

ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0175	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0662	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0665	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0667	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0085	19-Jun-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0087	19-Jan-23	19-Jul-24	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0491	13-Jan-23	13-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0492	13-Jan-23	13-Jan-24	12
Sea Water	pH at 25 °C	pH meter	RYG_EN0183	27-Feb-23	27-Feb-24	12
Sea Water	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Sea Water	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Sea Water	BOD	Incubator	RYG_EN0154	29-May-23	29-Nov-24	18
Sea Water	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Sea Water	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Sea Water	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Sea Water	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Sea Water	Conductivity	Conductivity meter	RYG_EN0029	4-Sep-23	4-Mar-25	18
Sea Water	Salinity	Conductivity meter	RYG_EN0029	4-Sep-23	4-Mar-25	18
Sea Water	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Sea Water	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Sea Water	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Temperature	pH meter	RYG_FS0605	4-Sep-23	4-Sep-24	12
Sea Water	Total Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Sea Water	Total Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Sea Water	Lead	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Sea Water	Lead	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Sea Water	Lead	Chamber (Cold Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Sea Water	Zinc	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Sea Water	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Sea Water	Zinc	Chamber (Cold Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Sea Water	Mercury	DUO-CVAFS / CVAAS	BKK_EL0023	24-May-23	24-May-24	12
Sea Water	Total Coliform	Autoclave	BKK_ML0037	17-Jul-23	17-Jan-25	18
Sea Water	Total Coliform	Incubator	BKK_ML0010	17-Jul-23	17-Jan-25	18
Sea Water	Total Coliform	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Sea Water	Fecal Coliform	Autoclave	BKK_ML0037	17-Jul-23	17-Jan-25	18
Sea Water	Fecal Coliform	Incubator	BKK_ML0010	17-Jul-23	17-Jan-25	18
Sea Water	Fecal Coliform	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Sea Water	Fecal Coliform	Water Bath	BKK_ML0056	20-Apr-23	20-Apr-24	12

1

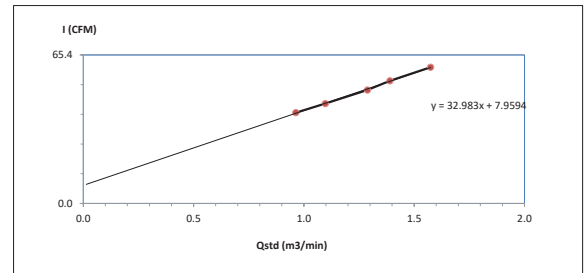
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High Volume Air Sampler Calibration Worksheet

Project Site :	Glow SPP 3 Co., Ltd	Barometric Pressure (mm Hg) :	756
Calibrate Location :	Thai Tank Farm	Temperature (°C) :	30
Calibrate Date :	24-Oct-23	High Volume ID :	RYG_FS0175
Calibration Sheet No.:	C-241023-RYG_FS0175	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	4801
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9638	40	Slope : 32.9830
2	2.6	1.0968	44	Intercept : 7.9594
3	3.6	1.2879	50	Correlation Coefficient : 0.9993
4	4.2	1.3899	54	
5	5.4	1.5740	60	



Calibrated by Chatchai Sukpia  
( Mr.Chatchai Sukpia )  
Field Scientist(1)

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

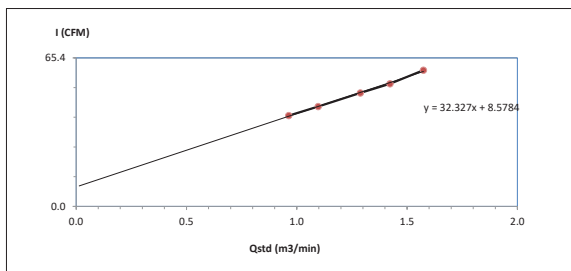
FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site :	Glow SPP 3 Co., Ltd	Barometric Pressure (mm Hg) :	756
Calibrate Location :	Map Ta Phut Port (North of Project)	Temperature (°C) :	30
Calibrate Date :	24-Oct-23	High Volume ID :	RYG_FS0662
Calibration Sheet No.:	C-241023-RYG_FS0662	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	6259
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9638	40	Slope : 32.3270
2	2.6	1.0968	44	Intercept : 8.5784
3	3.6	1.2879	50	Correlation Coefficient : 0.9986
4	4.4	1.4223	54	
5	5.4	1.5740	60	



Calibrated by Chatchai Sukpia  
( Mr.Chatchai Sukpia )  
Field Scientist(1)

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

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

RYG\_EN0001

Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel : +66 2643 8351-6 , e-mail : service.thailand@sartorius.com



SARTORIUS  
REVIEW BY : Prasit K.  
APPROVED BY : D. K.  
NEXT CAL DATE : 01/03/24

# Certificate of Calibration

Model Number :	LA130S-F	Certificate No. :	23BCI0110
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	25409684	Reference No. :	204833
ID No. :	RYG_EN0001	Page No. :	1 of 2
Manufacturer :	Sartorius		

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

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

Calibrated By : Mr.Chonchai Inthana  
Calibration 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 :	Ambients Conditions:
Capacity : 150 g Readability : 0.0001 g	Temperature : 24.2 °C ± 5.0 °C
	Humidity : 60.0 % RH ± 10.0 % RH
	Pressure : ±
Reasons for calibration	Equipment Condition: <input checked="" type="checkbox"/> Good Operate <input type="checkbox"/> Fair
<input type="checkbox"/> New Installation <input type="checkbox"/> Service / Repaired <input checked="" type="checkbox"/> Re-calibration/ Maintenance	

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

## Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Luton MHB-382SD	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.

Mr.chonchai inthana(Technical Manager)



SOP FM 33 03 February 2022



# Certificate of Calibration

Model Number : LA130S-F  
Description : Analytical Balance  
Serial Number : 25409664  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius

Certificate No. : 23BCI0110  
Issued Date : Friday, March 03, 2023  
Reference No. : 204833  
Page No. : 2 of 2

## Calibration Results : Without Adjustment

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

Nominal Value : (Low Load)	10.0000	100.0001
10 g	10.0000	100.0002
Tolerance	10.0001	100.0001
0.0001 g	10.0000	100.0000
	9.9999	100.0002
Nominal Value : (High Load)	10.0000	100.0001
100 g	10.0001	100.0001
Tolerance	10.0000	100.0001
0.0001 g	9.9999	100.0002
	9.9998	100.0001
Standard Deviation	0.00009	0.00006

**Eccentricity (Off-center loading error)**  
The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R116).

Nominal value : 50 g	50	g
Tolerance	0.0004	g

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

Tolerance	0.0002	g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00022
0.05	0.0500	0.0500	0.0000	0.00023
0.1	0.1000	0.1000	0.0000	0.00023
0.5	0.5000	0.5000	0.0000	0.00023
1	1.0000	1.0000	0.0000	0.00023
2	2.0000	2.0000	0.0000	0.00023
5	5.0000	5.0000	0.0000	0.00022
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00023
100	100.0000	100.0002	0.0002	0.00026

End of Report

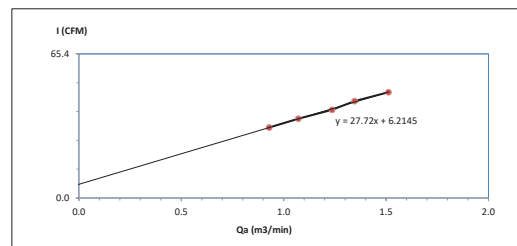
SOP FM 33 03 February 2022

## High Volume Air Sampler Calibration Worksheet

Project Site : Glow SPP 3 Co., Ltd.  
Calibrate Location : Thai Tank Farm  
Calibrate Date : 24-Oct-23  
CalibrationSheet No. : C-241023-RYG\_FS0665  
Calibrator ID : RYG\_FS0206  
Calibrator Model : TE-5028A  
Calibrator S/N : 1543

Barometric Pressure (mm Hg) : 756  
Temperature (°C) : 30  
High Volume ID : RYG\_FS0665  
High Volume Model : TE-5009X  
High Volume S/N : 6264  
Calibrator Slope : 0.92345  
Calibrator Intercept : -0.0095

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.929	32	Slope : 27.7197
2	2.4	1.072	36	Intercept : 6.2145
3	3.2	1.236	40	Correlation Coefficient : 0.9985
4	3.8	1.346	44	
5	4.8	1.511	48	



Calibrated by :   
(Mr. Chatchai Sukpia)  
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16

