

## ภาคผนวก จ

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เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



รายการเครื่องมือที่ใช้ในการวิเคราะห์ วัสดุ

right solutions.  
right partner.

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_F50022	-	-	-
Ambient	Total Suspended Particulate	High Volume	RYG_F50096	-	-	-
Ambient	Total Suspended Particulate	High Volume	RYG_F50181	-	-	-
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_F50732	4-Jan-25	4-Jul-25	6
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_F50731	4-Jan-25	4-Jul-25	6
Ambient	Nitrogen Dioxide	NO <sub>x</sub> Analyzer	RYG_F50457	4-Jan-25	4-Jul-25	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_F50733	4-Jan-25	4-Jul-25	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_F50730	4-Jan-25	4-Jul-25	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_F50458	4-Jan-25	4-Jul-25	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_F50609	18-Jul-24	18-Jan-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_F50143	20-Aug-24	20-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_F50141	20-Aug-24	20-Feb-26	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_F50213	16-Jan-25	16-Jan-26	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50016	19-Sep-24	19-Sep-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50017	27-Jan-25	27-Jan-26	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	19-Jan-24	19-Jul-25	18
Rayong Lab	Nitrate	Spectrophotometer	RYG_EN0037	18-Mar-25	18-Sep-26	18
Rayong Lab	Ammonia Nitrogen	pH meter	RYG_EN0183	18-Jan-24	18-Jul-25	18
Rayong Lab	Ammonia Nitrogen	SPECTROPHOTOMETER	RYG_EN0037	18-Mar-25	18-Sep-26	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0154	11-Jun-24	11-Dec-25	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	20-Jan-25	20-Jul-26	18
Rayong Lab	BOD	Incubator	RYG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	BOD	Burette	RYG_EN0216	24-Sep-24	24-Sep-25	12
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Mar-25	18-Sep-26	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	20-Feb-25	20-Feb-26	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_EN0188	11-Mar-24	11-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_EN0152	18-Jun-25	18-Dec-26	18
Water Lab	Total Phosphorus	Digestion Unit	BKK_EN0366	9-Apr-25	9-Apr-26	12
Water Lab	Total Phosphorus	Discrete analyzer	BKK_EN0037	16-Aug-24	16-Aug-25	12
Water Lab	Lead	ICP-MS	BKK_EL0043	4-Oct-24	3-Apr-26	18
Water Lab	Lead	Hot Block	BKK_EL0054	4-Mar-25	4-Sep-26	18
Water Lab	Lead	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Copper	ICP-MS	BKK_EL0043	4-Oct-24	3-Apr-26	18
Water Lab	Copper	Hot Block	BKK_EL0054	4-Mar-25	4-Sep-26	18
Water Lab	Copper	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Cadmium	ICP-MS	BKK_EL0043	4-Oct-24	3-Apr-26	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	4-Mar-25	4-Sep-26	18
Water Lab	Cadmium	Chamber (Cooling Room)	BKK_EN0167	4-Jun-25	4-Dec-26	18
Water Lab	Mercury	DUO-CVAFS / CVAAS	BKK_EL0023	12-Dec-20	12-Jun-26	18
Water Lab	Total Coliform	Autoclave	BKK_ML0043	26-Sep-24	26-Mar-26	18
Water Lab	Total Coliform	Incubator	BKK_ML0010	3-Dec-24	3-Dec-25	12
Water Lab	Total Coliform	Hot Air Oven	BKK_ML0013	23-Apr-24	23-Oct-25	18

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## High Volume Air Sampler Calibration Worksheet

Project Site : WHA Industrial Development Public Company Limited Barometric Pressure (mm Hg) : 754.3

Calibrate Location : โรงโม่ปูน Temperature (°C) : 29.0

Calibrate Date : 14-Feb-25 High Volume ID : RYG\_F50292

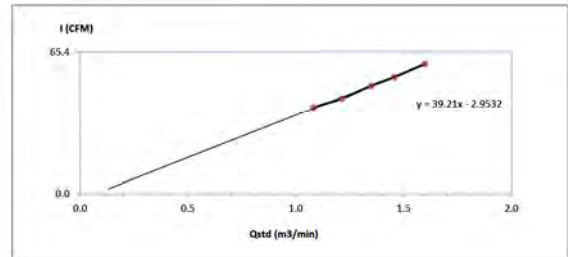
Calibration Sheet No. : C-140225-RYG\_F50292 High Volume Model : TE-S170D

Calibrator ID : RYG\_F50205 High Volume S/N : 5334

Calibrator Model : TE-S028A Calibrator Slope : 1.52567

Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0820	40	Slope : 39.2099
2	3.3	1.2145	44	Intercept : -2.9532
3	4.1	1.3495	50	Correlation Coefficient : 0.9983
4	4.8	1.4572	54	
5	5.8	1.5983	60	



Calibrated by

[Redacted Signature]

RYG-Field Services Scientist (2)

RYG-Field Services Section Head

FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



## High Volume Air Sampler Calibration Worksheet

Project Site : WHA Industrial Development Public Company Limited Barometric Pressure (mm Hg) : 754.3

Calibrate Location : เขตพัฒนาอุตสาหกรรมนิคม Temperature (°C) : 29.0

Calibrate Date : 14-Feb-25 High Volume ID : RYG\_F50396

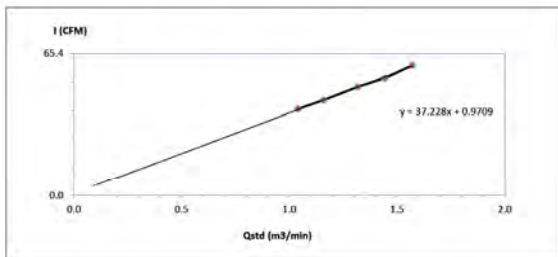
Calibration Sheet No. : C-140225-RYG\_F50396 High Volume Model : TE-S170D

Calibrator ID : RYG\_F50205 High Volume S/N : 5688

Calibrator Model : TE-S028A Calibrator Slope : 1.52567

Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.4	1.0410	40	Slope : 37.2285
2	3.0	1.1596	44	Intercept : 0.9709
3	3.9	1.3171	50	Correlation Coefficient : 0.9983
4	4.7	1.4424	54	
5	5.6	1.5711	60	



Calibrated by

[Redacted Signature]

RYG-Field Services Scientist (2)

RYG-Field Services Section Head

FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



## High Volume Air Sampler Calibration Worksheet

Project Site : WHA Industrial Development Public Company Limited Barometric Pressure (mm Hg) : 754.3

Calibrate Location : โรงโม่ปูน Temperature (°C) : 29.0

Calibrate Date : 14-Feb-25 High Volume ID : RYG\_F50181

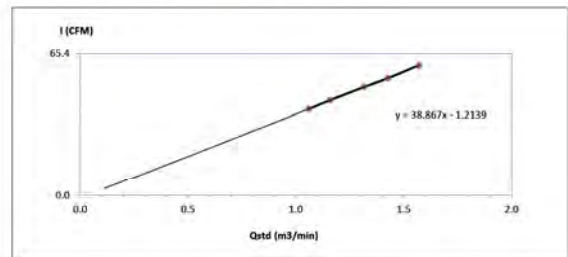
Calibration Sheet No. : C-140225-RYG\_F50181 High Volume Model : TE-S170D

Calibrator ID : RYG\_F50205 High Volume S/N : 5334

Calibrator Model : TE-S028A Calibrator Slope : 1.52567

Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.5	1.0617	40	Slope : 38.8672
2	3.0	1.1596	44	Intercept : -1.2139
3	3.9	1.3171	50	Correlation Coefficient : 0.9998
4	4.6	1.4273	54	
5	5.6	1.5711	60	



Calibrated by

[Redacted Signature]

RYG-Field Services Scientist (2)

RYG-Field Services Section Head

FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



# Certificate of Calibration

Model Number : LA130S-F  
Description : Analytical Balance  
Serial Number : 25409864  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius

Certificate No. : 24BCI0068  
Issued Date : Friday, February 23, 2024  
Reference No. : 228196

Page No. : 1 of 2

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

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

Calibrated By : Mr.Chonchai Inthana  
Calibration Date : Thursday, February 22, 2024

Calibration Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

Metrological data :  
Capacity : 150 g Readability : 0.0001 g

Ambients Conditions:  
Temperature : 23.6 °C ± 5.0 °C  
Humidity : 54.0 % RH ± 10.0 % RH  
Pressure : ±

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

Equipment Condition: ☒ Good Operate ☐ Fair

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

## Traceability:

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

This certificate relate and apply this equipment only.

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

SOP FM 33 03 February 2022

Mr.chonchai inthana(Technical Manager)



# Certificate of Calibration

Model Number : LA130S-F  
Description : Analytical Balance  
Serial Number : 25409864  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius

Certificate No. : 24BCI0068  
Issued Date : Friday, February 23, 2024  
Reference No. : 228196

Page No. : 2 of 2

## Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
<p>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.</p> <p>Nominal Value : (Low Load) 10 g Tolerance 0.0001 g</p> <p>Nominal Value : (High Load) 100 g Tolerance 0.0001 g</p> <p>Standard Deviation 0.00005 0.00006</p>	<p>The off-center loading error is yielded by the difference between the resultant of the load, i.e. 1/2 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).</p> <p>Nominal value : 50 g Tolerance 0.0004 g</p> <p>Difference 1 - 2 -0.0001 3 0.0001 4 0.0002 5 0.0000 6 -</p>

## Linearity

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

Tolerance 0.0002 g	Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
	0.01	0.0100	0.0100	0.0000	0.00020
	0.05	0.0500	0.0500	0.0000	0.00021
	0.1	0.1000	0.1000	0.0000	0.00021
	0.5	0.5000	0.5000	0.0000	0.00021
	1	1.0000	1.0000	0.0000	0.00021
	2	2.0000	2.0000	0.0000	0.00021
	5	5.0000	5.0000	0.0000	0.00021
	10	10.0000	10.0001	0.0001	0.00024
	20	20.0000	20.0001	0.0001	0.00021
	100	100.0000	99.9999	-0.0001	0.00024

End of Report.

SOP FM 33 03 February 2022

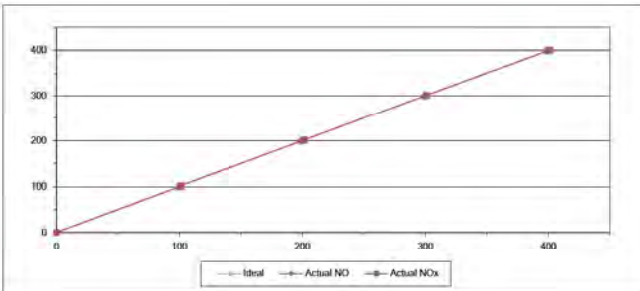


## MULTIPOINT CALIBRATION REPORT

Calibration Date : 4-Jan-25  
Manufacturer : Teledyne API  
Serial No. : 122  
Calibrator Manufacturer : Teledyne API  
Serial No. : 947  
Std. Gas Concentration (PPM) : 55.88  
Cylinder Pressure (psi) : 1800  
Certified Date : 9-Feb-22

Equipment Name : NOx Analyzer  
Model : N200  
Equipment ID : RYG\_FS0732  
Model : 700  
Cylinder No. : GN0027222  
Certified By : Airgas Inc.  
Expired Date : 9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	101.30	1.30	1.30
2	200.00	198.70	-1.30	-0.65	201.30	1.30	0.65
3	300.00	298.80	-1.20	-0.40	301.30	1.30	0.43
4	400.00	398.50	-1.50	-0.38	401.30	1.30	0.33
AVERAGE (%)				-0.43			0.56



Calibrated By

Approved By

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

(Mr.Sarayuth Jitranont)  
Assistant General Manager

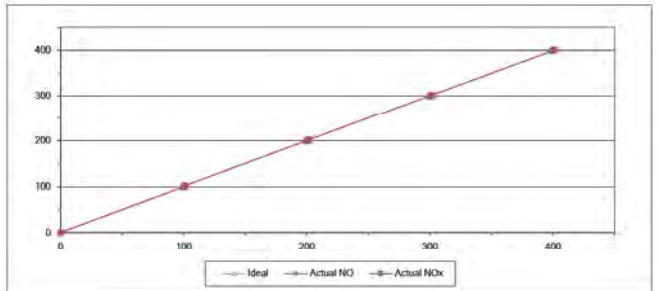


## MULTIPOINT CALIBRATION REPORT

Calibration Date : 4-Jan-25  
Manufacturer : Teledyne API  
Serial No. : 107  
Calibrator Manufacturer : Teledyne API  
Serial No. : 947  
Std. Gas Concentration (PPM) : 55.88  
Cylinder Pressure (psi) : 1800  
Certified Date : 9-Feb-22

Equipment Name : NOx Analyzer  
Model : N200  
Equipment ID : RYG\_FS0731  
Model : 700  
Cylinder No. : GN0027222  
Certified By : Airgas Inc.  
Expired Date : 9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.30	1.30	1.30
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.70	-1.30	-0.43	301.70	1.70	0.57
4	400.00	398.10	-1.90	-0.47	401.30	1.30	0.33
AVERAGE (%)				-0.51			0.59



