL Humid. ( % )	54	59
AC Supply ( Volt )	223	226

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

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Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-2  
 Procedure Used :-

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
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.89	1.2	1.1	2

Calibration Point ( °C )		Measured Temperature ( °C )								
		Position								
		1	2	3	4	5	6	7	8	9 (ref.)
104.0		103.768	103.734	103.723	103.600	104.215	104.131	104.132	103.740	103.747
180.0		179.723	179.309	179.439	179.499	180.351	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 excludes 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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RYG\_EN0006



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
 540 PATTANA MAHAROD ROAD 9TH FLOOR UNIT 901 ANULASU RANGKONG 10150  
 TEL : 0 2115 9000 FAX : 0 2115 9007



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

## Certificate of Calibration

Equipment : Hot Air Oven  
 Manufacturer : Memmert  
 Model : UM 400  
 Serial No. : b495 0699  
 ID No. : RYG\_EN0006  
 Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
 616/10 Moo 5, T. Maenam Khu,  
 A. Phukdaeng,  
 Rayong 21140, Thailand  
 Location : Oven Room  
 Received Order : 20 October 2022  
 Calibration Date : 26 October 2022  
 Ambient Temperature : ( 26 ± 10 ) °C  
 Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Preecha Hianth

Approved by :

( ) Pombhappa Tameyakit  
 (✓) Malue Bulkrud  
 ( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

Approved by the head of Corporate Services & Equipment Calibration and Testing Services

A 0046905



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-1  
 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

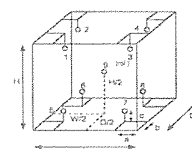
2. This certificate is valid only to the item calibrated on date and place of calibration

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
b = 5.0 cm	H = 0.40 m	c = 5.0 cm	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	16-16RTD-01
2	16-16RTD-02
3	16-16RTD-03
4	16-16RTD-04
5	16-16RTD-05
6	16-16RTD-06
7	16-16RTD-07
8	16-16RTD-08
9 (ref.)	16-16RTD-09

a 1132473





Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-1  
 Result of Calibration : ( \* ) Without Adjustment  
 Function of UUC\* : Temperature Source  
 Fresh air setting : Close

Cert. No.: 22TM1492  
 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
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C)								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.886	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 series  
**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



TECHNOLOGY PROMOTION ASSOCIATION (TPA) AND JAPAN  
 CALIBRATION SERVICE EQUIPMENT CALIBRATION AND TESTING SERVICES  
 50-1 PATANAKARN KORN SUEK SUK AND NAKHON RANGSIK HON  
 TEL. 02-592 9902-1 FAX. 02-592 9903



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

## Certificate of Calibration

Equipment : Water Bath

Manufacturer : Mommert

Model : WNB22

Serial No : L513.0648

ID No : RYG\_EN0061

Submitted by : A.I.S Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
 616/10 Moo 5, T. Maenam Khu,  
 A. Pluekdaeng  
 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 Hlaib

Approved by :   
 Approved Signatory

( ) Ponthipha Tameyakul  
 (x) Maico Butkrues  
 ( ) Suwit Injai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced or otherwise used without the prior written  
 Approval of the Head of Equipment Services (JCST) Calibration and Testing Services

a 0046906



Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2210-03760C-4  
 Procedure Used :-

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

Calibration were conducted using in-house calibration procedure GP-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

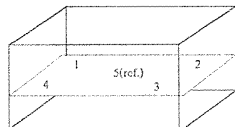
2 This certificate is valid only to the item calibrated on date and place of calibration.

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	N37P300728
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)				
			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
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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
551-4 PATTANAKARN RD NO. 11, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL: 02-210-2000 FAX: 02-210-9444



Cert.No.: 23CH630  
Page: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2GO S2  
Serial No. : C221115514  
ID No. : RYG\_F50586  
Condition As-Received: Used Item  
Received Date : 30 June 2023  
Calibration Date : 03 July 2023  
Reference : 2306-0964DSC-6  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
610/10 Moo 5, T. Maenam Kru,  
A. Phakdaeng, 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-CH6 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :   
Approved Signatory

(/ ) Malee Butkrua  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 6 July 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may be reproduced only when it fully complies with the above terms.