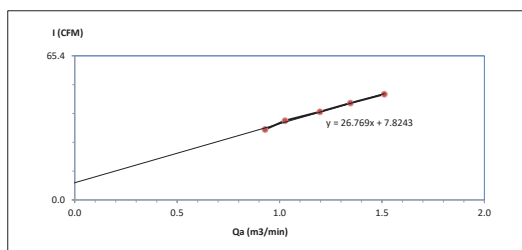


## High Volume Air Sampler Calibration Worksheet

Project Site : Glow SPP 3 Co., Ltd.  
Calibrate Location : Map Ta Phut Port (North of Project)  
Calibrate Date : 24-Oct-23  
CalibrationSheet No. : C-241023-RYG\_FS0667  
Calibrator ID : RYG\_FS0206  
Calibrator Model : TE-5028A  
Calibrator S/N : 1543

Barometric Pressure (mm Hg) : 756  
Temperature (°C) : 30  
High Volume ID : RYG\_FS0667  
High Volume Model : TE-5009X  
High Volume S/N : 6266  
Calibrator Slope : 0.92345  
Calibrator Intercept : -0.0095

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.929	32	Slope : 26.7687
2	2.2	1.026	36	Intercept : 7.8243
3	3.0	1.197	40	Correlation Coefficient : 0.9965
4	3.8	1.346	44	
5	4.8	1.511	48	



Calibrated by :   
(Mr. Chatchai Sukpia)  
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16



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E-mail : jnac-calibration@jiranatee.com  
Web site : www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer  
MANUFACTURER : Novolynx  
MODEL/TYPE : Sensor: WS-02F

SERIAL NUMBER : Data logger: 200-WS-25DL

ID NUMBER : Sensor: WSO-A4985

CONDITION AS-RECEIVED : Data logger: A4985

CUSTOMER : RYG\_FS0085

RECEIVED DATE : Used item

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

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

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

CALIBRATION CONDITIONS :

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

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

Diameter of mounting pipe : - mm

Blockage ratio of test object : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.

Measurement Condition : The average values during measurement are (25.0) °C, (42.7) %RH and (1011.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by :   
Mr. Sorawit Thachalad  
Miss Jitragorn Lertsomphol



Approved signatory :   
Mr. Parinya Booncharoen  
Calibration Department Manager

Remarks:

1. Nozzle cross-section area of the wind tunnel

2. Projected cross-section area of the tested object include mounting pipe

3. Diameter of mounting pipe

4. Ratio 1/3

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

CC-008-66

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{std}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{std}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
1.025	24.90	24.95	0.9	-0.1	0.31
2.026	24.96	24.95	1.9	-0.1	0.31
2.997	25.00	24.95	2.9	-0.1	0.31
4.126	25.00	24.95	4.0	-0.1	0.31
5.02	24.90	24.95	4.9	-0.1	0.31
6.00	24.88	24.95	5.9	-0.1	0.31
7.05	24.90	24.95	7.0	-0.1	0.31
8.18	24.74	24.95	8.0	-0.1	0.31
9.09	24.84	24.95	9.0	0.0	0.31
10.07	24.70	24.95	10.0	-0.1	0.31
11.14	24.78	24.95	11.1	-0.1	0.31
12.12	24.70	24.95	12.0	-0.1	0.31
13.17	24.70	24.95	13.1	0.0	0.35
14.24	24.70	24.95	14.1	-0.2	0.31
15.20	24.70	24.95	15.2	0.0	0.44
16.28	24.70	24.95	16.2	-0.1	0.31

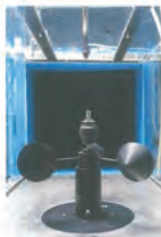
## Remark:

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

<sup>2</sup> Velocity of standard

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

## PHOTO OF CALIBRATION SET-UP



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



Certificate Number

CC-008-66

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 counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	$D'_{std}$ Degree (°)	$D'_{std}$ Degree (°)	Error Degree (°)	$U$ (k=2) Degree (°)
5.01	45.000	44	-1	1.0
	90.001	87	-3	1.0
	135.000	132	-3	1.0
	180.000	179	-1	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	319	4	1.0
	360.000	359	-1	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

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



JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.  
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Mobile: +66(0)8399453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-15 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CC-008-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

## MEASUREMENT ITEM

## MANUFACTURER

## MODEL/TYPE

## SERIAL NUMBER

## ID NUMBER

## CONDITION AS-RECEIVED

## CUSTOMER

## Wind Direction Sensor

: Novamix

: Sensor: WS-02F

: Data logger: 200-WS-25DL

: Sensor: WSO-A4985

: Data logger: A4985

: RYG\_F50085

: Used Item

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

: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand.

## RECEIVED DATE

## MEASUREMENT DATE

## ISSUE DATE

: 16 Jun 2023

: 19 Jun 2023

: 19 Jun 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 Jiranatee 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> 129 cm<sup>2</sup>: Diameter of mounting pipe<sup>3</sup> - mm: Blockage ratio of test object<sup>4</sup> 0.143 [-]

## Preconditioning

## Measurement Condition

: 24 hours at ambient conditions.

: The average values during measurement are (24.1°C, (55.4) %RH and (1008.5) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

☒ Mr. Sorawit Thichakul

☐ Miss Jitragorn Lertsomphol



## Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

## Remark:

<sup>1</sup> Nozzle 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" to "b"

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



JIRANATEE ASSOCIATES CO., LTD.

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Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-15 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

RECEIVED BY: *Manaborn P.*  
APPROVED BY: *47/6*  
DATE: 19/6/24

Certificate Number

CL-010-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

## MEASUREMENT ITEM

## MANUFACTURER

## MODEL/TYPE

## SERIAL NUMBER

## ID NUMBER

## CONDITION AS-RECEIVED

## CUSTOMER

## Wind Direction Sensor

: Novamix

: Sensor: WS-02F

: Data logger: 200-WS-25DL

: Sensor: -

: Data logger: A4985

: RYG\_F50087

: Used Item

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

: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand.

## RECEIVED DATE

## MEASUREMENT DATE

## ISSUE DATE

: 16 Jan 2023

: 19 Jan 2023

: 20 Jan 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 Jiranatee 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> 129 cm<sup>2</sup>: Diameter of mounting pipe<sup>3</sup> - mm: Blockage ratio of test object<sup>4</sup> 0.143 [-]

## Preconditioning

## Measurement Condition

: 24 hours at ambient conditions.

: The average values during measurement are (23.5°C, (47.4) %RH and (1015.6) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

☒ Mr. Sorawit Thichakul

☐ Miss Jitragorn Lertsomphol



## Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

## Remark:

<sup>1</sup> Nozzle 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" to "b"

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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 counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
5.02	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	225	0	0.68
	270.000	273	3	0.58
	315.000	319	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\*\*\*



JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.  
8/14-15, 8/17/19-16  
Petchkasem 7/71, 82 Watthana, Bangkok.  
Bangkok 10600 (Thailand)  
Tel: +66(0)860112  
Mobile: +66(0)9594453  
E-mail: jaco-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TS1-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

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## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

## MEASUREMENT ITEM:

Cup anemometer

## MANUFACTURER

Novallux

## MODEL/TYPE

Sensor: WS-02F

Data logger: 200-WS-25DL

## SERIAL NUMBER

Sensor: -

Data logger: A4966

## ID NUMBER

RYG\_FS0087

## CONDITION AS-RECEIVED

Used item

## CUSTOMER

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

## Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model 8455B2 and pitot tube with precision differential pressure meter model: DPM2500 in an air speed measurement of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as calibration guideline.

## Traceability:

This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0056-22

## Uncertainty of Measurement:

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

## ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature	23.0 ± 3.0	°C
Relative Humidity	55.0 ± 15.0	%RH
Atmospheric Pressure	1010 ± 10	hPa

## PLACE OF CALIBRATION

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

## CALIBRATION CONDITIONS

Wind tunnel cross-section area	900	cm <sup>2</sup>
Win direction frontal area	100	cm <sup>2</sup>
Diameter of mounting pipe	-	mm
Blockage ratio of test object <sup>4</sup>	0.111	(-)

## Preconditioning

24 hours at ambient conditions.