Calibrated By

Approved By

Field Environmental Scientist (3)

Assistant General Manager

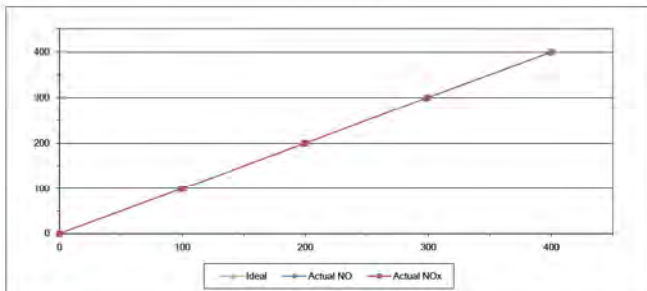




## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-25 Equipment Name NOx Analyzer  
Manufacturer HORIBA Model APNA-370  
Serial No. T2T8YRLL Equipment ID RYG\_FS0457  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222  
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70	100.30	0.30	0.30
2	200.00	198.40	-1.60	-0.80	199.80	-0.20	-0.10
3	300.00	297.70	-2.30	-0.77	298.50	-1.50	-0.50
4	400.00	398.60	-1.40	-0.35	400.50	0.50	0.13
AVERAGE (%)				-0.70			-0.01



Calibrated By

Approved By

(Mr. [Redacted])  
Field Environmental Scientist (3)

(Mr. [Redacted])  
Assistant General Manager

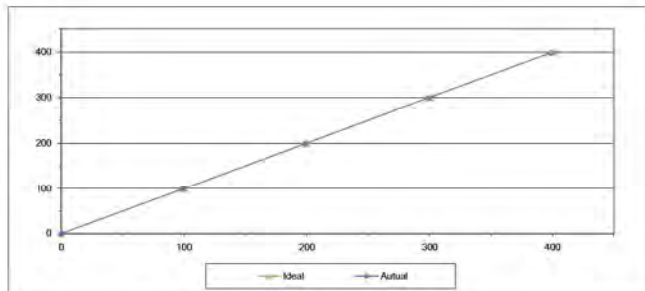
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-25 Equipment Name SO2 Analyzer  
Manufacturer Teledyne API Model N100  
Serial No. 115 Equipment ID RYG\_FS0733  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222  
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70
2	200.00	198.50	-1.50	-0.75
3	300.00	298.50	-1.50	-0.50
4	400.00	398.10	-1.90	-0.47
AVERAGE (%)				-0.66



Calibrated By

Approved By

(Mr. [Redacted])  
Field Environmental Scientist (3)

(Mr. [Redacted])  
Assistant General Manager

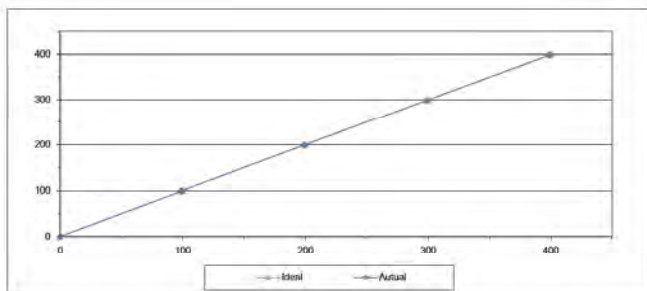
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-25 Equipment Name SO2 Analyzer  
Manufacturer Teledyne API Model N100  
Serial No. 114 Equipment ID RYG\_FS0730  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222  
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20
2	200.00	198.90	-1.10	-0.55
3	300.00	298.70	-1.30	-0.43
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				-0.49



Calibrated By

Approved By

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

(Mr. Sarayuth Jitranont)  
Assistant General Manager

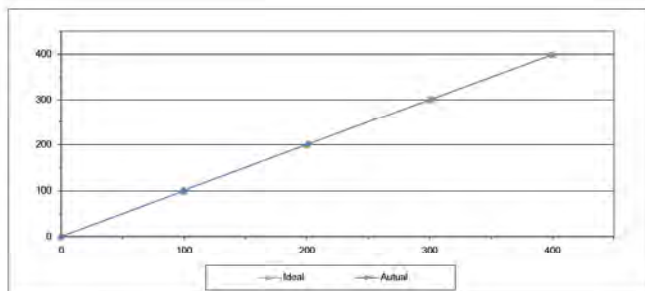
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-25 Equipment Name SO2 Analyzer  
Manufacturer HORIBA Model APSA-370  
Serial No. PAUY077A Equipment ID RYG\_FS0458  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222  
Cylinder Pressure (psi) 1800 Certified By Airgas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90
2	200.00	201.00	1.00	0.50
3	300.00	302.30	2.30	0.77
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				0.02



Calibrated By

Approved By

(Mr. [Redacted])  
Field Environmental Scientist (3)

(Mr. [Redacted])  
Assistant General Manager

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

Certificate Number

CWS-026-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE  
SERIAL NUMBER  
ID NUMBER  
CONDITION AS-RECEIVED  
CUSTOMER

1. Cup anemometer  
: Novasys  
: Sensor: WS-02F  
Data logger: 110-WS-250L-D  
: Sensor: WSD-A5910  
Data logger: AS910  
: RVG, JS0609  
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

08 Jul 2024  
18 Jul 2024  
18 Jul 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:  
Temperature  
Relative Humidity  
Atmospheric Pressure

: 23.0 ± 3.0 °C  
: 55.0 ± 15.0 %RH  
: 1010 ± 10 hPa

### PLACE OF CALIBRATION

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

### CALIBRATION CONDITIONS

: Wind tunnel cross-section area  
: 900 cm<sup>2</sup>  
Wind direction frontal area  
: 100 cm<sup>2</sup>  
Diameter of mounting pipe  
: 1.1 mm  
Blockage ratio of test object  
: 0.11 [-]

Preconditioning  
Measurement Condition

: 24 hours at ambient conditions.  
: The average values during measurement are (23.8) °C, (44.9) %RH and (1001.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thachakul  
☐ Miss Jitraporn Lertbongphol



Approved signature

REVIEW BY  
APPROVED BY  
NEXT CAL DATE



Remarks:  
1. Notice 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 "a"

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

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 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>u</sub> <sup>2</sup> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v <sub>u</sub> <sup>2</sup> (m/s)	Error (m/s)	U (k=2) (m/s)
0.997	23.70	23.80	0.9	-0.1	0.31
2.021	23.90	23.80	1.8	-0.2	0.31
2.990	23.70	23.80	2.9	-0.1	0.31
4.094	23.70	23.80	3.6	-0.3	0.31
4.97	23.72	23.80	5.0	0.0	0.31
5.97	23.60	23.80	6.0	0.0	0.31
7.04	23.80	23.80	7.0	0.0	0.31
7.98	23.62	23.80	8.0	0.0	0.31
9.00	23.72	23.80	9.1	0.1	0.31
9.98	23.50	23.80	10.1	0.1	0.31
10.97	23.70	23.80	11.1	0.1	0.31
12.04	23.90	23.80	12.1	0.1	0.31
13.66	23.80	23.80	13.1	0.1	0.31
14.10	23.50	23.80	14.2	0.1	0.31
15.04	23.70	23.80	15.2	0.2	0.31
15.97	23.60	23.80	16.2	0.2	0.31

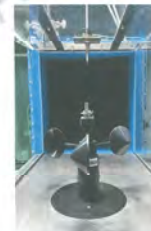
### Remark:

<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

CWD-026-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE  
SERIAL NUMBER  
ID NUMBER  
CONDITION AS-RECEIVED  
CUSTOMER

1. Wind Direction Sensor  
: Novasys  
: Sensor: WS-02F  
Data logger: 110-WS-250L-D  
: Sensor: WSD-A5910  
Data logger: AS910  
: RVG, JS0609  
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

08 Jul 2024  
18 Jul 2024  
18 Jul 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:  
Temperature  
Relative Humidity  
Atmospheric Pressure

: 23.0 ± 3.0 °C  
: 55.0 ± 15.0 %RH  
: 1010 ± 10 hPa

### PLACE OF CALIBRATION

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

### CALIBRATION CONDITION

: Wind tunnel cross-section area  
: 900 cm<sup>2</sup>  
Wind direction frontal area  
: 129 cm<sup>2</sup>  
Diameter of mounting pipe  
: 1.1 mm  
Blockage ratio of test object  
: 0.143 [-]

Preconditioning  
Measurement Condition

: 24 hours at ambient conditions.  
: The average values during measurement are (22.2) °C, (47.5) %RH and (1001.7) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thachakul  
☐ Miss Jitraporn Lertbongphol



Approved signature

REVIEW BY  
APPROVED BY  
NEXT CAL DATE



Remarks:  
1. Notice 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 "a"

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

Certificate Number

CWD-026-67

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 <sup>1</sup> <sub>rot</sub> Degree (°)	D <sup>2</sup> <sub>rot</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.80
	45.000	44	-1	0.80
	90.000	87	-3	0.80
	135.000	131	-4	0.80
5.04	180.000	176	-4	0.80
	225.000	222	-3	0.80
	270.000	272	2	0.80
	315.000	320	5	0.80

### 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\*\*\*





## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-121-67

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
: Data Logger with Temperature sensor  
**MANUFACTURER**  
: Novolyse  
**MODEL/TYPE**  
: 110-WS-25DL-D  
**SERIAL NUMBER**  
: AS910  
**ID NUMBER**  
: RYG\_150609  
**CONDITION AS-RECEIVED**  
**CUSTOMER**  
: Used item  
: ALS laboratory group (Thailand) Co., Ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd.,  
Khuang Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE**  
: 06 Jul 2024  
**MEASUREMENT DATE**  
: 18 Jul 2024  
**ISSUE DATE**  
: 18 Jul 2024

### ENVIRONMENTAL CONDITIONS:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

**Calibration procedure:**  
The temperature calibration was done by in-house calibration method as WPCT-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

**Traceability:**  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: IT-0047-24, Certificate number: ER-0101-23

**Reference Used During Calibration:**  
1. Standard Temperature Probe  
Model: STS-100 A150Q, Serial No.: 967682-05,  
Due date: 26 Mar 2025  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 673407-00591 Due date: 14 Sep 2024

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

Calibrated by:  
☐ Mr. Sorawit Thachalad  
☒ Miss Jiraporn Lertsomphol  
☐ Miss Ruangrumpal Phoommit



Approved signature  
Mr. Panyra Booncharoen  
Calibration Department Manager

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

Continuation of Certificate of Calibration Number CDT-121-67

Page 2 of 2 Pages

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 °C to 40 °C

### Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: U3641223.  
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.047	19.6	-0.4	0.099
80	25.043	24.6	-0.4	0.099
80	30.034	29.7	-0.3	0.099
80	35.028	34.7	-0.3	0.099
80	40.018	39.5	-0.5	0.099

UUC\*: Unit Under Calibration

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

## CERTIFICATE OF CALIBRATION

Certificate No. : CRT-023-67

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
: Relative humidity with data logger  
**MANUFACTURER**  
: Novolyse  
**MODEL/TYPE**  
: Data Logger: 110-WS-25DL-D  
Sensor: HMP60  
**SERIAL NUMBER**  
: Data Logger: AS910  
Sensor: U3641223  
**ID NUMBER**  
: RYG\_150609  
**CONDITION AS-RECEIVED**  
**CUSTOMER**  
: Used item  
: ALS laboratory group (Thailand) Co., Ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd, Khuang Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE**  
: 08 Jul 2024  
**MEASUREMENT DATE**  
: 18 Jul 2024  
**ISSUE DATE**  
: 18 Jul 2024

### ENVIRONMENTAL CONDITIONS:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

**Calibration procedure:**  
The Relative Humidity and Air Temperature calibration was done by in-house calibration method as WPCT-001 and WPCT-070 according to comparison method with Standard chilled mirror hygrometer with Temperature sensor and standard humidity generator chamber.

**Traceability:**  
The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH6079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-021-67.