Approved for the Board of Corporate Services & Equipment Calibration and Testing Services

A 0055863



Cert.No.: 23CH830  
Page: 2 of 3

### Condition of this calibration result

1. Reference Standard Instrument :  
Instrument Serial No. ID No. Cert. No. Due Date  
1) Document Process Calibrator 54030049 130RC116 22E2769 24 Aug 2023  
2) Ref. Standard Thermometer 4582054 110RC044 2211306 27 Oct 2023  
This certification is traceable to the International System of Unit maintained at -  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution Manufacturer Lot No. Exp. date  
pH 4.008 CPA chem 863832 28 Dec 2024  
pH 6.986 CPA chem 863933 26 Dec 2023  
pH 10.010 CPA chem 863935 28 Dec 2023

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

### Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
			mV	pH		
pH Meter	4.00	177.46	178	4.00	0.58	2.00
S/N.: C221115514	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.46	-178	10.00	0.58	2.00

Malee

a 1169603



Cert.No.: 23CH830  
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.: 2465853	4.008	4.01	182	0.0085	2.05
	6.986	6.99	10	0.0099	2.00
	10.010	10.01	-169	0.0095	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLabSEExpert Go-ISM

- Serial No. : 2465853

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	25.003	25.2	0.197	0.13	2.00
30.0	30.002	30.2	0.198	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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Malee

a 1169602



Automation Service Co., Ltd.

829,929/1 Soi Pattanakarn 30, Pattanakarn Rd., Suanluang, Suanluang, Bangkok 10250  
Head Office : Tel. 02-319-9991 ext.1 Fax: 02-318-4261 E-mail : atsc@automation.co.th  
Rayong Branch : 11/15 Muang Rd., A. Muang, Rayong 21150 Tel. 038-592-152 Fax: 038-693-345  
Lamphun Branch : 12/25 M.4, T. Ban Klang, A. Muang, Lamphun 51000 Tel/Fax: 053-581-876  
website : www.automation.co.th

MTOC : L-0508/2023

Report No. : ALS-416/01

## TOC-L Maintenance Report

Instrument : Total Organic Carbon Analyzer Measuring : TC 0 - 30000 mg/L  
Model : TOC-LCSH Place of Installation : -  
Serial No. : H54425300416 Department : LABORATORY  
Manufacture : Shimadzu

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

Date of Maintenance : 11 / 05 / 2023

Ambient Condition : Temperature 25.5 ± 5 °C

: Humidifier 56 ± 15 %RH

Maintenance By :   
( Mr. Peerapong Sangpan )  
Technician

Approved By :   
( Mr. Nipon Phungsomsak )  
Technician Manager

User Name :   
( Siriluk Pungpan )

REVIEW BY   
APPROVED BY   
NEXT CAL. DATE 11/05/2024

SHIMADZU ANALYZER  
1/4

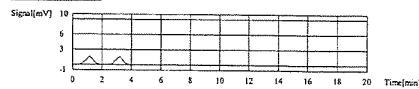


# TOC-Control L Report

2023\_05\_11\_001\_784\_1\_23K

Peak	Area	Height	Width	Retention Time
1	5.537	0.042	0.004	0.117
2	5.537	0.042	0.004	0.117

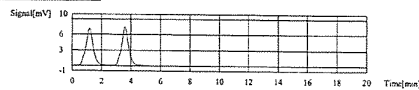
Acid Add: 0.000%  
Mean Area: 5.495  
SD Area: 0.24788  
CV Area: 1.00%



Conc: 5.000mg/L

Peak	Area	Height	Width	Retention Time
1	24.82	0.042	0.004	0.117
2	24.82	0.042	0.004	0.117

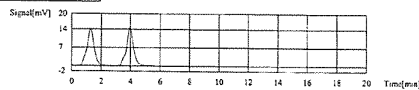
Acid Add: 0.000%  
Mean Area: 24.69  
SD Area: 0.2133  
CV Area: 0.91%



Conc: 10.00mg/L

Peak	Area	Height	Width	Retention Time
1	48.84	0.042	0.004	0.117
2	48.84	0.042	0.004	0.117

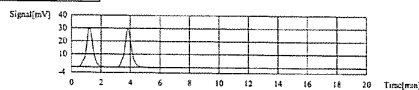
Acid Add: 0.000%  
Mean Area: 48.66  
SD Area: 0.3311  
CV Area: 0.68%