## Measurement Condition

The average values during measurement are (23.6) °C, (55.3) %RH and (1013.5) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

## Calibrated by:

Mr. Soravith Thichanont  
Miss Jiraporn Jongsomphol

## 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 pipe

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

<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>



## Approved signature:

26/Jan/23

Mr. Padiya Boontarareon  
Calibration Department Manager

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Certificate Number

CL-010-66

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MEASUREMENT RESULTS<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V <sub>std</sub> <sup>1</sup> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>std</sub> <sup>2</sup> (m/s)	Error (m/s)	U (k=2) (m/s)
0.985	23.68	23.60	0.8	-0.2	0.15
2.033	23.54	23.60	1.8	-0.2	0.16
3.046	23.68	23.60	2.9	-0.1	0.19
4.136	23.66	23.60	3.9	-0.2	0.20
5.03	23.50	23.60	4.9	-0.1	0.20
5.98	23.50	23.60	5.9	-0.1	0.18
7.05	23.36	23.60	7.0	-0.1	0.18
8.18	23.54	23.60	8.0	-0.2	0.20
9.10	23.30	23.60	8.9	-0.2	0.20
10.10	23.50	23.60	10.0	-0.1	0.19
11.14	23.28	23.60	11.1	-0.1	0.22
12.12	23.40	23.60	11.9	-0.2	0.21
13.19	23.10	23.60	13.0	-0.2	0.26
14.25	23.46	23.60	14.0	-0.2	0.32
15.26	23.10	23.60	15.0	-0.2	0.23
16.31	23.26	23.60	16.2	-0.1	0.29

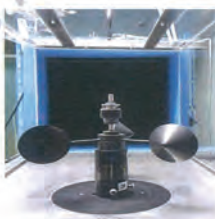
## Remark:

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

<sup>2</sup> Velocity of standard

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

## PHOTO OF CALIBRATION SET-UP



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

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

SITHIPHORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

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



Cert. No. : ACC23005  
Pages : 1 of 3

## Calibration Certificate

## Equipment :

SOUND CALIBRATOR

## Manufacturer :

RION

## Model :

NC-75

## Serial No.:

35002736

## ID No.:

RYG\_FS0496

## Condition As Found :

GOOD

## Customer :

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 :

06 JANUARY 2023

## Calibration Date :

17 JANUARY 2023

## Date of Issue :

19 JANUARY 2023

## Calibrated by :

Nathakorn Pisutpaisan

## Approved by :

T. Petchurai  
( Thanakul Petchurai )

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QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACC23005  
Job No. : VC66AC0024  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

## Calibration Method :

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

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## Continuation of Calibration Certificate

Cert. No. : ACC23005  
Job No. : VC66AC0024  
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	93.98	-0.02	0.14	0.40

## 2. Frequency

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

## 3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23040  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00709746 / 187332 / 01297  
ID No.: RYG\_FS0491

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurai*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL23040  
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	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23040  
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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23040  
Job No. : VC66AC0024  
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## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	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	12.5
C - weight	18.3
Flat	23.6

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.0	0.0	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.7	1.7	1.7	± 5.0

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23040  
Job No. : VC66AC0024  
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## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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T. Petch

## Continuation of Calibration Certificate

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Job No. : VC66AC0024  
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## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.1	0.1	± 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	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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T. Petch



## Continuation of Calibration Certificate

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Job No. : VC66AC0024  
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## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

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

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

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T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
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## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23042  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00900071 / 188464 / 01733  
ID No.: RYG\_FS0492

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

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

QF-TS12-04-04-020664

T. Petchur



## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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

QF-TS12-04-04-020664

~ B.T.H.

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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)
14.6

## 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	17.9
Flat	23.9

## 3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

~ B.T.H.

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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	0.0	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	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

~ B.T.H.

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

~ B.T.H.



## Continuation of Calibration Certificate

Cert. No. : ACL23042  
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, 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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert.No. : ACL23042  
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	0.1	±1.5
89.5	89.6		

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3009-29 FAX: 0-2719-9484

Cert.No.: 23CH275  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenCompact S220  
Serial No. : C104059460  
ID No. : RYG\_ENO183  
Condition As-Received: Used Item  
Received Date : 24 February 2023  
Calibration Date : 27 February 2023  
Reference : 2302-0886DSC-2  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
618/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In - house method :  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Walailak Sirithean

Approved by :   
Approved Signatory

( ) Malee Butkrues  
(✓) Saithip Meangmaj  
( ) Warakorn Lemgagrakul

Issue Date : 28 February 2023  
The Uncertainties are for a confidence probability of approximately 95%

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

A 0051538

Cert.No.: 23CH275  
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   | 4982054    | 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-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	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)

Performing standard curve by HPLC at pH (4.7, 7)						
Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter S/N.: C104059460	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

a 1149925





Cert.No.: 23CH275  
Page.: 3 of 3

#### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode	4.008	4.008	179.1	0.0046	2.00
S/N.: 1453404	6.987	6.988	4.7	0.0084	2.00
	10.010	10.013	-172.4	0.0069	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLabExpert Pro-ISM

- Serial No. : 1453404

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor k
25.0	25.001	24.8	-0.201	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 %.

-o-o-

Saithip

a 1149924



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



#### Certificate of Calibration

Certificate No.: 23E753  
Page : 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenCompact S220  
Serial No.: C104059460  
ID No.: RYG\_EN0183

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

Condition As-Received: Used item  
Received Date: 24 February 2023  
Calibration Date: 28 February 2023

Reference: 2302-0886DSC  
Ambient Temperature: ( 23  $\pm$  2 ) °C  
Relative Humidity: ( 50  $\pm$  10 ) %

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

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

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

#### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6440007	22E1670	18 May 2023
2.This result of calibration was made on requested at the point specified by customer.				
3.The certificate is valid only to the item calibrated on date and place of calibration.				
4.This Certification is traceable to the International System of Unit maintained at:- -National Institute of Metrology Thailand (NIMT)				

Calibrated by : Wutthareeporn Wongchutikrane  
Issue Date : 02 March 2023

Approved Signatory :

[ ] Phaiinee Prabpai  
[x] Nuntawat Khamchai  
[ ] Ponthippa Tameyaykul

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Cert. No.: 23E753  
Page.: 2 of 2

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

Function:	DC voltage measuremer	Range:	2000	mV
	Standard Value	UUC* Reading	Error	Uncertainty
	( mV )	( mV )	( mV )	( $\pm$ $\mu$ V )
	-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	99.9	-0.1	65
	150.0000	149.9	-0.1	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.

-o-o-

a 1150477



#### Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.  
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100  
Bangkok Tel : +668 9205 6951 : +669 8247 2380

Website : www.scieco.co.th E-Mail : calibrate@scieco.com



Certificate No. T230116

Page 1 of 4

#### Certificate of Calibration

Equipment : Chamber ( Cooling Room )

Manufacturer : MODULAR

Model : IREVCOHCOO

Serial No. : C00351459

Customer Code : RYG\_EN0184

ID No. : T1939A5

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

616/10 Moo 5 T.Maenam Khu,

A.Pluaekdaeng, Rayong 21140

Customer Location : Laboratory

Date of Receipt : 23 January 2023

Calibrated By : Atiphong Rongrat ( Technician )

Approved By : Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 07 FEB 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

F53-L1-0183108-4

Certificate No. T230116

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 25 January 2023  
Environment : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ) .

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

### 2. Reference Standard Instrument

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244 )

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant : 1 Hour - Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

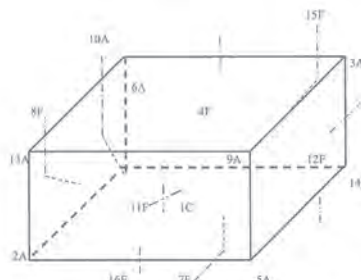
Approved By: *[Signature]*

FORM 15 (17/15-010-11)

Certificate No. T230116

Page 3 of 4

## Calibration Report



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

1C = TN141	12F = TN152
2A = TN142	13A = TN153
3A = TN143	14A = TN154
4F = TN144	15F = TN155
5A = TN145	16E = TN156
6A = TN146	
7F = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11F = TN151	

Approved By: *[Signature]*

FORM 15 (17/15-010-11)

Certificate No. T230116

Page 4 of 4

## Calibration Report

### Measurement Results

	Average Standard Reading at each position (°C)											
Calibration Point	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24	3.34
	TN153	TN154	TN155	TN156								
	3.28	3.22	3.28	3.21								

Chamber ( Cooling Room )			Temperature Distribution			
Setting ( °C )	Reading ( °C )		Stability ( °C )	Uniformity ( °C )	Uncertainty ( ± °C )	Coverage Factor k
	Min, Max	Average				
3.0	2.8, 4.1	3.5	1.20	1.20	1.90	2.07

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By: *[Signature]*

FORM 15 (17/15-010-11)

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

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Received Date : 21 July 2023  
Test Date : 24 July 2023  
Reference : 2307-0713DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Rayong Branch  
616/10 Moo 5, T.Maenam Khui, A.Pluakdaeng,  
Rayong 21140, Thailand

Laboratory Condition : Temperature ( 25 ± 5 ) °C  
Humidity ( 50 ± 20 ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean  
Approved by : *[Signature]*  
Approved Signatory