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

Calibrated by:  
☐ Mr. Sorawit Thachalad  
☒ Miss Jiraporn Lertsomphol  
☐ Miss Ruangrumpal Phoommit



Approved signature  
Calibration Department Manager

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

Continuation of Certificate of Calibration Number: CRT-023-67

Page 2 of 2 Pages

### Measurement Result:

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

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 20 °C are reported in table below.  
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ± (%RH)
29.79	19.30	17.7	-1.6	0.83
29.83	50.52	47.9	-2.7	1.3
29.80	81.80	78.0	-3.8	2.3

UUC\*: Unit Under Calibration

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

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Nowlyne  
**MODEL/TYPE** : Sensor: WS-029  
Data logger: WS-25DL  
**SERIAL NUMBER** : Sensor: WSD-A4562  
Data logger: A4562  
**ID NUMBER** : BKK\_150143  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasukan 40, Phatthanasukan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 08 Aug 2024  
**MEASUREMENT DATE** : 20 Aug 2024  
**ISSUE DATE** : 20 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH  
Atmospheric Pressure : 100.0 ± 10 hPa

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

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area<sup>1</sup> : 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> : 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> : 1 mm  
Blockage ratio of test object<sup>4</sup> : 0.111 1/1

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.2) °C, (41.9) %RH and (1007.9) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thachitad  
☐ Miss Jitraporn Lertsomphol

**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 1/10

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

**Calibration procedure:**  
The Cup anemometer was calibrated against Standard air velocity transducer model: 845502 and pilot tube with precision differential pressure meter model: DPM2500 in anemometer calibration of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WS-029 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 a 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 NMI (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0055-23

### Uncertainty of Measurement:

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

Approved signature

REVIEW BY

APPROVED BY

NEXT CAL. DATE 20/12/26

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pilot tube with precision differential pressure meter which was installed 20 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under rising and falling air velocity in the range of 1 m/s to 36 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> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>UUC</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.959	23.88	24.20	0.9	-0.1	0.37
2.043	24.42	24.20	1.8	-0.2	0.31
3.582	25.80	24.20	2.9	-0.1	0.31
4.108	23.82	24.20	3.8	-0.3	0.31
4.97	23.62	24.20	4.9	-0.1	0.31
5.95	23.94	24.20	6.0	0.0	0.31
7.01	23.46	24.20	7.0	0.0	0.31
7.96	23.80	24.20	8.0	0.0	0.31
8.98	23.90	24.20	9.1	-0.1	0.31
9.96	23.74	24.20	10.1	0.1	0.31
10.94	24.00	24.20	11.1	0.2	0.31
12.61	23.82	24.20	12.2	0.2	0.31
12.92	24.00	24.20	12.4	0.2	0.31
14.05	23.86	24.20	14.2	0.2	0.31
15.00	24.00	24.20	15.2	0.2	0.31
15.93	23.96	24.20	16.2	0.2	0.31

### Remarks:

<sup>1</sup> Calibration results only cover 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\*\*\*  
J NAC  
JIRANATEE ASSOCIATES CO., LTD.

Certificate Number:

CWD-030-67

Page 2 of 2 Pages

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

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise 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>std</sub> Degree (°)	D <sub>UUC</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	95.000	41	-4	0.89
	90.000	7	-3	0.89
	135.000	132	-3	0.89
	180.000	181	1	0.89
	225.000	229	4	0.89
	270.000	275	5	0.89
	315.000	320	5	0.89
	360.000	359	-1	0.89

### Remarks:

<sup>1</sup> Calibration results only cover 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\*\*\*  
J NAC  
JIRANATEE ASSOCIATES CO., LTD.

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Nowlyne  
**MODEL/TYPE** : Sensor: WS-029  
Data logger: WS-25DL  
Sensor: WSD-A4562  
Data logger: A4562  
**SERIAL NUMBER** : BKK\_150143  
**ID NUMBER** : BKK\_150143  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasukan 40, Phatthanasukan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 08 Aug 2024  
**MEASUREMENT DATE** : 20 Aug 2024  
**ISSUE DATE** : 20 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH  
Atmospheric Pressure : 100.0 ± 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>  
Wind direction frontal area<sup>2</sup> : 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> : 1 mm  
Blockage ratio of test object<sup>4</sup> : 0.143 1/1

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.7) °C, (42.6) %RH and (1007.9) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thachitad  
☐ Miss Jitraporn Lertsomphol

**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 1/10

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

**Calibration procedure:**  
The wind direction sensor was calibrated against Standard Rotary Encoder model: A1900075 DMS-P15-L10 in anemometer calibration of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WS-029 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 a 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 NMI (National Metrology Institute of Thailand) via Certificate number: DI-0036-23

### Uncertainty of Measurement:

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

Approved signature

REVIEW BY

APPROVED BY



## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Cup anemometer  
Novallisa  
Sensor: WS-028  
Data logger: WS-250L

### SERIAL NUMBER

Sensor: WSD-A4481  
Data logger: AA481

### ID NUMBER

84X\_F50141

### CONDITION AS RECEIVED

Used item

### CUSTOMER

ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

### RECEIVED DATE

08 Aug 2024

### MEASUREMENT DATE

20 Aug 2024

### ISSUE DATE

20 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

### PLACE OF CALIBRATION

Diffel type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITIONS

Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 109 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - 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 (23.9) °C, (42.7) %RH and (1005.0) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lerttongphol

### Remark:

<sup>1</sup> Actual gross 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  $\frac{A_o}{A_t}$

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

### Calibration procedure:

The Cup anemometer was calibrated against Standard air velocity transducer model (WSD-028) and prior tube with precision differential pressure meter model (DPA-250L) in anemometer section of Diffel type wind tunnel with 900 cm<sup>2</sup> cross section area. The W-CL-001 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 a 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-0007-24 and MW-0005-23

### Uncertainty of Measurement:

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



Approved signature:

REVIEW BY: *Markon P*  
APPROVED BY: *4/4*  
NEXT CAL. DATE: 20/8/26

Certificate Number

CWQ-029-67

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 16 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 16 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the power plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$v_{std}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{std}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
1.015	23.50	23.90	0.8	-0.2	0.31
2.041	24.28	23.90	1.8	-0.2	0.31
3.007	23.30	23.90	2.9	-0.1	0.31
4.108	23.34	23.90	3.8	-0.3	0.31
4.98	23.36	23.90	5.0	0.0	0.31
5.95	23.50	23.90	6.0	0.1	0.31
7.02	23.34	23.90	7.1	0.1	0.31
7.96	23.30	23.90	8.0	0.3	0.31
8.98	23.26	23.90	9.1	0.3	0.31
9.96	23.16	23.90	10.1	0.1	0.31
10.95	23.50	23.90	11.1	0.1	0.31
12.02	23.30	23.90	12.2	0.1	0.31
12.94	23.50	23.90	13.2	0.2	0.31
14.08	23.28	23.90	14.2	0.1	0.31
15.02	23.60	23.90	15.2	0.2	0.31
15.95	23.50	23.90	16.3	0.3	0.31

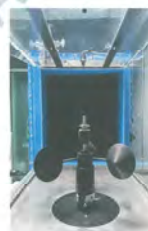
### Remark:

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

<sup>2</sup> Velocity of standard

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\*\*\*

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor  
Novallisa  
Sensor: WS-028  
Data logger: WS-250L

### SERIAL NUMBER

Sensor: WSD-A4481  
Data logger: AA481

### ID NUMBER

84X\_F50141

### CONDITION AS RECEIVED

Used item

### CUSTOMER

ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

### RECEIVED DATE

08 Aug 2024

### MEASUREMENT DATE

20 Aug 2024

### ISSUE DATE

20 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

### PLACE OF CALIBRATION

Diffel type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITION

Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.143 [-]

### Preconditioning

24 hours at ambient conditions.

### Measurement Condition

The average values during measurement are (23.7) °C, (45.7) %RH and (1007.7) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lerttongphol

### Remark:

<sup>1</sup> Actual gross 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  $\frac{A_o}{A_t}$

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

### Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder, model: AA481/31/3104A-P3-S-10 in anemometer section of Diffel type wind tunnel with 900 cm<sup>2</sup> cross section area. The W-CL-001 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 a 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: DA-0016-23

### Uncertainty of Measurement:

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



Approved signature:

REVIEW BY: *Markon P*  
APPROVED BY: *4/4*  
NEXT CAL. DATE: 20/8/26

Certificate Number

CWQ-029-67

Page 2 of 2 Pages

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

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise 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 (°)	$D_{UUC}$ Degree (°)	Error Degree (°)	$U$ (k=2) Degree (°)
5.01	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	134	-1	0.80
	180.000	182	2	0.80
	225.000	230	5	0.80
	270.000	275	5	0.80
	315.000	320	5	0.80
	360.000	359	-1	0.80

### Remark:

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

<sup>2</sup> Direction of standard

Direction of Unit Under Calibration

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





### Certificate of Calibration

#### Customer

Name : ALS Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang,  
Bangkok 10250

Certificate No : 25-ACT-010  
Request No : Req-2025-0091

#### Unit Under Calibration Details

Measurement item : Acoustic Calibrator  
Manufacturer : RION  
Model : NC-74  
Serial Number : 34178121  
ID : RYG\_FS0213  
Class : 1  
Range : 94 dB / 1000 Hz  
Instrument Status : Used

#### Calibration Environment and Details

Temperature : (23 ± 2 °C)  
Humidity : (50 ± 20 %RH)  
Barometric Pressure : (1013 ± 10.0 hPa)  
Received Date : 15 January 2025  
Calibration Date : 16 January 2025  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

REVIEW BY : *Nathakorn P.*  
APPROVED BY : *[Signature]*  
NEXT CAL DATE : 16/01/26

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	12 June 2025
THD Multimeter	2015	1047765	NIMT	16 January 2025

**Traceability** : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

#### Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor  $k=2$ , providing a level of confidence approximately 95 %.

#### Calibrated By :

*[Signature]*  
Service Calibration Engineer

Calibration Engineer Supervisor

Issue Date : 16 January 2025

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-ACT-02 Rev.03 Issue date 5/6/24

Certificate No : 25-ACT-010

Request No : Req-2025-0091

#### Sound pressure level

#### Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	94.11	0.11	-	-	0.13	0.25	Pass

#### Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
	Measured (Hz)	Deviated	Measured (Hz)	Deviated			
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70	Pass

#### Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
	Measured (%)	Deviated	Measured (%)	Deviated			
94 dB / 1000 Hz	1.21	-	-	-	0.40	2.5	Pass

#### Note :

Function	Maximum-permitted Uncertainty of measurement
Sound pressure level	0.15 dB
Frequency	0.20%
Total distortion+noise	0.50%

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-ACT-02 Rev.03 Issue date 5/6/24

Certificate No : 25-ACT-010

Request No : Req-2025-0091

#### Decision Rule for Statements of Conformity

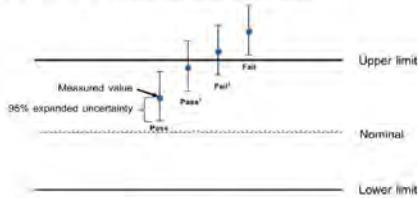
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019, Guidelines on the Reporting of Compliance with Specifications as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-ACT-02 Rev.03 Issue date 5/6/24

### SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

401-401/1 Sirinthon Road, Bangbuang, Bangkok, 10700 Thailand  
Tel: +66 2433 8381 Email: calibration@sithiporn.com

SITHIPORN  
ASSOCIATES

ILAC-MRA

ANAB  
ACCREDITED  
CALIBRATION LAB

Cert. No. : ACL24282

Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01122567 / 143473 / 22605  
ID No. : RYG\_FS0016

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHAENG 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 : 04 SEPTEMBER 2024  
Calibration Date : 19 SEPTEMBER 2024  
Date of Issue : 20 SEPTEMBER 2024

Calibrated by :

Nathakorn Pientapanan

Approved by :

*[Signature]*

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

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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



Cert. No. : ACL24282  
Job No. : VC67AC0148  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25

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).

*G. Petch*

**SITHIPORN**  
**associates**

**SITHIPORN ASSOCIATES**  
**CALIBRATION LABORATORY**

Cert. No. : ACL24282  
Job No. : VC67AC0148  
Pages : 3 of 8

**Summary of Measurement Result :**

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	0.3	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

*G. Petch*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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



Cert. No. : ACL24282  
Job No. : VC67AC0148  
Page : 4 of 8

**Result of calibration :**

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

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

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.4	-2.4	-2.4	±5.0

*G. Petch*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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



Cert. No. : ACL24282  
Job No. : VC67AC0148  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

*G. Petch*



Cert. No. : ACL24282  
Job No. : VC67AC0148  
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	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.8	-0.2	± 1.1

*T. Petch.*

Cert. No. : ACL24282  
Job No. : VC67AC0148  
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)
130	94.0	94.0	0.0	± 1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	29.9	-0.1	± 1.1

9. Tone burst response

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

*T. Petch.*

Cert. No. : ACL24282  
Job No. : VC67AC0148  
Pages : 8 of 8

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
One	136.4	136.0	-0.4	± 3.0

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

*T. Petch.*

Cert. No. : ACL25086  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 01122578 / 143842 / 74027  
ID No. : RYG\_TS0017

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 : 07 JANUARY 2025  
Calibration Date : 27 JANUARY 2025  
Date of Issue : 28 JANUARY 2025

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

*[Signature]*

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.