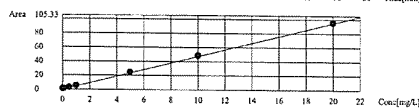
Conc: 20.00mg/L

Peak	Area	Height	Width	Retention Time
1	97.7	0.042	0.004	0.117
2	97.7	0.042	0.004	0.117

Acid Add: 0.000%  
Mean Area: 97.7  
SD Area: 0.3415  
CV Area: 0.35%



Diode: 4.742  
Intercept: 0.000  
R<sup>2</sup>: 1.000  
RSE(%): N/A  
Zero Shift: Yes



22

5/11/2023 13:24:77

# TOC-Control L Report

2023\_05\_11\_001\_784\_1\_23K

## Instat Information

Instrument Options  
Catalyst

TOC/AS/OC User:  
Regular Solvent

## Sample

Sample Name  
Sample ID  
Origin  
Status  
CNA Result

TC 3  
Control  
TC 3.1 - 23 typical  
Completed

Peak	Area	Height	Width	Retention Time
1	24.82	0.042	0.004	0.117
2	24.82	0.042	0.004	0.117

1 Det

Anal: TC

Peak	Area	Height	Width	Retention Time
1	24.82	0.042	0.004	0.117
2	24.82	0.042	0.004	0.117

Mean Area

Mean Conc

24.82

5.282mg/L

Signal(mV)

10

6

3

-1

0

2

4

6

8

10

12

14

16

18

20

Time(min)

11

5/11/2023 13:24:77

# TOC-Control L Report

2023\_05\_11\_001\_784\_1\_23K

## Instat Information

Instrument Options  
Catalyst

TOC/AS/OC User:  
Regular Solvent

## Sample

Sample Name  
Sample ID  
Origin  
Status  
CNA Result

Water  
Untested  
TC 3.1 - 23 ppm ml  
Completed

Peak	Area	Height	Width	Retention Time
1	1.283	0.042	0.004	0.117
2	1.283	0.042	0.004	0.117

1 Det

Anal: TC

Peak	Area	Height	Width	Retention Time
1	1.283	0.042	0.004	0.117
2	1.283	0.042	0.004	0.117

Mean Area

Mean Conc

1.283

0.778mg/L

Signal(mV)

10

6

3

-1

0

2

4

6

8

10

12

14

16

18

20

Time(min)

14

5/11/2023 13:23:77



## Automation Service Co., Ltd.

929,929/1 Soi Pattanakarn 33, Pattanakarn Rd., Suanluang, Suanluang, Bangkok 10259  
Head Office : Tel. 02-319-9994 ext.1 Fax. 02-316-4961 E-mail : ats@automation.co.th  
Rayong Branch : 1715 Huayong Rd., A. Muang, Rayong 21150 Tel. 038-692-152 Fax. 038-692-345  
Lamphun Branch : 12205 M.4, T. San Klang, A. Muang, Lamphun 51000 Tel/Fax. 053-581-876  
website : www.automation.co.th

MTOC : L-0509/2023

Report No. : ALS-799/01

## ASI Maintenance Report

Instrument : Automatic Sample Injector Measuring : Vial 40 mL  
Model : ASI-L Place of Installation : -  
Serial No. : H57415200799 Department : LABORATORY  
Manufacture : Shimadzu

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

Date of Maintenance : 11 / 05 / 2023

Ambient Condition : Temperature 25.5 ± 5 °C

Humidifier 56 ± 15 %RH

Maintenance By : Peerapong Sangpan  
( Mr. Peerapong Sangpan )  
Technician

Approved By : N. Phungsomsak  
( Mr. Nipon Phungsomsak )  
Technician Manager

User Name : Sinluk P.  
( Mr. Sinluk Peerapong )

REVIEW BY	<u>Sinluk P.</u>
APPROVED BY	<u>N. Phungsomsak</u>
NEXT CAL. DATE	<u>11/5/2024</u>