( ) Malee Butkruea  
(✓) Saithip Meangmai  
( ) Warakorn Lemgatrakul

Issue Date : 26 July 2023

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

#### Condition of this result of calibration

##### 1. Reference Standard Instruments :

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

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

##### 2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

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

a 1172155



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



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

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 25 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Preecha Hlahib

Approved by :   
Approved Signatory

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

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616



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

Cert. No.: 23LM125  
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	2188080	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.: 1228475367

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

UUC\* : Unit Under Calibration

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

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Swit

a 1159515



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TEL. 0-2717-3000-29 FAX. 0-2719-9484



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

## Certificate of Calibration

Equipment : Low Temp. Incubator  
Manufacturer : Memmert  
Model : IPP750  
Serial No. : V818.0084  
ID No. : RYG\_EN0154  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand  
Location : BOD Room  
Received Order : 29 May 2023  
Calibration Date : 29 May 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Man Pattanaapongpaiboon

Approved by :   
Approved Signatory

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

Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0054967





Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2

Cert. No.: 23TM962  
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

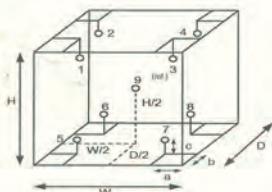
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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

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	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

a 1165130



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

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

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

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.408	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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a 1165129

RYG\_EN0002

Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel : +66 2643 8361-6, e-mail: service.thailand@sartorius.com



NSC-TIS-TIS 17025  
CALIBRATION 0426

SARTORIUS

REVIEW BY *Thiraporn*  
APPROVED BY *D. J.*  
NEXT CAL DATE 01/05/24

## Certificate of Calibration

Model Number : MSE224S-100-DU	Certificate No. : 23BCI0112
Description : Analytical Balance	Issued Date : Friday, March 03, 2023
Serial Number : 0026207038	Reference No. : 204833
ID No. : RYG_EN0002	Page No. : 1 of 2
Manufacturer : Sartorius	

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

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

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

Metrological data :	Ambients Conditions:	
Capacity : 220 g	Readability : 0.0001 g	Temperature : 23.6 °C ± 5.0 °C
		Humidity : 60.0 % RH ± 10.0 % RH
		Pressure : ±

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

#### Measurement Method UKAS Publication Ref : Lab 14

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

#### Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	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.

Mr.chonchai inthana(Technical Manager)



Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel : +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU	Certificate No. : 23BCI0112
Description : Analytical Balance	Issued Date : Friday, March 03, 2023
Serial Number : 0026207038	Reference No. : 204833
ID No. : RYG_EN0002	Page No. : 2 of 2
Manufacturer : Sartorius	

#### 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 series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g		Difference		
Nominal Value : (High Load)	20.0000	199.9999			
200 g	20.0000	200.0000			
Tolerance	0.0001 g				
	20.0000	199.9999			
	20.0000	200.0000			
	20.0000	199.9999			
	20.0000	200.0000			
Standard Deviation	0.00003	0.00005			

#### Linearity

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

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (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	10.0001	0.0001	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report





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



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

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UFE 500  
Serial No. : G511.1572  
ID No. : RYG\_EN0010  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
618/10 Moo 5 T. Maenam Khu.  
A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : Oven Room  
Received Order : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Man Pattanapongpaiboon  
Approved by : Melu  
( ) Pornhippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

REVIEW BY Tranhtall  
APPROVED BY D. Me  
NEXT CAL. DATE 30/04/24

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0046908



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

Cert. No.: 22TM1517  
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard instrument:-

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

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

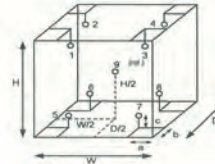
3. This certification is traceable to the International System of Unit.

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

Function of UUC\* : Temperature Source

Fresh air setting : Close

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



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>

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

Melu

a 1132456



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

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

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

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

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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a 1132456



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



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

## Certificate of Calibration

Equipment : Conductivity Meter  
Manufacturer : Mettler Toledo  
Model : S230  
Serial No. : B241407147  
ID No. : RYG\_EN0029  
Condition As-Received : Used Item  
Received Date : 01 September 2023  
Calibration Date : 04 September 2023  
Reference : 2309-0010DSC-7  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch  
618/10 Moo 5, T.Maenam Khu,  
A.Pluaakdaeng, Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In -house method :  
- CP-CH6 : based on direct measurement by using certified reference material (CRM)  
Calibrated by : Warakorn Lemgagrakul  
Approved by : Sailhip  
( ) Sailhip Meangmai  
( ) Warakorn Lemgagrakul  
( ) Ponpan Paipim  
Issue Date : 7 September 2023

REVIEW BY Tranhtall  
APPROVED BY D. Me  
NEXT CAL. DATE 04/03/25

The Uncertainties are for a confidence probability of approximately 95%

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

A 0058059





Cert.No.: 23CH1088

Page: 2 of 2

**Condition of this result of calibration****1. Reference Standard Instrument :-****Instrument**

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	23435	10 Apr 2024

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

**2. Certified Reference Materials :-**

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

Conductivity Solution	Manufacturer	Lot No.	Exp. date
84.000 $\mu\text{S/cm}$	CPA Chem	885120	28 Mar 2024
1413.0 $\mu\text{S/cm}$	CPA Chem	913596	14 July 2024
12.880 mS/cm	CPA Chem	885123	28 Mar 2024

- Control Conductivity calibration solution temperature by Water bath (25 $\pm$ 0.1)  $^{\circ}\text{C}$ 

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

**Calibration results**

Function : Conductivity Measurement

(\*) After Adjustment at 1413.0  $\mu\text{S/cm}$ 

Conductivity Electrode Serial No.: 5823251000

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
84.000 $\mu\text{S/cm}$	83.8 $\mu\text{S/cm}$	85.3 $\mu\text{S/cm}$	0.62 $\mu\text{S/cm}$	2.00
1413.0 $\mu\text{S/cm}$	1388 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12.880 mS/cm	12.41 mS/cm	12.63 mS/cm	0.086 mS/cm	2.00

**Remark** - UUC\* = Unit Under Calibration- Cell constant = 0.545371  $\text{cm}^{-1}$ The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95 %.

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Salip

a 1178950



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



Cert. No.: 22TM1492

Page: 1 of 3

**Certificate of Calibration**

Equipment :	Hot Air Oven
Manufacturer :	Memmert
Model :	UM 400
Serial No. :	b495.0899
ID No. :	RYG_EN0006
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location :	Oven Room
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	( 26 $\pm$ 10 ) $^{\circ}\text{C}$
Relative Humidity :	( 50 $\pm$ 30 ) %
Calibrated by :	Preecha Hiahib
Approved by :	 Approved Signatory
	( ) Ponthippa Tameyakul ( ) Malee Butkruea ( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0046905



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

Cert. No.: 22TM1492

Page: 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration****1. Reference standard instrument:-**

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

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

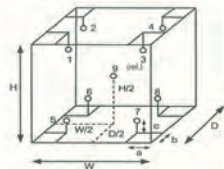
3. This certification is traceable to the International System of Unit.

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

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( $^{\circ}\text{C}$ )	28	29
REL.Humid. ( % )	43	47
AC Supply ( Volt )	220	221

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

a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
	Capacity = 0.053 $\text{m}^3$

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

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Mali

a 1132473



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

Cert. No.: 22TM1492

Page: 3 of 3

**Result of Calibration :-**

( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Calibration Point ( $^{\circ}\text{C}$ )	UUC* Setting ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Temperature stability ( $\pm$ $^{\circ}\text{C}$ )	Temperature uniformity ( $^{\circ}\text{C}$ )	Overall Variation ( $^{\circ}\text{C}$ )	Uncertainty ( $\pm$ $^{\circ}\text{C}$ )	Coverage Factor k
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point ( $^{\circ}\text{C}$ )	Measured Temperature ( $^{\circ}\text{C}$ )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

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

UUC\* : Unit Under Calibration

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

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

Mali

a 1132472





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-27 FAX: 0-2719-9484



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

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNB22  
Serial No. : L513.0648  
ID No. : RYG\_EN0061  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140, Thailand  
Location : Wet Chemistry Lab  
Received Order : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Preecha Hlahib  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

REVIEW BY   
APPROVED BY   
NEXT CAL DATE 20/04/24

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0046906



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

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

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

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

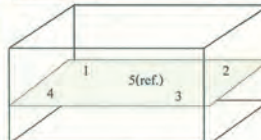
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

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



Front

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

a 1132471



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2210-0376OC-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

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

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

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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