Cert. No. : ACL25086  
Job No. : VC68AC0059  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33310A	MY48017076	EE-0006-24	05-FEB-25
Waveform Generator	33311B	MY52302742	EE-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL-BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL-BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL-BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100115	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAT	34360495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

Z. Petch

Cert. No. : ACL25086  
Job No. : VC68AC0059  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	0.3	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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Cert. No. : ACL25086  
Job No. : VC68AC0059  
Page : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	-93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
17.6

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

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

## 3. Acoustical signal tests of frequency weightings

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

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

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Cert. No. : ACL25086  
Job No. : VC68AC0059  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

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Cert. No. : ACL25086  
Job No. : VC68AC0059  
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	78.9	-0.1	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	63.9	-0.1	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	48.9	-0.1	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.2	0.2	± 1.1

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Cert. No. : ACL25086  
Job No. : VC68AC0059  
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)
130	94.0	94.0	0.0	± 1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	28.9	-0.1	± 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
Slow	200	800	134.0	134.0	0.0	± 1.0
	2	8	108.0	108.0	0.0	1.5 ; -5.0
SEL	200	800	127.6	127.6	0.0	± 1.0
	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

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Job No. : VC68AC0059  
Pages : 8 of 8

## 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	130.0	130.0	0.0	± 3.0
One	133.4	133.3	-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	± 2.0
Positive half cycle	135.4	135.2	-0.2	± 2.0
Negative half cycle	135.4	135.2	-0.2	± 2.0

## 11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.0	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

Z. Petch

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 11, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484Cert.No.: 24CH96  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenCompact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received : Used Item  
Received Date : 18 January 2024  
Calibration Date : 19 January 2024  
Reference : 2401-057903C-2  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5, T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
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 temperature standard

Calibrated by : Warakorn Lernagatrakul

Approved by :

(✓) Saithip Meangmai  
( ) Warakorn Lernagatrakul  
( ) Ponpan Paipim

Issue Date : 24 January 2024

The Uncertainties are for a confidence probability of approximately 95 %

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

A 0062854



Cert.No.: 24CH96  
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	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	940102	27 Nov 2025
pH 6.986	CPA chem	940104	02 Nov 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

#### Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading	Uncertainty of Measurement	Coverage factor
	pH	mV	mV	( $\pm$ mV)	k
pH Meter	4.000	177.48	177.4	0.058	2.00
S/N.: C104059460	7.000	0.00	0.0	0.058	2.00
	10.000	-177.48	-177.5	0.058	2.00

Santhip

a 1198287



Cert.No.: 24CH96  
Page: 3 of 3

#### Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.01,7.00,10.01)

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	4.013	176.0	0.0054	2.07
S/N.: 3225367	6.986	6.983	2.2	0.0084	2.00
	9.997	9.996	-174.1	0.0065	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM

- Serial No. : 3225367

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	25.2	0.199	0.13	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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Santhip

a 1198288



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TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 24E289  
Page : 1 of 2

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenCompact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received: Used Item  
Received Date : 18 January 2024  
Calibration Date : 23 January 2024

Reference : 2401-0579DSC  
Ambient Temperature : ( 23  $\pm$  2 ) °C  
Relative Humidity : ( 50  $\pm$  10 ) %  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand

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

#### Condition of this result of calibration

##### 1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	E2U2300035	29 May 2024

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 through:-

-NA Caltechnologies Co.,Ltd., ANAB Accredited No. Calibration AC-2658

Calibrated by : Wutharaporn Wongchulkrane  
Issue Date : 24 January 2024  
Approved Signatory :  
[ ] Phalinee Pratsapaipal  
[x] Nuntawat Khanchai  
[ ] Pongsagom Boonyaporn

B 0333296



Cert. No.: 24E289  
Page: 2 of 2

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

Function: DC voltage measurement

Range: 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty ( $\pm$ $\mu$ V)
-200.0000	-200.0	0.0	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	99.9	-0.1	63
150.0000	149.9	-0.1	65
200.0000	199.9	-0.1	68

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

UUC\* = Unit Under Calibration.

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a 1198963





## Certificate of Calibration

Equipment: SPECTROPHOTOMETER  
Model: DR6000  
Serial No. (or ID.): 1627845 (RYG\_EN0037)  
Manufacturer: HACH  
Condition: In Condition

Certificate No.: C06250108  
Issued Date: 18 March 2025  
Job No.: WO-00064379  
Page: 1 of 3

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

Environment Condition: Temperature 24.4 °C ± 0.3 °C  
Humidity 60.8 %RH ± 3.5 %RH

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

Calibration By: Mr.Preecha Phooarsai  
Calibration Date: 18 March 2025  
The Method used: In house method, CAL-W-24, base on ASTM E 275-08 and ASTM E 387-04  
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.



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

The measurement uncertainty stated in the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) at provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items listed, calibrated or sampled. The result shall not be reproduced except in full without approval of DKSH Technology Limited.

DKSH Technology Limited  
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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CAL-FM-C06-16, 11 Mar 2024



Certificate No.: C06250108 Page 2 of 3

### Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The Spectral Bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.5	0.11	0.13	
536.68	536.7	-0.04	0.13	
637.88	638.3	-0.32	0.13	
746.48	748.6	-0.32	0.13	
807.03	807.5	-0.47	0.13	

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.291	0.0020	0.0045
	0.5168	0.518	-0.0012	0.0045
	1.0298	1.031	-0.0012	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.285	0.0017	0.0045
	0.5073	0.508	-0.0007	0.0045
	1.0083	1.008	-0.0007	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2916	0.290	0.0016	0.0045
	0.4595	0.461	-0.0015	0.0045
	0.9334	0.935	-0.0016	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.246	0.0001	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9488	0.946	-0.0012	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.004	-0.0008	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.258	-0.0001	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.973	-0.0010	0.0045

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Certificate No.: C06250108 Page 3 of 3

### Calibration Results: Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7365	0.738	-0.0025	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2864	0.290	-0.0036	0.0080
358 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)	
260.62 +/- 0.11 nm	260.6	1.7	1.770	
391.44 +/- 0.11 nm	391.4	1.4	1.854	
Spectral Resolution *				
Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.68	266.69	1.38	2.06
UUC: Wavelength (nm)	268.2	266.2		
Std Absorbance (A)	0.4566	0.2780		
UUC: Absorbance (A)	0.413	0.299		

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

The End of Certificate

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Phraekhong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CAL-FM-C06-16, 11 Mar 2024



## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00064379

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

ตรวจรอบ (ปี)		รายการตรวจเช็ค	ตรวจรอบ (ครั้ง)		หมายเหตุ
18 Mar 2025			18 Mar 2025		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<i>General</i>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		<i>Spectrophotometer</i>			
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แสงยูวีสะสมแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	13.5 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็นแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	893.0 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ร้อยวงหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		<i>pH Meter and Conductivity Meter</i>			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาป้องกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		<i>Turbidimeter</i>			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นเพื่อทดสอบ (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง ( >= 2.5 ไม่น้อย 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		<i>Automatic titrator</i>			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาวะ Piston Bursties	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบจ่ายยาและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพื่อบันทึกผลการวัด: \* 656.1nm = 656.1nm

\* 486.0nm = 485.7nm

Mr.Preecha Phooarsai  
Service Engineer

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Phraekhong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-R31-03, 20 Jul 2022



## Metrology

SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.  
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100  
Bangkok Tel : +668 9205 6851 , +669 8247 2360  
Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T241120

Page 1 of 4

### Certificate of Calibration

Equipment : Chamber ( Cold Room )  
Manufacturer : MODULAR  
Model : IREVCOHCOO  
Serial No. : C00351459  
Customer Code : RYG\_EN0184  
ID No. : T1939A5  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd. ( Rayong Branch )  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140  
Customer Location : Laboratory  
Date of Receipt : 5 June 2024  
Calibrated By : Sujjar Naknakred ( Site Calibration Manager )  
Approved By : Preecha Phisassuthikul (Temperature Calibration Manager)  
Date of Issue : 12 JUN 2024

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

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

FM-L14 I19/18-08-66



## Metrology

SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T241120

Page 2 of 4

### Calibration Report

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

#### Condition of this results of calibration :

- This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T240713	19 April 2025
TC	TYPE T	TN171-TN180	T240713	19 April 2025
DATA LOGGER	34970A	T149	T240713	19 April 2025
- This certificate is traceable to :  
National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)
- Condition of calibrated item : good  
Equipment Description :  
Time Constant 3 Hour 30 Minute At 3 °C  
Fresh Air Dumper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available
- Adjustment :  
( ) without adjustment ( X ) after adjustment

Approved By:

FM-L15 I18/18-08-66



## Metrology

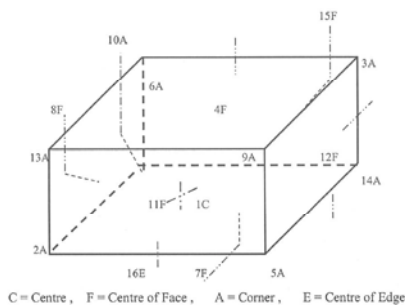
SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T241120

Page 3 of 4

### Calibration Report



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

Approved By:

FM-L15 I18/18-08-66



## Metrology

SCI ECO Services Company Limited  
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T241120

Page 4 of 4

### Calibration Report

#### Measurement Results:

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

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

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

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

Approved By:

FM-L15 I18/18-08-66





## Certificate of Calibration

Cert. No.: 25LM10  
Page.: 1 of 2

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 : 17 January 2025

Calibrated Date : 20 January 2025

Ambient Temperature : ( 20 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Warakorn Lemgatrakul

Approved by :

( ) Chakrit Waewwanjua

(✓) Suwit Imjai

( ) Kunchit Promprat

Issue Date : 23 January 2025

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : DO Meter with Sensor

Condition As-Received : Used Item

Reference : 2501-0600DSC-2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPT ) 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	2411022	TPA	17 Sep 2025

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

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

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

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.00	60	20.002	19.81	-0.192	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 %.

-o0o-



## Certificate of Testing

Cert.No.: 25TW15  
Page.: 1 of 2

Equipment : DO Meter

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG\_EN0032

Received Date : 17 January 2025

Test Date : 20 January 2025

Reference : 2501-0600DSC-1

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

Laboratory Condition : Temperature ( 25 ± 5 ) °C

Humidity ( 50 ± 20 ) %

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

Tested by : Walalak Sirithean

Approved by :

( ) Ponthipha Tameyakul

( ) Ponpan Palpim

(✓) Salthip Meangmai

Issue Date : 21 January 2025



Cert.No.: 25TW15  
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	14233821	110RC001	24MM131	04 July 2025

2. Standard Material :-

Material	Manufacturer	Lot No.	Assay
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %  
Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0084

This report was certified only for the instrument we tested. It is allowable to use for study  
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

-o0o-





## Certificate of Calibration

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

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 : 01 November 2024

Calibration Date : 01 November 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by :

Approved by :

( ) Ponpan Palpim

( ) Suwit Imjai

(✓) Kunchit Promprat

Issue Date : 07 November 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2411-0002OC-1  
Procedure Used :-

Cert. No.: 24TM1663  
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD). The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY44073381	24LM73	TPA	18 May 2025

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

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

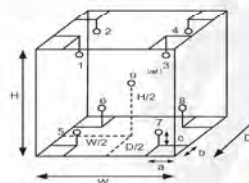
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (\*) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

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



### Probe Installation Details :

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

### Dimension of Chamber :

D = 0.60 m  
W = 1.0 m  
H = 1.2 m  
Capacity = 0.72 m<sup>3</sup>

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



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

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

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

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

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

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

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

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

UUC\* : Unit Under Calibration

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

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

-000-



## Certificate of Calibration

Cert.No.: 24CG3711  
Page: 1 of 2

Equipment : Burette

Capacity : 50 mL

Serial No. :

ID. No. :

Manufacturer :

Made in :

Submitted by :

Burette

50 mL

-

RYG\_EN0216

Wifeg

Germany

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

Ambient Temperature : (20 ± 2.5) °C

Relative Humidity : (50 ± 10) %

Barometric Pressure : 756 mmHg

Calibration Procedure : ASTM E 542 - 01

Calibrated by : Sa-ngeunkam Wongsa

Approved by :

(✓) Srisuda Khamtha

( ) Ponpan Palpim

( ) Unnopphol Harachai

Issue Date :

24 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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





Equipment : Burette  
Received Date : 19 September 2024  
Condition As-Received : Used Item  
Calibration Date : 24 September 2024  
Reference : 2409-0756DSC-3

Cert.No.: 24CG3711  
Page.: 2 of 2

#### Condition of this result of calibration

##### 1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID. No.	Certificate No.	Traceability	Due date
1) Balance	XP205	B134206712	140RC007	24MM316	TPA	15 July 2025
2) Data Logger	HL-20D	20683159	140EC012	23H2174	TPA	10 Oct 2024
3) Thermometer	-	1594592	140EC010	24I175	TPA	20 Feb 2025

This certification is traceable to SI Unit

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

3. True value is converted to true volume at the standard temperature of 20 °C

#### Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty ( $\pm$ mL)	k Factor
10	10.0259	0.0082	2.00
20	20.0214	0.0085	2.00
30	30.0006	0.0089	2.00
40	40.0003	0.0094	2.00
50	49.9988	0.011	2.00

Remark mL = cm<sup>3</sup>

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

-00-

SARTORIUS



Accredited by

NSC-TISI-TIS 17025  
Calibration 0426

#### Calibration certificate

Calibration Certificate No. 25BKL0004

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made
Type	MSE224S-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Welding) SCP WI 08
Serial / QM Ident. no.	26207038   RYG_EN0002	This certificate relate and apply this equipment only
Customer	ALO Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)	
	816/10 Moo 5 T Maenam Khu, A-Pluak Daeng, Rayong 21140, Thailand	
Order no.	2230	
Number of pages	4	
Date of calibration	20 Feb 2025	

REVIEW BY .....  
APPROVED BY .....  
NEXT CAL DATE: 20/02/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid

The user is obliged to have the object recalibrated at appropriate intervals.