# Automation Service Co.,Ltd.

929,929/1 Soi Pattanakarn 30, Pattanakarn Rd., Suanluang, Bangkok 10250  
Head Office : Tel. 02-319-9994 ext.1 Fax 02-318-4991 E-mail : atsc@automation.co.th  
Rayong Branch : 1/15 Huaypong Rd., A. Muang, Rayong 21150 Tel. 038-692-152 Fax. 038-692-345  
Lamphun Branch : 122/5 M.4, T.Ban Klang, A.Muang, Lamphun 51000 Tel/Fax. 053-581-876  
website : www.automation.co.th

MTOC : L-0509/2023

Report No. : ALS-799/01

## Maintenance Sheet

Customer : ALS Laboratory

Date : 11 / 05 / 2023

Model : ASI-L

Serial No. H57415200799

Item	Carry out maintenance work	Result	Exchange	Comment
1.	Arm Drive section	O.K.		
	Check Arm Drive Belt for wear and tension	O.K.		
	Check grease of Screw Arm Drive	O.K.		
2.	Rinse pump (only ASI-V 24mL, 40mL)	O.K.		
	Check pump rate(>40mL/min)	O.K.		
	Check pump and tube connection for leakage	O.K.		
	Check if outlet flow is in proper condition	O.K.		
3.	Check and if necessary exchange consumable, Maintenance parts	O.K.		See appropriate list of maintenance parts
4.	Check Stirrer (When installed)	O.K.		
5.	Verify ASI function via mechanical check	O.K.		

Inspection by :

Peerapong Sangpan  
( Mr. Peerapong Sangpan )  
Technician

SHIMADZU ANALYZER  
2/3



# Automation Service Co.,Ltd.

929,929/1 Soi Pattanakarn 30, Pattanakarn Rd., Suanluang, Bangkok 10250  
Head Office : Tel. 02-319-9994 ext.1 Fax 02-318-4991 E-mail : atsc@automation.co.th  
Rayong Branch : 1/15 Huaypong Rd., A. Muang, Rayong 21150 Tel. 038-692-152 Fax. 038-692-345  
Lamphun Branch : 122/5 M.4, T.Ban Klang, A.Muang, Lamphun 51000 Tel/Fax. 053-581-876  
website : www.automation.co.th

MTOC : L-0509/2023

Report No. : ALS-799/01

## List of Consumable, Maintenance parts

Pos.	Part Number	Part Name	Result	Exchange	Recommended Interval
1.	017-27021-01	Grease Paste, Lubricant 100g	O.K.	✓	1 time per year
2.	032-22661-02	Belt, 6052m596, Arm Drive	O.K.		1 time per year
3.	034-03067-02	Spring, F-642, Arm Drive	O.K.		Depending on condition
4.	042-00405-11	Pump Head, for ASI Rinse Pump (only ASI-V 24mL, 40mL)	O.K.		After 300 h of operating
5.	638-41448-01	Std. Needle Type1 24mL, 40mL* (for tube 2, 1x1, 6), Sparge needle	N/A		Depending on condition
6.	638-41448-02	Std. Needle Type1 125mL* (for tube 2, 1x1, 6)	N/A		Depending on condition
7.	631-41660-03	Flare Pipe 2x1.5x700mm* (for Standard Needle Type1 24mL, 40mL, 125mL)	N/A		Depending on condition (may cut to origin length 600mm)
8.	638-41450-01	Needle for Suspended Particles,* 0.8mm (only ASI-V 24mL, 40mL)	N/A		Depending on condition
9.	638-41450-01	Std. Needle Type2 125mL* (for tube 1, 4x0.9)	N/A		Depending on condition
10.	638-41472-01	Std. Needle Type2 24mL, 40mL* (for tube 1, 4x0.9)	O.K.		Depending on condition
11.	631-41660-02	Flare Pipe 1,4x0.9x600mm* (for Suspended + Needle Type2)	O.K.		Depending on condition
12.	638-41449-01	Double Needle, only 24mL, 40mL (simultaneous sparge type)*	N/A		Depending on condition
13.	631-41660-01	Flare Pipe 1,1x0.6x600mm* (for Double Needle 24mL, 40mL)	N/A		Depending on condition

\*Note: needed parts depending on installed needle types!

Inspection by :

Peerapong Sangpan  
( Mr. Peerapong Sangpan )  
Technician

SHIMADZU ANALYZER  
3/3