Cert.No.: 23CH1085  
Page: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2Go S2  
Serial No. : C232588424  
ID No. : RYG\_FS0605  
Condition As-Received : Used Item  
Received Date : 01 September 2023  
Calibration Date : 04 September 2023  
Reference : 2309-0010DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch  
616/10 Moo 5, T.Maenam Khu,  
A.Pluaakdaeng, 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)  
Calibrated by : Warakorn Lernagatrakul  
Approved by :   
( ) Saitthip Meangmai  
( ) Warakorn Lernagatrakul  
( ) Ponpan Paipim  
Issue Date : 7 September 2023

REVIEW BY   
APPROVED BY   
NEXT CAL DATE 04/09/24

The Uncertainties are for a confidence probability of approximately 95%

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

A 0058056





Cert. No.: 23CH1085  
Page.: 2 of 2

#### Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	43160066	130RC092	23E1284	09 Apr 2024

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.986	CPA chem	863833	28 Dec 2023
pH 10.010	CPA chem	863835	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 ( $\pm$ mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: C232588424	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode S/N.: 2465869	4.008	4.01	185	0.0085	2.05
	6.986	6.99	12	0.0099	2.00
	10.010	10.01	-165	0.0092	2.00

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

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Saitip

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK, 10250  
TEL. 0-2715-3000-29 FAX. 0-2719-9484



Cert. No.: 23LM153  
Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter with Sensor  
Manufacturer : Mettler Toledo  
Model : Seven2GO S2  
Serial No. : C232588424  
ID No. : RYG\_FS0605  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 01 September 2023  
Calibrated Date : 05 September 2023  
Ambient Temperature : (  $26 \pm 10$  ) °C  
Relative Humidity : (  $50 \pm 30$  ) %  
AC Line Voltage : (  $220 \pm 22$  ) V  
Calibrated by : Kunchit Promrat  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Ponpan Paipim  
(✓) Suwit Imjai  
Issue Date : 6 September 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0058111



Equipment : pH Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2309-0010DSC-2  
Cert. No.: 23LM153  
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	A7B843	23I24	TPA	04 Jan 2024

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

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 2465869

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( $\pm$ °C )	Coverage Factor k
25.0	120	25.003	25.3	0.297	0.16	2.00
30.0	120	30.003	30.3	0.297	0.16	2.00
40.0	120	40.004	40.4	0.396	0.16	2.00
50.0	120	50.003	50.4	0.397	0.16	2.00

UUC\* : Unit Under Calibration

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

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Saitip

a 1178764



Agilent Technologies

Agilent Technologies (Thailand) Limited  
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Bangkok 10500 Thailand  
Tel: +662 637 6363  
Fax: +662 632 4334  
Email: cco-sm@agilent.com  
Website: www.agilent.com/thailand

#### Customer Contact:

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan  
TAX ID : 8105540004859  
Chanattagarn.lmchom@alsglobal.com  
27603068

#### Invoice To:

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

#### Delivery Site:

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

#### Location:

Room  
Bldg  
Lab  
Dept

#### SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 6006041263	Service Confirmation: 6905338201

REVIEW BY   
APPROVED BY   
NEXT CAL DATE 15/06/2025

#### Direct Inquiries to:

Contact Name: Customer Contact Center  
Contact E-mail: cco-sm@agilent.com  
Contact Telephone: +662 637 6363  
Contact Fax: +662 632 4334

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Tax ID : 8105540004859

Citibank N.A. Bangkok Branch  
399 Interchange 21 Building, Sukhumvit Road, Ekamai New  
Sub-district, Watana District, Bangkok 10110 Thailand  
Acc. No: 012-4462 007  
THB-Kuon Thai Bank PCL  
Sum Square Bldg. 416/1-2 Rama 1 Rd., Pathumwan, BKK 10330  
Thailand

ORIGINAL



Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7700-E	ICPMS 7700 System Enhanced		ICP MS 7700 (HPLC)	
G1316A	1260 Thermostated Column Compartment	DEACN12300	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1329B	1260 Standard Autosampler	DEAAC1109B	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1311B	1260 Quaternary Pump	DEAB704380	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G3281A	Agilent 7700x ICP-MS	JP12081612	ICP MS 7700 (HPLC)	SYS-IM-7700-E



Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQC	Enterprise Operations Qualification	1.00	Agreement Entitlement: 100 % covered	12.12.2023	12.12.2023
1010	5185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement: 100 % covered		

Additional Information:

Page 2 of 3

Service Information:

<b>Problem Description:</b> WU-00-IM/HPLC-7700-5001143313		
<b>Service Provided:</b> Perform OQ Hardware control test CSD Iegon, Autosampler, IBS, Auto tune, BG and Stability. After done the instrument BKF_EL0026 calibrated pass all.		
<b>Service Overview Code:</b> Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
<b>Reported Hours:</b> 8.0	<b>Travel Hours:</b> 1.0	
<b>Customer Field Service Representative Name:</b> Panthap Kureathaine	<b>Customer Field Service Representative Signature:</b> 	<b>Date:</b> 12 Dec 2023
<b>Customer Name:</b> Supakwan Mak	<b>Customer Signature:</b> 	<b>Date:</b> 12 Dec 2023
<b>Additional Comments:</b>		

Page 3 of 3



## Metrological Center

SCI ECO Services Company Limited

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


Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 1 of 6

## Certificate of Calibration

Equipment : HEATING BLOCK  
Manufacturer : Environmental Express  
Model : SC 196  
Serial No. : 6974CECW3285  
Customer Code : BKK\_EL0054  
ID No. : T5306A3  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
Khet Suan Luang, Bangkok 10250  
Customer Location : Acid Digestion Lab  
Date of Receipt : 13 September 2023  
Calibrated By : Saneek Musikawan ( Site Calibration Manager )  
Approved By :  / Sujjar Naknakred ( Site Calibration Manager )  
Date of Issue : 26 SEP 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L12 109/30-05-57



## Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 2 of 6

## Calibration Report

Equipment : HEATING BLOCK  
Date of Calibration : 22 September 2023  
Environment : Temperature : 21.8-23.1 °C  
Line Voltage : 221.6-226.3 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

- This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024
- This certificate is traceable to :  
National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244 )
- Condition of calibrated item : good  
Equipment Description :

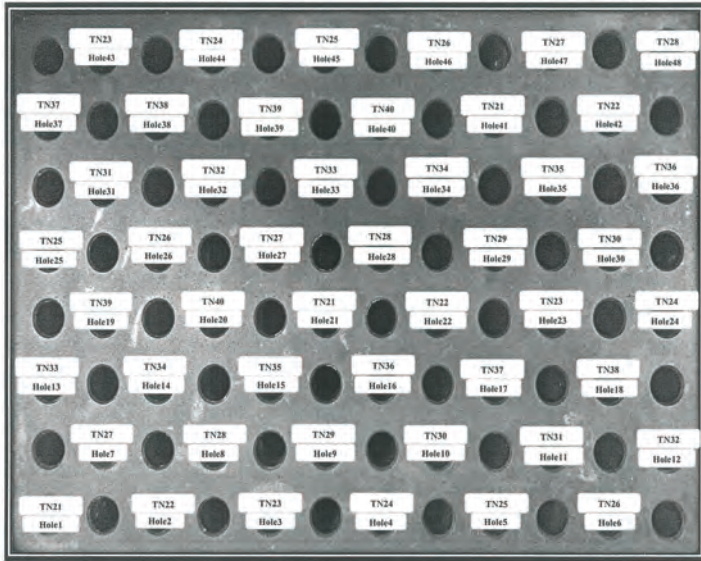
Time Constant	2	Hour	20	Minute	At	95	°C
Fresh Air Damper	<input type="checkbox"/> Open	<input type="checkbox"/> Min	<input type="checkbox"/> Medium	<input type="checkbox"/> Max			
	<input type="checkbox"/> Close						
	<input checked="" type="checkbox"/> Not Available						
- Adjustment :  
( ) without adjustment ( X ) after adjustment

Approved By: 