Date	06 Mar 2025	Approval of the Calibration Certificate	Person in charge
		Mr. Chonchai Inthana	

Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang  
10310 Bangkok

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Page 1 | 4

Calibration certificate No.: 25BKL0004

Calibration Certificate

#### Calibration object

##### Single range instrument

Model	MSE224S-100-DU
Serial Number	26207038
QM Ident. no   Inventory no.	RYG_EN0002   ---

Maximum capacity (Max. load)	220.0000 g
Measured range	220.0000 g
Scale interval	0.0001 g

#### Place of calibration

Address	According to page 1
Department   Cost center	Laboratory Department.   ---
Building   Floor	---   1st Floor.
Room	Balance Room.
Maximum temperature variation at place of calibration	5 K

#### Calibration procedure

EURAMET cg-18. V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

#### Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Calibration certificate No.: 25BKL0004

Calibration Certificate

#### Adjustment Status

The measuring device was internally adjusted before the calibration.

#### Environmental and measuring conditions

Date of calibration	20 Feb 2025
Temperature at place of calibration   Temp. diff.	24.4 °C   0.6 K
Twilight - T <sub>place</sub>	
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 50.2 %RH.

#### Measurement results | Measurement uncertainties

Repeatability	Eccentricity
Test load (nominal): 10 g   200 g	Test load (nominal): 100 g
10 g	200 g
1 10.0000 g 200.0000 g	Center 100.0000 g
2 10.0000 g 200.0001 g	Front left 99.9998 g
3 10.0001 g 200.0001 g	Back left 100.0000 g
4 10.0000 g 200.0000 g	Back right 100.0000 g
5 10.0001 g 200.0000 g	Front right 100.0000 g
6 10.0001 g 200.0001 g	Maximum deviation from centric loading indication
7 10.0000 g 200.0000 g	$ \Delta_{\text{load}} _{\text{max}} = 0.0002 \text{ g}$
8 10.0000 g 200.0001 g	
9 10.0001 g 200.0000 g	
10 10.0000 g 200.0000 g	
$s = 0.00005 \text{ g}$ $s = 0.00005 \text{ g}$	

Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
L	I	E	k	U(E)	U <sub>rel</sub> (E)
0.0100 g	0.0100 g	0.0000 g	2.00	0.00013 g	1.3 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.027 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00014 g	0.0027 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00014 g	0.0014 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00072 %
50.0000 g	50.0000 g	0.0000 g	2.00	0.00016 g	0.00032 %
100.0000 g	100.0001 g	0.0001 g	2.00	0.00021 g	0.00021 %
200.0000 g	200.0000 g	0.0000 g	2.00	0.00034 g	0.00017 %
220.0000 g	220.0000 g	0.0000 g	2.00	0.00039 g	0.00018 %
Maximum error of indication		$ E _{\text{max}} = 0.0001 \text{ g}$			

U<sub>rel</sub>(E) is the quotient of U(E) and test load L. The uncertainty of measurement U(E) is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under Appendix to the calibration certificate Interpretation of measurement results.  
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guidelines EURAMET cg 18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate



## Uncertainty of measurement in use

Device adjusted before measurement

Yes

Temperature deviation considered

1.5 K (isoCAL active)

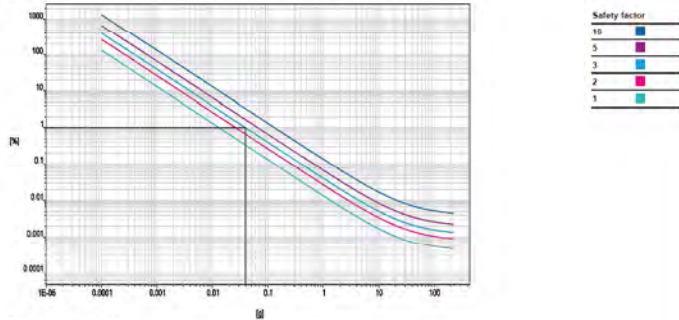
Temperature coefficient considered

1 · 10<sup>-6</sup>/KUncertainty of the weighing result  $U_{95}(W)$  $U_{95}(W) = 0.00013 \text{ g} + 3.95 \cdot 10^{-6} \cdot R$ 

Reference note: The current uncertainty of measurement is calculated by entering of the reading  $R$  into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cp-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication $R$	Uncertainty $U_{95}(W)$	Uncertainty relative $U_{95}(W)_{rel}$
1 %	2.2000 g	0.00014 g	0.0063 %
25 %	55.0000 g	0.00035 g	0.0063 %
50 %	110.0000 g	0.00056 g	0.0051 %
75 %	165.0000 g	0.00078 g	0.0047 %
100 %	220.0000 g	0.00100 g	0.0045 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy 1.00 %  
 Safety factor 3  
 Minimum sample weight 0.0395 g

Sartorius (Thailand) Co., Ltd.  
 129 Rama 9 Road, Huaykwang  
 10310 Bangkok

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Page 4 | 4



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
 CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
 S34/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
 TEL.0-2717-3000-29 FAX.0-2719-9484



## Certificate of Calibration

Cert. No.: 24TM632

Page : 1 of 3

Equipment : Hot Air Oven  
 Manufacturer : Memmert  
 Model : UFE 500  
 Serial No. : G511.1572  
 ID No. : RYG\_EN0010  
 Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
 616/10 Moo 5 T. Maenam Khu,  
 A. Pluakdaeng,  
 Rayong 21140 Thailand  
 Location : Oven Room  
 Received Order : 21 March 2024  
 Calibration Date : 21 March 2024  
 Ambient Temperature : (26 ± 10) °C  
 Relative Humidity : (50 ± 30) %  
 Calibrated by : Man Pattanapongpaiboon  
 Approved by :  
 ( ) Ponthippa Taneyakul  
 ( ) Unnopphol Harachai  
 (x) Suwit Injai  
 Issue Date : 22 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2403-0563OC-1  
 Procedure Used :-

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

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

The temperature scale used was based on ITS-90.

## Condition of this result of calibration

1. Reference standard instrument:-

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

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

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

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

Result of Calibration :- ( ) Without Adjustment

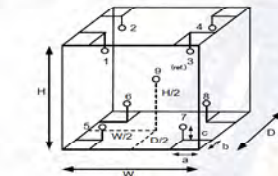
Function of UUC\* : Temperature Source

Fresh air setting : Close

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

Ref. Std. ID No.: @  
 Calibration Point

Position	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



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 m³



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2403-0563OC-1  
 Result of Calibration :- ( ) Without Adjustment  
 Function of UUC\* : Temperature Source  
 Fresh air setting : Close

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

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

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

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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## Certificate of Calibration

Represent to Certificate of Calibration No. C29240007

Equipment: Block Digestion Unit Certificate No.: C29240011  
Model: KT-20s Issued Date: 22 March 2024  
Serial No. (or ID.): 5720210009/5770200073 Job No.: WO-00020429  
Manufacturer: Gerhardt Page: 1 of 4  
Condition: In Condition Digestion Block: 20 holes.

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

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

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

Calibration By: Mr. Thanathorn Phunook

Calibration Date: 11 March 2024

The Method used: In house method, base on by comparison with standard

Traceability: This certificate is traceable to the SI Units maintained by National Institute of  
Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)  
Certificate No.: TC22/0080

REVIEW BY  
APPROVED BY  
NEXT CAL. DATE

Certificate No.: C29240011

Page: 2 of 4

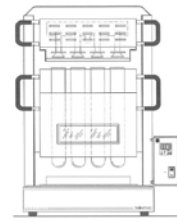
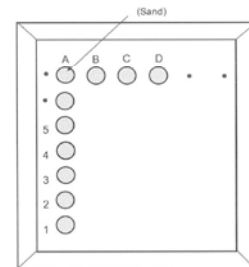


Fig. 1.: Front view



Location of standard

Fig. 2.: Digestion block

## Definitions

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

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

This certificate is issued in the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C29-07: 20 Jul 2022

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CAL-FM-C29-07: 20 Jul 2022

Certificate No.: C29240011

Page: 3 of 4

## Calibration Results:

## Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	380	380	380	401.5	21.5	1.5
A2				401.2	21.2	1.5
A3				399.1	19.1	1.5
A4				397.8	17.8	1.5
A5				395.1	15.1	1.5
B1				396.6	16.6	1.5
B2				396.1	16.1	1.5
B3				392.9	12.9	1.5
B4				391.6	11.6	1.5
B5				390.7	10.7	1.5
C1				395.3	15.3	1.5
C2				395.6	15.6	1.5
C3				392.8	12.8	1.5
C4				391.7	11.7	1.5
C5				390.3	10.3	1.5
D1				397.6	17.6	1.5
D2				396.6	16.6	1.5
D3				395.0	15.0	1.5
D4				394.2	14.2	1.5
D5				393.6	13.6	1.5

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CAL-FM-C29-07: 20 Jul 2022

Certificate No.: C29240011

Page: 4 of 4

## Calibration Results:

## Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
A1	380	365	365	382.5	17.5	1.5
A2				382.4	17.4	1.5
A3				382.1	17.1	1.5
A4				379.7	14.7	1.5
A5				378.3	13.3	1.5
B1				380.1	15.1	1.5
B2				380.1	15.1	1.5
B3				378.5	13.5	1.5
B4				378.3	13.3	1.5
B5				379.1	14.1	1.5
C1				380.1	15.1	1.5
C2				380.1	15.1	1.5
C3				378.9	13.9	1.5
C4				378.2	13.2	1.5
C5				377.3	12.3	1.5
D1				380.5	15.5	1.5
D2				380.6	15.6	1.5
D3				378.1	13.1	1.5
D4				378.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C29-07: 20 Jul 2022

## ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00020429

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

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

ข้อเสนอแนะ:

บริษัท ดิเคช เอเชีย จำกัด  
DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Thailand 10259  
Phone: +66 2533 1760 Email: info.asia@dksh.com Website: www.dksh.com/thailand  
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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No.: 23E3924  
Page: 1 of 2

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 08 December 2023  
Calibration Date: 14 December 2023  
Reference: 2312-0151DSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 10 ) %

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

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

### Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435802	EE-0041-23	26 Apr 2024

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 through:  
- National Institute of Metrology Thailand (NIMT)

Calibrated by: Napachanok Prasomsosiri  
Issue Date: 15 December 2023

Approved Signatory:

B 0331106



Cert. No.: 23E3924  
Page.: 2 of 2

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

Function: DC voltage measurement	Range:	2000	mV
Standard Value	UUC* Reading	Error	Uncertainty
( mV )	( mV )	( mV )	( ± μV )
-200.0000	-199.9	0.1	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	100.0	0.0	63
150.0000	150.0	0.0	65
200.0000	199.9	-0.1	68

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

UUC\*= Unit Under Calibration.

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## Certificate of Calibration

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

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 08 December 2023  
Calibration Date: 15 December 2023  
Reference: 2312-0151DSC-3  
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand

Ambient Temperature: (25 ± 2.5) °C  
Relative Humidity: (50 ± 15) %  
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:

Approved by:

( ) Saitip Meangmai  
( ) Warakom Lernagatrakul  
( ) Ponpan Palpim

Issue Date: 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 23CH1574  
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	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

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

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

#### Calibration Results

##### Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: B834291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

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

#### Calibration Results

##### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode S/N.: 3225368	4.008	4.013	184.1	0.0045	2.00
	6.986	6.998	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0088	2.11

##### Function : Temperature Measurement

##### (\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM

- Serial No. : 3225368

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	25.003	24.3	-0.703	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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## Certificate of Calibration

25CH709/1  
1 of 3

This Certificate was issued to replace to the Certificate No.25CH709

1. Reference Standard Instrument

2. Certified Reference Materials

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

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

5. The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,  
Deutsche Akkreditierungsstelle, Accredited No.D-IRM-15184-01-00

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

7. The measurement results are traceable to SI through CPA chem Ltd.,  
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The Uncertainties are for a confidence probability of approximately 95%

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

1 July 2025

Walalak Sirthean

Saitip

Approved Signatory

( ) Chakrit Waewwanjua  
( ) Ponpan Paipim  
(✓) Saitip Meangmai



25CH709/1  
2 of 3

#### 1. Reference Standard Instrument

1) Document Process Calibrator	54030049	130RC116	24E2759	25 Aug 2025
2) Ref. Standard Thermometer	4982054	110RC044	24I757	14 July 2025

- This measurement result is traceable to SI through Technology Promotion Association (Thailand - Japan)

#### 2. Certified Reference Materials

The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,  
Deutsche Akkreditierungsstelle, Accredited No.D-IRM-15184-01-00

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ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

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Unit Under Calibration	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor k
pH Meter S/N.: B834291445	4.000	177.48	177.3	4.000	0.058
	7.000	0.00	-0.1	7.000	0.058
	10.000	-177.48	-177.5	10.000	0.058



25CH709/1  
3 of 3

am h m s  
m s

	0	1	2	3	4
pH Electrode	4.007	4.006	181.1	0.0044	2.00
S/N: 5211504	7.000	7.000	4.9	0.0084	2.00
	10.010	10.007	-170.6	0.0066	2.00

am h m s  
m s

This equipment was connected with Temperature Probe:

- Model : InLabExpert Pro-TSM  
- Serial No. : 5211504  
Dimension of probe  
- Length : 120 mm.  
- Diameter : 12 mm.  
- Immersion Depth : 100 mm.