FM-L13 108/30-05-57



## Calibration Report



FRONT CONTROL

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	95.17
95	Min	94.57	93.95	94.75	94.92	94.00
	Average	94.79	94.18	94.98	95.17	94.26
R2 Hole7-Hole12	TN27	TN28	TN29	TN30	TN31	TN32
	Max	95.36	95.43	95.19	95.16	95.35
	Min	94.94	94.95	94.72	94.71	94.90
	Average	95.15	95.19	94.96	94.94	95.13
R3 Hole13-Hole18	TN33	TN34	TN35	TN36	TN37	TN38
	Max	95.37	95.50	95.22	95.21	95.33
	Min	94.99	95.09	94.78	94.82	94.88
	Average	95.18	95.30	95.00	95.02	95.11
R4 Hole19-Hole24	TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.59	94.42	94.52	94.24	94.63
	Min	95.21	94.06	94.13	93.88	94.28
	Average	95.40	94.24	94.33	94.06	94.45
R5 Hole25-Hole30	TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.93	95.30	95.14
	Min	94.83	95.03	92.56	94.95	94.79
	Average	95.01	95.20	92.75	95.12	94.96
R6 Hole31-Hole36	TN31	TN32	TN33	TN34	TN35	TN36
	Max	94.63	94.90	94.77	94.31	94.24
	Min	94.24	94.55	94.44	93.98	93.92
	Average	94.43	94.72	94.60	94.14	94.08
R7 Hole37-Hole42	TN37	TN38	TN39	TN40	TN21	TN22
	Max	94.30	94.44	94.04	93.81	94.89
	Min	93.95	94.05	93.67	93.48	94.39
	Average	94.13	94.24	93.86	93.65	94.64
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	Max	95.99	95.63	95.28	95.29	95.45
	Min	95.57	95.15	94.82	94.84	94.99
	Average	95.78	95.39	95.05	95.07	95.22

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44
105	Min	104.94	103.95	105.15	105.04	104.11
	Average	105.09	104.13	105.29	105.15	104.28
R2 Hole7-Hole12	TN27	TN28	TN29	TN30	TN31	TN32
	Max	105.30	105.12	105.18	105.22	105.12
	Min	105.11	104.92	104.96	105.00	104.92
	Average	105.20	105.02	105.07	105.11	105.02
R3 Hole13-Hole18	TN33	TN34	TN35	TN36	TN37	TN38
	Max	105.37	105.63	105.02	104.80	104.69
	Min	105.17	105.37	104.75	104.59	104.50
	Average	105.27	105.50	104.88	104.69	105.09
R4 Hole19-Hole24	TN39	TN40	TN21	TN22	TN23	TN24
	Max	105.31	104.43	106.41	104.71	105.63
	Min	105.08	104.22	106.15	104.41	105.37
	Average	105.19	104.33	106.28	104.56	105.50
R5 Hole25-Hole30	TN25	TN26	TN27	TN28	TN29	TN30
	Max	104.95	106.26	103.34	105.78	105.59
	Min	104.67	105.96	103.08	105.56	105.36
	Average	104.81	106.11	103.21	105.67	105.48
R6 Hole31-Hole36	TN31	TN32	TN33	TN34	TN35	TN36
	Max	104.75	104.86	104.80	105.20	104.50
	Min	104.54	104.63	104.59	105.00	104.32
	Average	104.65	104.75	104.69	105.10	104.41
R7 Hole37-Hole42	TN37	TN38	TN39	TN40	TN21	TN22
	Max	104.30	104.90	104.85	104.65	104.88
	Min	104.09	104.72	104.66	104.49	104.63
	Average	104.19	104.81	104.75	104.57	104.76
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	Max	105.71	105.85	105.39	105.61	105.42
	Min	105.45	105.61	105.14	105.27	105.18
	Average	105.58	105.73	105.27	105.44	105.30

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57

## Calibration Report

### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min, Max	Average		
100.0	100.3, 100.5	100.4	0.26	0.81
107.0	107.0, 107.1	107.1	0.19	0.78

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57



Certificate No. T232160

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber ( Cooling Room )

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK\_EN0167

ID No. : T2463A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Laboratory

Date of Receipt : 29 November 2023

Calibrated By : Atiphong Rongrat ( Technician )

Approved By : Boonchai Suriyawong ( Site Calibration Manager )

Date of Issue : 09 JAN 2024

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 11/15-08-66

Certificate No. T232160

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )

Date of Calibration : 6 December 2023

Environment : Temperature : 23.4-24.9 °C

Line Voltage : 221.4-230.2 V

Relative Humidity : 55 - 65 %RH

## Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ) .

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

## 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

## 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TIS-17025 CALIBRATION 0244 )

## 4. Condition of calibrated item : good

## Equipment Description :

Time Constant	1 Hour	30 Minute	At 3 °C
Fresh Air Damper	<input type="checkbox"/> Open	<input type="checkbox"/> Min	<input type="checkbox"/> Medium <input type="checkbox"/> Max
	<input type="checkbox"/> Close		
	<input checked="" type="checkbox"/> Not Available		

## 5. Adjustment :

( X ) without adjustment

( ) after adjustment

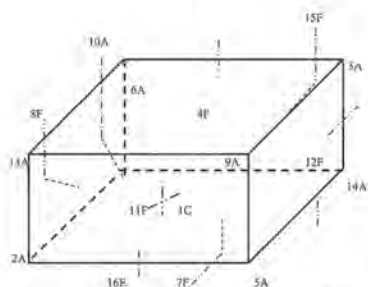
Approved By : Boonchai Suriyawong

FM-L15 11/15-08-66

Certificate No. T232160

Page 3 of 4

## Calibration Report



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

1C = TN161	12F = TN172
2A = TN162	13A = TN173
3A = TN163	14A = TN174
4F = TN164	15F = TN175
5A = TN165	16E = TN176
6A = TN166	
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	
11F = TN171	

Approved By : Boonchai Suriyawong

FM-L15 11/15-08-66

Certificate No. T232160

Page 4 of 4

## Calibration Report

## Measurement Results

Calibration Point	Average Standard Reading at each position (°C)							
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168
3.0	2.83	3.34	2.95	3.46	3.45	3.76	3.25	3.46
	TN173	TN174	TN175	TN176				
	3.33	3.39	3.13	3.43				

Chamber ( Cooling Room )		Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)
	Min	Max				
3.0	2.8	4.1	3.5	3.36	1.10	2.00

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By : Boonchai Suriyawong

FM-L15 11/15-08-66

REVIEW BY	อนันต์ จ.
APPROVED BY	Smita N
NEXT CAL. DATE	24/05/24

Serial-No.: K170A0143 Customer-No.:  
Date: 24 May 2023 Carried out by: Srichai Fak-on

Maintenance with following Operational Qualification (OQ)  
(requires a separate OQ protocol) ☐

Company	บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด
User	
Department	ห้องแล็บปฏิบัติการ
Street	104 ซอย 40 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง
Zip Code, City	กรุงเทพมหานคร 10250
Country	ประเทศไทย
Phone	
Fax	
E-mail	

## Maintenance Protocol

### Atomic Fluorescence Spectrometer mercur DUO / mercur DUO plus

#### Maintenance works basic unit

tightness visual check inside the Mercur	<input checked="" type="checkbox"/>
visual check if gold-traps are broken	<input checked="" type="checkbox"/>
visual check if spectrometer is contaminated	<input checked="" type="checkbox"/>
visual check of the fluorescence cell	<input checked="" type="checkbox"/>
visual check of the absorption cell, incl. window	<input checked="" type="checkbox"/>
reactor cleaning	<input checked="" type="checkbox"/>
check pump-hose, if necessary change it	<input checked="" type="checkbox"/>
check swivel drive (SEV)	<input checked="" type="checkbox"/>
check drying-hose, output gas-liquid-separator	<input checked="" type="checkbox"/>
test Bubble-Sensor	<input checked="" type="checkbox"/>
check gas flows	<input checked="" type="checkbox"/>
check volume flows, reagents	<input checked="" type="checkbox"/>
recording stray light values	<input checked="" type="checkbox"/>
measurement with 30 ng/l	<input checked="" type="checkbox"/>

#### Maintenance works Autosampler

Serial No.: 701 739

lubricate the dosing-winding (Teflon-grease-spray)	<input checked="" type="checkbox"/>
clean the dosing cylinder, if necessary exchange it	<input checked="" type="checkbox"/>
lubricate the winding system of the height drive with some drops of oil	<input checked="" type="checkbox"/>
check the toothed belt	<input checked="" type="checkbox"/>
check the position of the mechanical stopper (height: 13mm )	<input checked="" type="checkbox"/>
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	<input checked="" type="checkbox"/>
check the pump rate of washing cup	<input checked="" type="checkbox"/>
check the electrical hose connections for good contact	<input checked="" type="checkbox"/>
check the connectors of the magnetic valves	<input checked="" type="checkbox"/>
check the dosing hose for buckling, if necessary exchange it	<input checked="" type="checkbox"/>

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor	o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
Valve 1	10 Nl/h or 0.166 NL/min	0.163 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.403 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.140 NL/min
Valve 4	10 Nl/h or 0.166 NL/min	0.108 NL/min
Check liquidflow		
Acid	2.5ml/min ± 1 ml	2.5 ml/min
Red.-agent	2.5ml/min ± 1 ml	2.5 ml/min
Sample	10ml/min ± 2 ml	10 ml/min
Adventitious light - values	(V)	from file
100	0	0
200	0	0
300	0	0
350	0	0
400	0	0
450	2	2
500	5	5
550	10	10
575	15	14
600	20	20



Device parameter	nominal value	actual value
<b>Analytical parameters Fluorescence cell</b>		
Conditions.: max.conc.: 10µg/L PMT-voltage: 360 V		
Blank-solution without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int. 0.00024 Int <sub>1</sub> 0.00172 RSD 0.45 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 352 V		
Blank-solution with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int. 0.00370 Int <sub>1</sub> 0.01069 RSD 2.38 %
Fok.- factor ( Int <sub>2</sub> / Int <sub>1</sub> )	> 3.5	6.16
<b>Analytical parameters Absorption cell</b>		
Blank-solution without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext. 0.00093 Ext. 0.00449 RSD 2.58 %
<b>Comments</b>		

Signature Technician

24 May 2023

Place, Date (DD/MM/YYYY)

Signature Customer

24 May 2023

Place, Date (DD/MM/YYYY)

## Service Report

Customer's address:	Customer's Ref. No.		
25th Avenue Industrial Park (Chang) Bldg.			
101 200 40 Industrial Park (Chang) Bldg.			
Phonphraphong Road			
E-mail:	Phone:	Fax:	
Job No. 2305282 PM	User:	Service Engineer: N. N. N.	
Instrument model: Mercur	Serial No. K170A0143	Date: 24/5/2023 Page: 1/1	
<input type="checkbox"/> Repair (RE)	<input checked="" type="checkbox"/> Maintenance (PM)	<input type="checkbox"/> Installation (IN)	
<input type="checkbox"/> Warranty	<input type="checkbox"/> Application (AP)	<input type="checkbox"/> Site Prep (SP)	
<input type="checkbox"/> Visit (VI)	<input type="checkbox"/> Error Code		
Fault / Claim:	- maintenance instrument report for No. 2305282 PM (170A0143)		
- 150 min PM Contract Year 2023 (1 Time / Year 2023)			
Action taken:	- Maintenance not Basic Unit - Check Device parameter. - Check gas flow - Check liquid flow - Check Advantitious light - values # Test run Analytical parameter Fluorescence cell Test run Analytical parameter Absorption cell		
Action Pending / Recommendation:	maintenance plan		
<input type="checkbox"/> Spare Part	<input type="checkbox"/> Instrument Configuration:		
Item No.	Name	Quantity	Unit Price
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
Hereafter the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts.		Date / Signature of Customer	Date / Signature of Service Engineer
*Traveled hours and kilometers can only be entered after the return of the service engineer.		Orawan T.	N. N. N.
Services are subject to the General Terms and Conditions of Analytik Jena AG, which will be sent on request.		Work completed?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

5/24/2023 12:46 Page 1/4

## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro\_032  
Program version: 4.7.10.0 Printed on: 5/24/2023 12:46  
Recording started on 5/24/2023 12:35 GMT+7.0

Operator: PSU,OTA  
Laboratory: ALS-BKK  
Code: II\_Hg095\_2023

Remarks:  
Food,water

## Method parameters

Method Without enrichment / FBR 30ng/L\_PM24052023  
Created on 5/24/2023 Time 12:27  
Program

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	30 s
PMT	360 V	Peak smoothing	8/5
AZ time	5 s		
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 NL/h
<b>Autosampler</b>			
Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		

Dilution

5/24/2023 12:46 Page 2/4

## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep. measurement	off	QC std. 2 no.	1(30.000 ng/L)
QC std. 1 no.	1(30.000 ng/L)	QC std. 2 limit	± 50.00%
QC std. 1 limit	± 50.00%	Reaction	flag + continue
QC std. act.	flag + continue	Reaction	off
Expect. blank abs.	0.0100± 0.0100	QC Recal.factor	Off
QC precision	off		

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	79	0.000	H: 0.000249 A: 0.004274	0.000132 0.001668	53.13 39.72
2	Cal-Std1	(--)	80	30.000	H: 0.001720 A: 0.02172	0.000067 0.000023	0.469 0.107

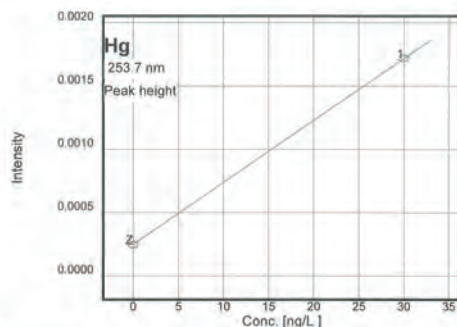
## Calibration function 1 5/24/2023 12:44 Calibration (Peak height)

Ints=k1+k2\*conc

k1=0.000249 k2=0.000049

Recal. factor: ---

Slope	0.00005 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



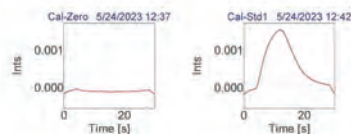
## Measurements and events (sorted by time)

Hg ID	Without enrichment / FBR 30ng/L PM 24052023	5/24/2023 12:35
Conc.	Ints	Time
Cal-Zero	0.000143	12:37
	0.000397	12:38
	0.000207	12:40
0ng/L	0.000249	12:40
Cal-Std1	0.001720	12:42
	0.001712	12:43
	0.001728	12:44
30.00ng/L	0.001720	12:44
Calibration	Calibration function: 01	12:44

Mercur

## Peak plots

Hg



## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro\_033

Program version: 4.7.10.0

Printed on:

5/24/2023 14:01

Operator: PSU,OTA

Recording started on

5/24/2023 13:37 GMT+7.0

Laboratory: ALS-BKK

Code: II\_Hg095\_2023

Remarks:

Food,water

## Method parameters

Hg

Method: Enrichment / FER 30ng/L PM\_24052023

Created on: 5/24/2023 Time: 13:36

Program: ---

## Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V	Peak smoothing	12/11
AZ time	5 s		
Delay	0 s		
Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	off	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	10 s	Gas AZ wait	10 NL/h
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	20 s		
Heat time coll.1	20 s	Cool. time coll.1	30 s

Mercur

## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep. measurement	off	QC std. 2 no.	1(30.000 ng/L)
QC std. 1 no.	1(30.000 ng/L)	QC std. 2 limit	± 50.00%
QC std. 1 limit	± 50.00%		
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

## Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

Hg

No	Name	State	Pos	Conc. / ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.003700 A: 0.02531	0.000081 0.000153	2.192 0.607
2	Cal-Std1	(--)	##	30.000	H: 0.01060 A: 0.06689	0.000253 0.002766	2.386 4.136

Mercur



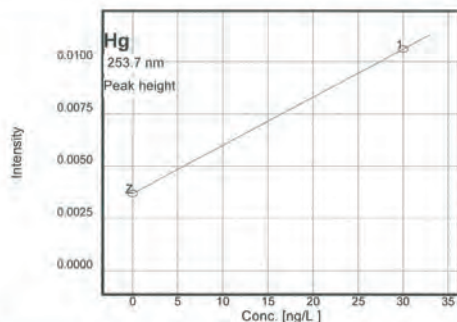
## Calibration function 1 5/24/2023 14:00 Calibration (Peak height)

Ints=k1+k2\*conc

k1=0.003700 k2=0.000230

Recal. factor: ---

Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



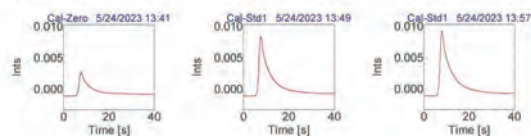
## Measurements and events (sorted by time)

Hg ID	Enrichment / FER	30ng/L	PM_24052023	5/24/2023 13:37
Conc.	Ints	BG	SD	RSD/%
Cal-Zero	0.003792			PkH
	0.003666			13:43
	0.003640			13:44
0ng/L	0.003700	0.000081090	2.192	13:44
Cal-Std1	0.009498			PkH
	0.008333			13:49
	0.008961			13:50
30.00ng/L	0.008931	0.0005830	6.528	13:52
Cal-Std1	0.01031			PkH
	0.01074			13:57
	0.01076			13:58
30.00ng/L	0.01080	0.0002530	2.386	14:00
Calibration	Calibration function: 01			14:00