	0	1	2	3	4
25.0	25.001	25.1	0.099	0.13	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 %.

am h m s



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10259  
TEL: 0-2717-3000-24 FAX: 0-2719-9484



## Certificate of Calibration

Certificate No.: 25E1979/1  
Page: 1 of 2

This Certificate was issued to replace to the Certificate No. 25E1979

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 12 June 2025  
Calibration Date: 16 June 2025  
Reference: 2506-0407DSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 10 ) %

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.

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

618/10 Moo 5, T.Maenam Khu, A.Plusdaeng,  
Rayong 21140, Thailand

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

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	25E1627	19 May 2026

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 measurement result is traceable to the International System of Unit maintained through:-  
-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Wutchareeporn Peethong  
Issue Date : 01 July 2025

Approved Signatory :  
[ ] Phalinee Pratsapal  
[x] Nuntawat Khanchai  
[ ] Pongsagorn Boonyaporn



Cert. No.: 25E1979/1  
Page.: 2 of 2

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

Function: DC voltage measurement

Standard Value	UUC* Reading	Range	Error	Uncertainty
( mV )	( mV )	2000 mV	( mV )	( ± μV )
-200.0000	-199.9		0.1	68
-150.0000	-150.0		0.0	65
-100.0000	-100.0		0.0	63
-50.0000	-50.0		0.0	61
0.0000	0.0		0.0	58
50.0000	50.0		0.0	61
100.0000	100.0		0.0	63
150.0000	149.9		-0.1	65
200.0000	199.9		-0.1	68

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.

-000-



SCG  
CEMENT-BUILDING MATERIALS

## Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhloi, 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. T250578

Page 1 of 4

## Certificate of Calibration

Equipment : Digestion Unit

Manufacturer : SCP Science

Model : DigiPRER HT

Serial No. : HTC1120480658

Customer Code : BKK\_EN0366

ID No. : T2635A5

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

104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab 1

Date of Receipt : 2 April 2025

Calibrated By : Atiphong Rongrat ( Technician )

Approved By : [Signature] Khanchai - Suriyawong ( Site Calibration Manager )

Date of Issue :

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.





## Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T250578

Page 2 of 4

### Calibration Report

Equipment : Digestion Unit  
Date of Calibration : 9 April 2025  
Environment : Temperature : 23.9 - 26.3 °C  
Line Voltage : 221.8 - 225.9 V  
Relative Humidity : 55 - 65 %RH

#### Condition of this results of calibration :

- This equipment was calibrated by insert four standard thermocouples type S into its chamber, the other one thermocouple type T use for ambient temperature measurement. The calibration was done in according to WI-T10.  
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 S M7-(CH1-CH4) T242035 04 December 2025  
DATA LOGGER 34970A T121 T242035 04 December 2025
- 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 40 Minute At 380 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available
- Adjustment :  
( X ) without adjustment ( ) after adjustment

Approved By:

FM-L13 108/30-05-57



## Metrological Center

SCI ECO Services Company Limited

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

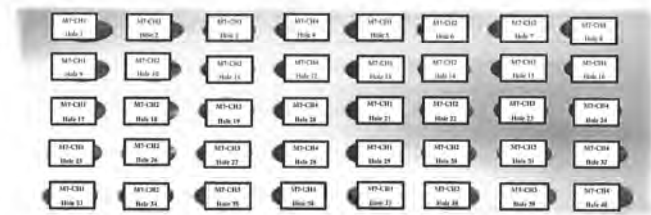
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

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

Certificate No. T250578

Page 3 of 4

### Calibration Report



FRONT

#### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	M7-CH1 Block 1	M7-CH2 Block 2	M7-CH3 Block 3	M7-CH4 Block 4	M7-CH5 Block 5	M7-CH6 Block 6	M7-CH7 Block 7	M7-CH8 Block 8
380.0	380.0	379.8 - 380.2	Max °C	380.0	381.0	380.9	379.6	380.3	380.9	381.3	380.1
			Min °C	379.6	380.8	380.6	379.3	379.9	380.5	380.9	379.6
			Average °C	379.8	380.9	380.7	379.5	380.1	380.7	381.1	379.9
			Stability ± °C	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	M7-CH1 Block 9	M7-CH2 Block 10	M7-CH3 Block 11	M7-CH4 Block 12	M7-CH5 Block 13	M7-CH6 Block 14	M7-CH7 Block 15	M7-CH8 Block 16
380.0	380.0	379.8 - 380.2	Max °C	378.9	378.7	379.8	381.0	382.4	381.3	381.7	380.8
			Min °C	378.3	378.2	379.3	380.7	382.1	380.5	381.3	380.0
			Average °C	378.6	378.5	379.5	380.9	382.4	380.9	381.5	380.2
			Stability ± °C	0.3	0.2	0.3	0.1	0.3	0.4	0.2	0.2

Approved By:

FM-L13 108/30-05-57



## Metrological Center

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Certificate No. T250578

Page 4 of 4

### Calibration Report

#### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	M7-CH1 Block 17	M7-CH2 Block 18	M7-CH3 Block 19	M7-CH4 Block 20	M7-CH5 Block 21	M7-CH6 Block 22	M7-CH7 Block 23	M7-CH8 Block 24
380.0	380.0	379.8 - 380.2	Max °C	379.3	379.2	379.1	377.5	380.9	381.1	382.5	381.3
			Min °C	379.1	379.0	378.8	377.2	380.5	380.8	382.1	381.1
			Average °C	379.2	379.1	379.0	377.3	380.6	380.9	382.3	381.2
			Stability ± °C	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	M7-CH1 Block 25	M7-CH2 Block 26	M7-CH3 Block 27	M7-CH4 Block 28	M7-CH5 Block 29	M7-CH6 Block 30	M7-CH7 Block 31	M7-CH8 Block 32
380.0	380.0	379.8 - 380.2	Max °C	378.5	378.2	379.5	378.5	380.4	380.8	380.4	380.9
			Min °C	378.2	377.9	379.2	378.2	380.0	380.5	380.1	380.6
			Average °C	378.3	378.0	379.4	378.3	380.2	380.7	380.2	380.8
			Stability ± °C	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	M7-CH1 Block 33	M7-CH2 Block 34	M7-CH3 Block 35	M7-CH4 Block 36	M7-CH5 Block 37	M7-CH6 Block 38	M7-CH7 Block 39	M7-CH8 Block 40
380.0	380.0	379.8 - 380.2	Max °C	379.9	380.0	379.8	379.7	380.1	380.2	379.7	379.9
			Min °C	379.6	379.6	379.5	379.3	379.9	379.4	379.5	379.5
			Average °C	379.8	379.8	379.7	379.5	379.9	380.1	379.5	379.7
			Stability ± °C	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.1

The expanded uncertainty of temperature measurement was ± 2.36 °C

The calibration result apply only the above calibrated item.

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

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

Approved By:

FM-L13 108/30-05-57



บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด  
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยสุขุมวิท 14 แขวงคลองเตย เขตคลองเตย กรุงเทพฯ 10110 โทรศัพท์: (02) 747-7009 โทรสาร: (02) 747-7008

4 Soi Sukhumvit 14, Bangna, Bangkok 10260 Tel: (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2024

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม												

#### Periodical maintenance check list for Konelab

	6M	12M	Note
1.Diluent wash tubing change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	None.
3.Syringe check/change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4.Dispensing check/ change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5.Waste tubing change when necessary	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6.Lamp check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
8.ISE needles check/change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	None.
9.Pump tubing check/ change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10.Broken/worn out part check /change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
11.Peristaltic pump check /cleaning/ lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
12.Heating check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
13.Cooling check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
16.Dispenser movement check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
18.Dispensing tubing tightness check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
22.Instrument cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
25.UPS Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Place: BS LAB Instrument: Konelab

Date/Time: 16/8/25 Serial no: 2027

Service done by: Dr. P. P. Install date: 16/08/2024

Signature of customer: Dr. P. P. Date/Time: 16/08/2024

Laboratory  
Analyzer User

8/16/2024 14:53

Performed 8/16/2024  
Lot WB34

ACCEPTANCE CRITERIA

	Result	Limit	Warning
Temperature (°C)	37.8	37.0 +/- 1.0	
Dispensing ratio	16.4	14.8 - 17.2	
CV%	0.29	<1.7	
Photometric noise			
Max SD L340 2 (nA)	0.17	<2.0	
Max SD L340 4 (nA)	0.87	<3.0	
Linearity of photometer			
Slope	1.0141	0.94 - 1.06	
Curvature	0.0053	+/- 0.02	
Max bias from linear fit (nA)	4.3	<15.0	
Max delta %	-1.6	+/- 6.0	
Linearity of sample dispensing			
Proport. volume XDISP2 (µl)	2.06	1.96 - 2.16	
Proport. volume XDISP4 (µl)	4.14	3.85 - 4.40	
XDISP2 CV%	1.21	<2.0	
XDISP4 CV%	0.90	<2.0	
XDISP10 CV%	0.68	<2.0	
Needle 0 µl volume			
Average (A)	0.005	<0.050	
Standard deviation (A)	0.002	<0.005	
Volume (µl)	0.03	<0.32	

OTHER INFORMATION

Dispensing ratio	Photom. noise: SD (nA)
Posit Result (A)	Posit L340 2 L340 4
1 0.1549	1 0.15 0.80
2 0.1549	2 0.17 0.79
3 0.1537	3 0.04 0.68
4 0.1547	4 0.16 0.31
5 0.1547	5 0.11 0.58
6 0.1545	6 0.14 0.87

Laboratory  
Analyzer User

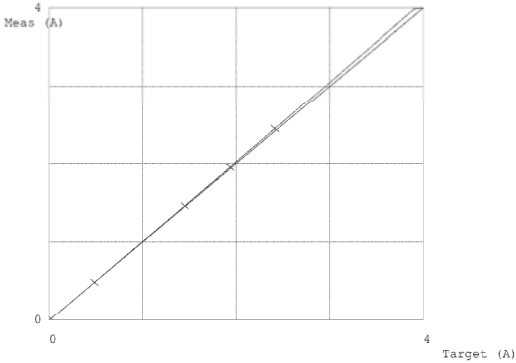
8/16/2024 14:53

Linearity of sample dispensing

Test	Absorbance (A)
XDISP2	0.306
XDISP4	0.612
XDISP10	1.471

Linearity of photometer

L340_	Target (A)	Meas (A)	Delta (A)	Delta %
1	0.002	0.006	-0.004	-217.7
2	0.486	0.493	-0.007	-1.5
3	1.451	1.469	-0.018	-1.2
4	1.936	1.963	-0.027	-1.4
5	2.415	2.454	-0.039	-1.6



BKK\_EL0043



Agilent Technologies (Thailand) Limited  
40 CHU LUNG BLDG 22/F UNIT A/D  
988 RAMA 4 ROAD, SILOM, BANGKOK  
Bangkok 10500 Thailand  
Tel: +662 637 6368  
Fax: +662 637 4334  
Email: ccc-sm@agilent.com  
Website: www.agilent.com/thai

Customer Contact:

ALS Laboratory Group (Thailand) Co.  
Ltd Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khwaeng Phatthanakan Khet Suan  
TAX ID: 0105541004859  
chanattagamimichom@siglobal.com  
227158760

Invoice To:

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

Delivery Site:

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

Location:  
Room  
Bldg  
Lab  
Dept

SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70371013
Service Request:	Service Request Date:
Service Order: 6068876680	Service Confirmation: 8905905441

REVIEW BY  
APPROVED  
NEXT CAL

Direct Inquiries to:

Contact Name:  
Contact E-mail:  
Contact Telephone:  
Contact Fax:

Customer Contact Center:  
ccc-sm@agilent.com  
+662 637 6363  
+662 632 4334

Service Confirmation Number: 8905905441

Service Confirmation Date: 08.10.2024

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7900	ICP-MS 7900 System			
G8410A	SPS 4 Autosampler	AU15430/22	ICP-MS 7900	SYS-IM-7900
G8411A	ISIS 3 for Agilent 7850/7900/8900	JP15610227	ICP-MS 7900	SYS-IM-7900
G3282A	PSC 610ST Chiller	2U15A1948	ICP-MS 7900	SYS-IM-7900
G8403A	Agilent 7800 ICP-MS	JP15471169	ICP-MS 7900	SYS-IM-7900

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQO	Enterprise Operational Qualification	1.00	Agreement Entitlement 100 % covered	04.10.2024	04.10.2024
1010	5185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement 100 % covered		

Additional Information:

0105541004859 | 0105541004859 | 0105541004859



Learn more about Agilent's Special Offers, Products, Services and our full range of laboratory productivity solutions, optimized for your applications and workflows. Visit us at [www.agilent.com/thai](http://www.agilent.com/thai)

Agilent Technologies (Thailand) Limited, Head Office  
40 Chu Lung Bldg 22/F Unit A/D  
988 Rama 4 Road, Silom, Bangkok  
Bangkok 10500, Thailand  
Tax ID: 0105541004859

Central MA, Bangkok (Branch)  
388 Interchange 21 Building, Sukhumvit Road, Klongtoey New  
Sub-district, Wattana District, Bangkok 10110 Thailand  
Acc. No: 912-4852-007  
THB-King Thai Bank PLC  
Bank Square B1, 11th / 12th Floor, Ekkamai Branch 10230  
Thailand

ORIGINAL

Service Information:

<b>Problem Description:</b> *WU-EOG-IM-7900-5001253655		
<b>Service Provided:</b> Perform OQ Hardware. Test CDS logon, auto sampler, Auto tune, BG and 20 Min stability. I calibrate the instrument No BKK_EL0043 test all pass.		
<b>Service Overview Code:</b> Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
<b>Reported Hours:</b> 7.0	<b>Travel Hours:</b> 2.0	
<b>Customer Field Service Representative Name:</b> Panthep Kurasathain	<b>Customer Field Service Representative Signature:</b> 	<b>Date:</b> 08 Oct 2024
<b>Customer Name:</b> Supakwan Mak	<b>Customer Signature:</b> 	<b>Date:</b> 08 Oct 2024
<b>Additional Comments:</b>		



Metrological Center

SCI ECO Services Company Limited

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



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

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

Certificate No. T250355

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 Phathanakan 40, Phathanakan Rd.,  
Khwaeng Phathanakan, Khet Suan Luang, Bangkok 10250  
**Customer Location** : Acid Digestion Lab  
**Date of Receipt** : 26 February 2025  
**Calibrated By** :  (Technician)  
**Approved By** :  (Suriyawong) (Site Calibration Manager)  
**Date of Issue** : 17 MAR 2025

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 109/30-05-17



Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T250355

Page 2 of 6

Calibration Report

**Equipment** : HEATING BLOCK  
**Date of Calibration** : 4 March 2025  
**Environment** : Temperature : 24.4-24.9 °C  
Line Voltage : 221.6-226.3 V  
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

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

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T240712	19 April 2025
TC	TYPE T	TN231-TN240	T240712	19 April 2025
TC	TYPE T	TN241-TN250	T240401	16 March 2025
TC	TYPE T	TN251-TN260	T240401	16 March 2025
DATA LOGGER	34970A	T193	T240401	16 March 2025

3. This certificate is traceable to :

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

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 2 Hour 40 Minute At 95 °C  
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Mix  
☐ Close  
☒ Not Available

5. Adjustment :

( ) without adjustment ( X ) after adjustment

Approved By



Metrological Center

SCI ECO Services Company Limited

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

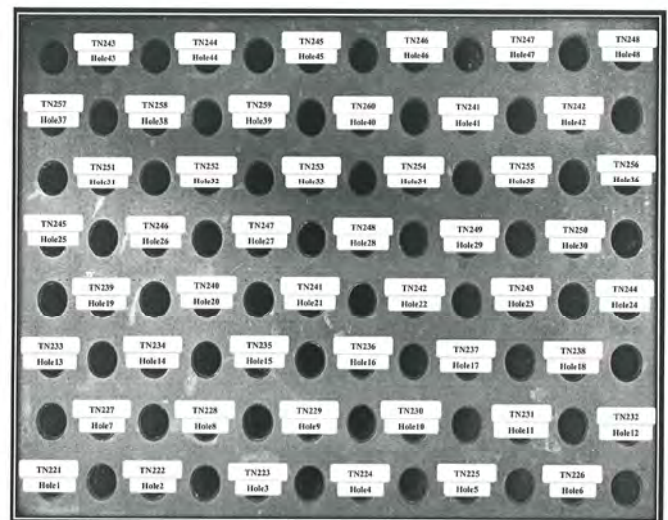
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

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

Certificate No. T250355

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By







## Metrological Center

SCI ECO Services Company Limited

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

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

Certificate No. T250355

Page 4 of 6

### Calibration Report

#### Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	94.85	95.37	95.03	95.25	95.32	94.75
	Min	94.17	94.66	94.38	94.63	94.37	94.12
	Average	94.51	95.02	94.70	94.94	95.20	94.43
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.71	94.56	94.79	95.32	95.44	95.06
	Min	94.05	93.88	94.10	94.65	94.90	94.65
	Average	94.38	94.22	94.44	94.99	95.17	94.85
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	93.26	95.41	95.40	95.71	95.41	95.06
	Min	94.54	94.64	94.71	95.10	94.86	94.42
	Average	94.90	95.03	95.06	95.41	95.13	94.74
R4 Hole19-Hole24		TN239	TN240	TN241	TN242	TN243	TN244
	Max	95.13	95.06	95.68	96.16	95.35	95.80
	Min	94.39	94.43	94.36	95.51	94.88	93.12
	Average	94.76	94.75	95.27	95.83	95.12	95.46
R5 Hole25-Hole30		TN245	TN246	TN247	TN248	TN249	TN250
	Max	94.93	95.81	95.39	95.82	95.66	95.66
	Min	94.87	95.03	94.67	94.99	94.34	94.87
	Average	94.71	95.42	95.03	95.41	95.25	95.27
R6 Hole31-Hole36		TN251	TN252	TN253	TN254	TN255	TN256
	Max	96.07	95.34	96.28	95.39	94.95	95.12
	Min	95.28	94.55	95.51	94.02	94.13	94.35
	Average	95.67	94.95	95.90	95.00	94.54	94.73
R7 Hole37-Hole42		TN257	TN258	TN259	TN260	TN261	TN262
	Max	95.15	95.03	96.11	95.09	95.34	95.51
	Min	94.38	94.88	95.32	94.28	94.54	94.72
	Average	94.76	95.25	95.71	94.69	94.94	95.11
R8 Hole43-Hole48		TN243	TN244	TN245	TN246	TN247	TN248
	Max	95.86	95.87	95.44	95.72	95.65	95.75
	Min	95.06	95.10	94.60	94.95	94.87	94.98
	Average	95.45	95.48	95.02	95.34	95.26	95.36

Approved By.

FM-L13 108/30-05-57



## Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T250355

Page 5 of 6

### Calibration Report

#### Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	104.48	104.40	104.60	105.27	105.24	105.19
	Min	104.15	104.02	104.25	104.94	104.91	104.93
	Average	104.32	104.21	104.42	105.10	105.08	105.06
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.20	105.45	105.58	105.96	105.81	106.03
	Min	104.92	105.14	105.29	105.64	105.53	105.79
	Average	105.06	105.29	105.43	105.80	105.67	105.91
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.09	106.14	105.83	106.25	105.97	105.88
	Min	105.80	105.89	105.57	106.00	105.69	105.65
	Average	105.94	106.01	105.70	106.13	105.83	105.77
R4 Hole19-Hole24		TN239	TN240	TN241	TN242	TN243	TN244
	Max	105.87	105.75	105.30	105.07	105.32	105.66
	Min	105.62	105.52	105.13	104.90	105.05	105.49
	Average	105.74	105.63	105.21	104.98	105.14	105.57
R5 Hole25-Hole30		TN245	TN246	TN247	TN248	TN249	TN250
	Max	105.02	105.54	105.52	105.73	105.97	105.69
	Min	105.45	105.35	105.31	105.57	105.81	105.49
	Average	105.23	105.44	105.41	105.66	105.89	105.59
R6 Hole31-Hole36		TN251	TN252	TN253	TN254	TN255	TN256
	Max	106.19	106.34	106.47	105.96	105.76	105.35
	Min	106.02	106.16	106.31	105.77	105.58	105.18
	Average	106.10	106.25	106.39	105.87	105.67	105.27
R7 Hole37-Hole42		TN257	TN258	TN259	TN260	TN261	TN262
	Max	106.21	105.59	105.45	105.36	106.08	106.09
	Min	106.04	105.42	105.28	105.20	105.90	105.92
	Average	106.12	105.51	105.37	105.28	105.99	106.00
R8 Hole43-Hole48		TN243	TN244	TN245	TN246	TN247	TN248
	Max	106.54	106.33	105.78	105.38	105.42	105.69
	Min	106.38	106.16	105.60	105.20	105.25	105.52
	Average	106.46	106.25	105.69	105.29	105.33	105.61

Approved By.

FM-L13 108/30-05-57



## Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T250355

Page 6 of 6

### Calibration Report

#### Measurement Results:

Setting (°C)	HEATING BLOCK		Temperature Distribution	
	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min, Max	Average		
102.0	-	102.0	0.43	0.83
107.0	-	107.0	0.20	0.70

\* 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



## Metrology

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 8205 6851, +669 8247 2360

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



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 Sam Luang, Bangkok 10250

Customer Location : Laboratory

Date of Receipt : 29 November 2023

Calibrated By : Atiplong 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-L13 110/18400-00

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-TISI-TIS 17025 CALIBRATION 0244).

## 4. Condition of calibrated item : good

## Equipment Description :

Time Constant 1 Hour 30 Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

## 5. Adjustment :

( X ) without adjustment ( ) after adjustment

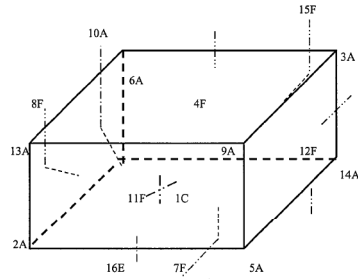
Approved By.

FM-L15 118/18-08-66

Certificate No. T232160

Page 3 of 4

## Calibration Report



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

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

Approved By.

FM-L15 118/18-08-66

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	TN169	TN170	TN171
3.0	2.83	3.34	2.95	3.46	3.45	3.76	3.25	3.46	3.39	3.50	3.58
	TN173	TN174	TN175	TN176							
	3.33	3.39	3.15	3.43							

Chamber (Cooling Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
3.0	2.8	4.1	3.5	3.36	1.10	2.00	1.90

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-L15 118/18-08-66

Certificate No. T250873

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 Room

Date of Receipt : 28 May 2025

Calibrated By : [Signature]

Approved By : [Signature] Suriyawong (Site Calibration Manager)

Date of Issue : [Signature]

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-FL06 102/27-03-68



Certificate No. T250873

Page 2 of 4

**Calibration Report**

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 4 June 2025  
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	TN91-TN100	T242036	3 December 2025
TC	TYPE T	TN101-TN110	T242036	3 December 2025
DATA LOGGER	34979A	T121	T242036	3 December 2025

**3. This certificate is traceable to :**

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

**4. Condition of calibrated item : good****Equipment Description :**

Time Constant 2 Hour 20 Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

**5. Adjustment :**

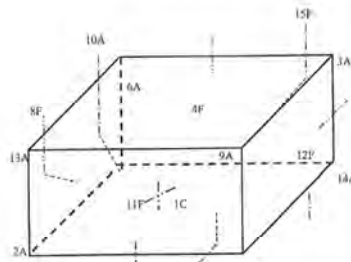
( X ) without adjustment ( ) after adjustment

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

FM-TL07 (02/27-03)-08

Certificate No. T250873

Page 3 of 4

**Calibration Report**

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

1C = TN91	12F = TN102
2A = TN92	13A = TN103
3A = TN93	14A = TN104
4F = TN94	15F = TN105
5A = TN95	16F = TN106
6A = TN96	
7F = TN97	
8F = TN98	
9A = TN99	
10A = TN100	
11F = TN101	

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

FM-TL07 (02/27-03)-08

Certificate No. T250873

Page 4 of 4

**Calibration Report****Measurement Results**

Calibration Point	Average Standard Reading at each position ( °C )											
	TN91	TN92	TN93	TN94	TN95	TN96	TN97	TN98	TN99	TN100	TN101	TN102
3.0	2.95	2.92	3.09	2.92	3.16	3.50	3.40	3.03	3.14	2.98	3.44	3.13
	TN103	TN104	TN105	TN106								
	3.19	3.06	3.45	2.92								

Chamber ( Cooling Room )			Temperature Distribution				
Setting ( °C )	Reading ( °C )		Average ( °C )	Stability ( ± °C )	Uniformity ( °C )	Uncertainty ( ± °C )	Coverage Factor k
	Min	Max					
3.0	2.8	2.9	3.4	1.20	1.30	1.90	2.04

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-TL07 (02/27-03)-08

REVIEW BY Oranan T.  
APPROVED BY Sawitri N.  
NEXT CAL DATE 12 Oct 2026

**Maintenance Protocol**

Atomic Fluorescence Spectrometer  
**mercur DUO /**  
**mercur DUO plus**

Serial-No.: K170A0143 Customer-No.:  
Date: 12 December 2024 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 works basic unit