Mercur

## Peak plots

Hg



## Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro\_034

Program version: 4.7.10.0 Printed on: 5/24/2023 14:33

Operator: PSU,OTA Recording started on 5/24/2023 14:19 GMT+7.0

Laboratory: ALS-BKK

Code: IL\_Hg095\_2023

Remarks:

Food,water

## Method parameters

Hg

Method Without enrichment / Abs / FBR 100ng/L\_PM 24052023

Created on 5/24/2023 Time 14:18

Program ---

## Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	225 V		
AZ time	5 s	Peak smoothing	2/5
Delay	8 s		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	5 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Delay	10 s		
Purge time1	50 s		
Purge time2	10 s	Gas wash time2	10 NL/h

Mercur

## QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std. 1 no.	1(100.00 ng/L)	QC std. 2 no.	1(100.00 ng/L)
QC std. 1 limit	± 50.00%	QC std. 2 limit	± 0.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

## Calibration settings

Calib. meth	Standard calib.		
No. standards	1	Calibr. unit	ng/L
Type of standards	---	Conversion fac.	1000000
		Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

## Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

Hg

No	Name	State	Pos	Conc. / ng/L	Abs.	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000932 A: 0.035926	0.000138 0.006208	14.88 17.28
2	Cal-Std1	(-)	##	100.00	H: 0.004494 A: 0.061286	0.000116 0.001275	2.586 2.082

Mercur

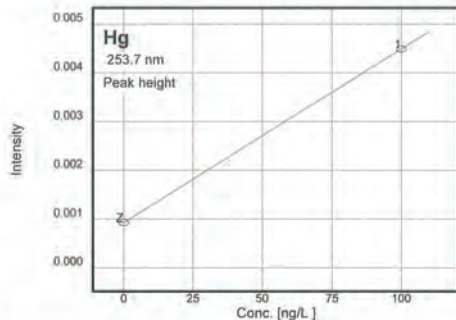
## Calibration function 1 5/24/2023 14:33 Calibration (Peak height)

Abs=k1+k2\*conc

k1=0.000932 k2=0.000036

Recal. factor: ---

Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



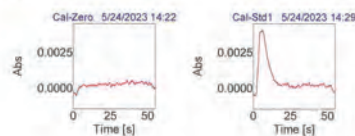
## Measurements and events (sorted by time)

Hg ID	Without enrichment / Abs / FBR 100ng/L_PM 24052023	5/24/2023 14:19
Conc.	Abs	Time
Cal-Zero	0.001039	14:22
	0.000775	14:23
	0.000981	14:25
0ng/L	0.000932	14:25
	0.004528	14:29
	0.004364	14:31
	0.004589	14:33
100.ng/L	0.004494	14:33
Calibration	Calibration function: 01	14:33

Mercur

## Peak plots

Hg



Mercur



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM1103  
Page: 1 of 3

## Certificate of Calibration

Equipment : Autoclave

Manufacturer : Sanyo

Model : MLS-3781

Serial No. : 830167

ID No. : BKK\_ML0037

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

Location : Media Preparation Room

Received Order : 17 July 2023

Calibration Date : 17 July 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by :

( ) Pornthippa Tameyakul

( ) Malee Butkruea

(✓) Suwit Injai

Issue Date : 24 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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



*P. Hlahib*  
Approved Signatory



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2307-0285OC-3

Cert. No.: 23TM1103  
Page: 2 of 3

## Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T. The temperature scale used was based on ITS-90.

## Condition of this result of calibration

## 1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013823	23LM66	TPA	25 Mar 2024

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

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

4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3\*\*

(\*\* = Categorization of pathogens according to hazard and categories of containment, second edition, 1990)  
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source



	Environmental		
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	22	53	220
Finished of Calibration	22	54	220

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	22-17TC-01
2 =	Temperature sensor	23-17TC-02
3 =	Exhaust port	19-17TC-03

a 1159503

A 0053615





Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2307-0285OC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM1103  
Page : 3 of 3

Operating parameter Set : Temperature = 121 °C  
Sterilization period = 15 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
121	121	1	120.877	0.39	0.12	1.0	2
		2	120.870				
		3	120.866				

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

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

UUC\* : Unit Under Calibration

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

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

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a 1159504



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/1 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM1146  
Page : 1 of 3

## Certificate of Calibration

Equipment : Incubator  
Manufacturer : SHEL-LAB  
Model : 1915A  
Serial No. : 0200599  
ID No. : BKK\_ML0010  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Location : Incubation & Micrological Reading  
Received Order : 17 July 2023  
Calibration Date : 17 July 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Man Pattanapongpaiboon

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
( ) Suwit Injai

Issue Date : 24 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0056489



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2307-0285OC-1  
Procedure Used :-

Cert. No.: 23TM1146  
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1 ) Data Acquisition	MY49001451	23LM27	TPA	25 Feb 2024

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

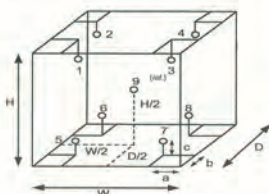
3. This certificate is traceable to the International System of Unit.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

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

Dimension of Chamber :

D = 0.50 m  
W = 0.75 m  
H = 1.2 m  
Capacity = 0.45 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	24	24
REL.Humid. ( % )	54	56
AC Supply ( Volt )	221	223

Position :	Ref. Std. ID No.:
1	19RTD-2/1
2	19RTD-2/2
3	19RTD-2/3
4	19RTD-2/4
5	19RTD-2/5
6	19RTD-2/6
7	19RTD-2/7
8	19RTD-2/8
9 (ref.)	19RTD-2/9

Malee

a 1172189



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2307-0285OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM1146  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
35.0	35.0	35.0	0.055	0.30	0.44	2

Calibration Point (°C)	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.888	34.933	34.815	34.813	35.064	35.019	35.156	35.141	35.087	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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Malee

a 1172188





Cert. No.: 22TM1571  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Binder

Model : ED 240/E2

Serial No. : 00-15533

ID No. : BKK\_ML0013

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

Location : Media Preparation Room

Received Order : 21 November 2022

Calibration Date : 21 November 2022

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Krisda Malee

Approved by :

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

Issue Date : 29 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0048150



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2211-0623OC-1

Cert. No.: 22TM1571  
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T.  
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44067817	22LM121	22 Aug 2023

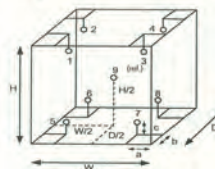
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) After Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :

a = 5.0 cm  
b = 5.0 cm  
c = 5.0 cm

Dimension of Chamber :

D = 0.50 m  
W = 0.80 m  
H = 0.60 m  
Capacity = 0.24 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	26	26
REL.Humid. ( % )	53	55
AC Supply ( Volt )	219	220

Position :	Ref. Std. ID No.:
1	21-15TC-01
2	21-15TC-02
3	21-15TC-03
4	21-15TC-04
5	21-15TC-05
6	21-15TC-06
7	21-15TC-07
8	21-15TC-08
9 (ref.)	21-15TC-09

a 1138049



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2211-0623OC-1  
Result of Calibration :- ( \* ) After Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 22TM1571  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
180	180	180	0.70	1.5	2.9	1.4	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
180	179.520	180.585	178.855	179.482	178.827	179.938	179.074	180.199	180.068

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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a 1138053



Cert. No.: 23TM637  
Page : 1 of 3

## Certificate of Calibration

Equipment : Water Bath

Manufacturer : Memmert

Model : WNE 45

Serial No. : L712.0429

ID No. : BKK\_ML0056

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

Location : Incubator & Microbiological Reading

Received Order : 20 April 2023

Calibration Date : 20 April 2023

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Kunchit Promprat

Approved by :

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

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0053357





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0253OC-1  
Procedure Used :-

Cert. No.: 23TM637  
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44073381	22LM78/1	12 May 2023

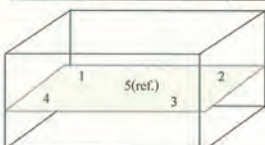
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This certification is traceable to the International System of Unit.

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

Function of UUC\* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	25	45	223
Finished of Calibration	25	43	223



Front

Position :	Ref. Std. S/N.:
1	4803988-006
2	4803988-007
3	4804539-014
4	4804539-015
5(ref.)	4804539-016

*Mal*

a 1158265



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0253OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM637  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )					Uncertainty  ( ± °C )
			Position					
			1	2	3	4	5 (ref.)	
44.5	44.5	44.5	44.492	44.463	44.475	44.510	44.491	0.15
45.0	45.0	45.0	45.005	44.962	44.979	45.016	44.986	0.15

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Coverage Factor k
44.5	0.051	0.022	2
45.0	0.080	0.026	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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*Mal*

a 1158264