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

### Maintenance works Autosampler

Serial No.: 701 739

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

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.:	changed:
visual check Goldtraps	o.k.:	changed:
visual check spectrometer		
Fluorescence cell	o.k.:	changed:
Absorption cell, incl. window	o.k.:	changed:
lens	o.k.:	changed:
Swivel drive (SEV)	o.k.:	changed:
check pump hoses	o.k.:	changed:
check hoses and hose connectors	o.k.:	changed:
check and clean reactor	o.k.:	changed:
check drying hose output Gas-liquid-separator	o.k.:	changed:
check bubble-sensor	o.k.:	not o.k.:
Check gasflow		
Argon pressure valve 4	1.2 - 1.5 bar	1.5 bar
Valve 1	10 NL/h or 0.166 NL/min	0.142 NL/min
Valve 2	50 NL/h or 0.833 NL/min	0.795 NL/min
Valve 3	5 NL/h or 0.083 NL/min	0.080 NL/min
Valve 4	10 NL/h or 0.166 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	1	1
450	2	3
500	6	7
550	13	15
575	18	21
600	25	29

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: .....360.....V		
Blank-solution without enrichment / FBR 30 ng/L	Int > 0.0015	Int...0.0004#
	RSD < 3 %	Int...0.00237... RSD...1.30...%
Conditions.: max.conc.: 1.7µg/L PMT-voltage: .....352.....V		
Blank-solution with enrichment / FBR 30 ng/L	Int > 0.008	Int.....
	RSD < 3 %	Int.....
Fok.- factor ( Int <sub>2</sub> / Int <sub>1</sub> )	> 3.5	RSD.....%
Analytical parameters Absorption cell		
Blank-solution without enrichment / FBR 100 ng/L	Ext. > 0.0012	Ext...0.0011....
	RSD < 5 %	Ext...0.0039... RSD...2.99...%
Comments		
การให้สารของ Tech: With enrichment ไม่สามารถวัดค่าได้เนื่องจาก Valve 4 (Gas flow) ไม่ทำงาน แต่ใช้ระบบควบคุมจาก Board control จ่ายปกติ 24 Vdc.		
หากมีตัวอย่างที่ต้องวัดด้วย Tech: With enrichment ต้องซ่อมเปลี่ยนตัว Gas box		




Place, Date (DD/MM/YYYY)

Place, Date (DD/MM/YYYY)



## Service Report

Customer's address : บริษัท อานอลิติก (ประเทศไทย) จำกัด 104 หมู่ 40 ถนนพหลโยธิน กรุงเทพมหานคร 10250		Customer's Ref. No. Co. no. Service 2024	
E-mail : Job No. 2612571PB		Phone : User : Service Engineer : ศุภชัย ธีระกุล	
Date 12/12/2024		Page : 1/1	
Instrument model : Mercury		Serial No. K170A0143	
Software Version No. WinAAS 4.7.3.0			
<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 (V)			
Fault / Claim : แจ้ง PM เครื่อง Mercury (Contact year 2025 / 1 Time)		<input type="checkbox"/> Error Code	
Action taken : • Maintenance work basic unit • Check Device parameters • Check gas flow • Check liquid flow • Check Adventitious light- Valves • Test run Analytical parameter Fluorescence cell • Test run Analytical parameter Absorption cell			
 • Action Pending / Recommendation : • แจ้งดำเนินการตรวจสอบ Tech: Without enrichment use Hg absorption • Hg low pressure lamp (Energy 300W/500W PMT voltage 8V) เปลี่ยนใหม่ • แจ้งดำเนินการ Hg low pressure lamp			
<input type="checkbox"/> Spare Part <input checked="" type="checkbox"/> Instrument Configuration :			
Item No.	Name	Quantity	Unit Price
1.	HPS-326	1	
2.	HPS-401, 502	1	
3.			
4.			
5.			
6.			
7.			
8.			
Here with the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.			
Date / Signature of Customer		Date / Signature of Service Engineer	
Work completed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

Services are subject to the General Terms and Conditions of Analytik Jena

## Mercur

Report file: C:\WinAAS\TMP\2024\Dec\Pro\_008  
Program version: 4.7.10.0 Printed on: 12/12/2024 11:37  
Recording started on: 12/12/2024 11:27 GMT+7.0  
Operator: PSU.OTA  
Laboratory: ALS-BKK  
Code: IL\_Hg067\_2024  
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	12/11
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

## Autosampler

Autosampler: ASS1S/F  
Working mode: continuous  
Tray type: 87/139

Dilution: ---

Mercur

## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std. 1 no.	1(30,000 ng/L)	QC std. 2 no.	1(30,000 ng/L)
QC std. 1 limit	± 50.00%	QC std. 2 limit	± 50.00%
QC std. act.	flag + continue	Reaction	flag + continue
Expect. blank abs.	0.0100 ± 0.0100	Reaction	off
QC precision	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	Mean	Meas. cycles	2
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

## Calibration standards

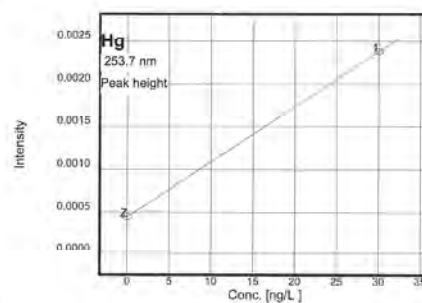
No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	79	0.000	H: 0.000445 A: 0.009414	0.000017 0.000140	3.813 1.497
2	Cal-Std1	(-)	80	30.000	H: 0.002375 A: 0.03403	0.000031 0.000423	1.306 1.244

Mercur

## Calibration function 1

12/12/2024 11:36 Calibration (Peak height)

Ints=k1+k2*conc			
k1=0.000446	k2=0.000084	Recal. factor:	---
Slope	0.00006 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	---



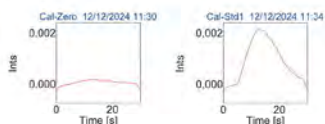
## Measurements and events (sorted by time)

Hg ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero	0.000436					PxH	11:30
	0.000436						11:31
	0.000465						11:32
0ng/L	0.000445		0.000017000	3.813			11:32
Cal-Std1	0.002402					PxH	11:34
	0.002341						11:35
	0.002381						11:36
30.00ng/L	0.002375		0.000031020	1.306			11:36
Calibration	Calibration function: 01						11:38

Mercur

## Peak plots

Hg



Mercur

## Mercur

Report file: C:\WinAAS\TMP\2024\DeclPro\_010  
 Program version: 4.7.10.0 Printed on: 12/12/2024 13:31  
 Recording started on: 12/12/2024 13:16 GMT+7.0  
 Operator: PSU.OTA  
 Laboratory: ALS-BKK  
 Code: Hg067\_2024  
 Remarks:  
 Food,water

## Method parameters

Hg

Method: Without enrichment / Abs / FBR 100ng/L PM 24052023  
 Created on: 12/12/2024 Time: 12:42  
 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	Peak smoothing	8/5
AZ time	5 s		
Delay	8 s		
	---		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	bn	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

## Autosampler

Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		

Dilution

Mercur

## QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	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.	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

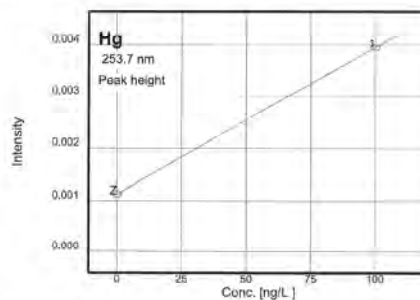
No	Name	State	Pos	Conc./ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	79	0.00	H: 0.001128 A: 0.039764	0.000086 0.004386	7.666 11.03
2	Cal-Std1	(-)	81	100.00	H: 0.003950 A: 0.070580	0.000118 0.004290	2.993 6.031

Mercur

## Calibration function 1

12/12/2024 13:31 Calibration (Peak height)

Abs=k1+k2*conc			
k1=0.001130	k2=0.000028	Recal. factor:	---
Slope	0.00003 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	154.568 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



## Measurements and events (sorted by time)

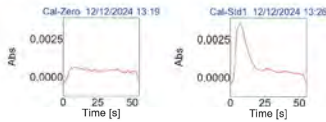
Hg	Without enrichment / Abs / FBR 100ng/L_PM 24052023					12/12/2024	13:16	
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time	
Cal-Zero		0.001052				PxH	13:19	
		0.001227					13:20	
		0.001095					13:22	
	0ng/L	0.001129		0.000086005	7.665		13:22	
Cal-Std1		0.003848				PxH	13:26	
		0.004085					13:27	
		0.003832					13:29	
	100.ng/L	0.003950		0.00011825	2.993		13:29	
Calibration	Calibration function: 01							13:31

Mercur



## Peak plots

Hg



Mercur



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

## Certificate of Calibration

Cert. No.: 24TM1318  
Page : 1 of 3

Equipment : Autoclave  
Manufacturer : AES CHEMUNEX  
Model : Masterclave 528  
Serial No. : 34677152  
ID No. : BKK\_ML0043

REVIEW BY Sithichok T.  
APPROVED BY [Signature]  
NEXT CAL DATE 26/03/26

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 : 26 September 2024  
Calibration Date : 26 September 2024  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Tawatchai Pama

Approved by :

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

Issue Date : 09 October 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2409-0695OC-6

Cert. No.: 24TM1318  
Page : 2 of 3

## Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT03 Based on BS 2646-5 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	MY49001451	24LM79	TPA	29 May 2025

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

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

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 )

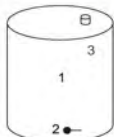
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

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	25	55	225
Finished of Calibration	26	50	226

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	24-19TC-01
2 =	Temperature sensor	24-19TC-02
3 =	Exhaust port	24-19TC-03



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2409-0695OC-6

Cert. No.: 24TM1318  
Page : 3 of 3

## Function of UUC\* :

Temperature Source

Operating parameter Set : Temperature = 121.0 °C

Sterilization period = 15 minute

UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( bar )	Uncertainty ( ± °C )	Coverage Factor k
121.0	120.9	1	121.127	0.19	1.5	0.75	2
		2	121.316				
		3	121.292				

Operating parameter Set : Temperature = 38.0 °C

Sterilization period = 30 minute

UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( bar )	Uncertainty ( ± °C )	Coverage Factor k
38.0	38.0	1	37.698	0.17	0.0	0.61	2
		2	37.865				
		3	37.679				

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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## Certificate of Calibration

Cert. No.: 24TM1398  
Page : 1 of 3

Equipment : Incubator  
Manufacturer : SHEL-LAB  
Model : 1915A  
Serial No. : 0200599  
ID No. : BKK\_ML0010

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

Received Order : 03 December 2024  
Calibration Date : 03 December 2024  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
AC Line Voltage :  $(220 \pm 22) \text{ V}$

Calibrated by :

Approved by :

( ) Pomthippa Tameyakul  
( ) Ponpan Paipim  
(✓) Suwit Imjai

Issue Date : 17 December 2024

The Uncertainties are for a confidence probability of approximately 95%

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

REVIEW BY : *Sithichok T.*  
APPROVED BY : *[Signature]*  
NEXT CAL DATE : 03/12/25



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2412-0004OC-1  
Procedure Used :-

Cert. No.: 24TM1398  
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

- Reference standard instrument:-  

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49023932	24LM119	TPA	27 Jul 2025
- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.

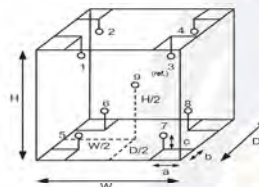
Remark : TPA : Technology Promotion Association ( Thailand - Japan )

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	24	24
REL.Humid. ( % )	51	55
AC Supply ( Volt )	223	223



### 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>

Position :	Ref. Std. ID No.:
1	19-16RTD-01
2	19-16RTD-02
3	19-16RTD-03
4	23-16RTD-04
5	19-16RTD-05
6	19-14RTD-06
7	21-16RTD-07
8	19-16RTD-08
9 (ref.)	19-16RTD-09



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2412-0004OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 24TM1398  
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	0.048	0.40	0.46	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.888	34.840	35.116	35.141	34.750	34.896	34.921	35.054	34.768	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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## Certificate of Calibration

Cert. No.: 24TM667  
Page : 1 of 3

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 : 23 April 2024  
Calibration Date : 23 April 2024  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$

Calibrated by :

Tawatchai Pama

Approved by :

*[Signature]*  
Approved Signatory

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

Issue Date : 26 April 2024

REVIEW BY : *Sithichok T.*  
APPROVED BY : *[Signature]*  
NEXT CAL DATE : 23/10/25

The Uncertainties are for a confidence probability of approximately 95%

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





Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2404-0439OC-8  
Procedure Used :-

Cert. No.: 24TM667  
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	MY49001451	24LM44	TPA	17 Mar 2025

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

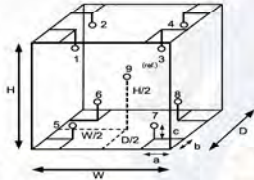
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	24	23
REL.Humid. ( % )	65	65
AC Supply ( Volt )	223	222

Position :	Ref. Std. ID No.:
1	24-19TC-01
2	24-19TC-02
3	24-19TC-03
4	24-19TC-04
5	24-19TC-05
6	24-19TC-06
7	24-19TC-07
8	24-19TC-08
9 (ref.)	24-19TC-09

#### Probe Installation Details :

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

#### Dimension of Chamber :

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



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2404-0439OC-8  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 24TM667  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor
180	180	180	0.64	2.7	3.7	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
180	181.009	181.511	180.922	181.359	181.217	183.659	181.664	181.986	181.474	1.5

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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