

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือวิเคราะห์และตรวจวัดคุณภาพสิ่งแวดล้อม



Certificate No.: T/O 660198

Date of issue : 11-Oct-2023

Equipment Description : Refrigerator
Equipment Model : P1010
Equipment Serial No. : P1010-1020-0005
I.D. No. or Control No. : TNP.LAB.01
Manufacturer : Entech Industrial Solution Co.,Ltd.
Customer Name : TNP ENVIRONMENT CO.,LTD.
Customer Address : 332/173 Moo. 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong,
Nonthaburi 11110
Total pages of certificate : 2 pages
Instrument Receiving Date : 9-Oct-2023
Receiving No. : O-230230
Environmental Conditions : All of the measurement were carried out in the working area
Temperature : (25 ± 15) °C
Humidity : (55 ± 30) % RH
Voltage : (220 ± 22) VAC
Calibration Place : 332/173 Moo. 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong,
Nonthaburi 11110
Calibration Procedure No. : This instrument was calibrated by comparison of reference radiation source standard
according to calibration work instration no WI-CL-18-C

The calibration certificate expended uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k , which for a normal distribution corresponds to a coverage probability of approximately 95%

*The standard uncertainty of measurement has been determined in accordance with M 3003
The expression uncertainty and confidence in measurement.*

This certificate is applied only to item under test environmental condition.

*This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal are not valid.*

This calibration certificate documents are traceability to national standards, which realize the unit of measurement according to the International system of units (SI).

Date of Calibration : 9-Oct-2023

Certificate No. : T/O 660198

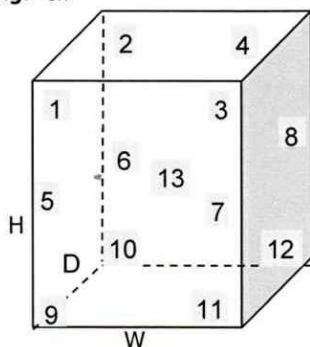
The Reference Standard Instrument :-

Instrument	Model	Serial No.	Cert No.	
1) Data logger with RTD Probe	Agilent 34972A	MY41187730	PSL-T 0651-1/66	21-Apr-2024
		MY60008352	PSL-T 0651-3/66	21-Apr-2024

Measured room conditions

Temperature :	Minimum: 30.8 °C	Maximum: 31.9 °C
Humidity :	Minimum: 50.7 %RH	Maximum: 57.2 %RH
Voltage :	Minimum: 219.8 VAC	Maximum: 223.4 VAC
Fresh Air Setting:	off	

Sensor Position :



Working Space of chamber :

(Inside Dimensions) W x D x H : 1560 mm x 500 mm x 1380 mm

Sensor Installation Details :

- Sensor Number 1 to 12 installed approximately 50 mm From each wall.
- Sensor Number 13 installed approximately geometric of the chamber.

Results : The measurement results of the calibration were reported in the table below.

(*) Without adjustment

() After adjustment

UUC* Setting	UUC* Reading	Temperature Reading of Standard Sensor								
(°C)	(°C)	Sensor Position								
		1	2	3	4	5	6	7	8	9
		4.02	4.35	4.01	4.20	4.37	4.22	4.17	4.39	4.05
		Sensor Position								
		10	11	12	13					
		4.29	4.30	4.28	4.19					

UUC* Setting	UUC* Reading	Temperature Uniformity	Temperature Stability	Overall Variation	Uncertainty of Measurement	Coverage Factor K
(°C)	(°C)	(°C)	(± °C)	(°C)	(± °C)	
4.0	4.1	1.19	1.08	2.47	1.5	2

UUC* = Unit Under Calibration

Remark :-

- Temperature reading of Standard Sensors shown in the table were taken from the average of Standard reading at each position.
- Temperature Uniformity was calculated from the difference between the maximum and minimum of actual temperature reading from all reference sensors at the same time.
- Temperature Stability was calculated from the maximum stability of nine positions, and formula of Stability is [(Maximum Temperature Value - Minimum Temperature Value) / 2]
- Overall Variation was calculated from the difference between the maximum and minimum measured temperature throughout observation time.

End of Report



CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

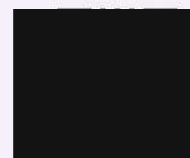
NOMENCLATURE : pH METER
MANUFACTURER : HORIBA
MODEL / TYPE : LAQUA-PH1100/9615S
SERIAL NO. : B80A0042/9X0B0575
CLID. NO. : 272001452
JOB CONTROL NO. : 230911100397

CUSTOMER : TNP ENVIRONMENT CO., LTD.
332/173 MOO 3 TAMBON BANG RAK PHATTANA,
AMPHOE BANG BUA THONG, NONTHABURI 11110

DATE OF RECEIVED : 11 September 2023

DATE OF ISSUED : 14 September 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.



REPORT OF CALIBRATION

FOR

NOMENCLATURE : pH METER
MANUFACTURER : HORIBA
MODEL / TYPE : LAQUA-PH1100/9615S
SERIAL NO. : B80A0042/9X0B0575
DATE OF CALIBRATION : 12 September 2023

ENVIRONMENT CONDITIONS :

Temperature : $(25 \pm 2.5) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \% \text{ RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPCH-01**. The calibration was performed by direct measurement with Certified Reference Material (CRM).

REFERENCE STANDARD USED :

1. pH Standard Solution, NIMT TRM CODE TRM-S-2003, TRM CODE TRM-S-2007.
2. pH Standard Solution, Control Company Catalog Number 06664263,11784256, Lot Number CC752722.

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).
Lot Number. 040822 , 230822. Due Date 26 April 2024.
2. The measurements are traceable to International System of Units (SI) , through Control Company.
Certificate No. 4288-13355261 , Due Date 06 May 2024.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

Certificate No. **Q23100397**

F3-011-04/01-12

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CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of pH meter.

CALIBRATION DATA

pH METER RESULT @ 25 °C

Standard pH Buffer Solution (pH)	pH Meter Reading (pH)	pH Meter Reading (mV)	Correction (pH)	Uncertainty of pH Measurement ($\pm$ pH)	k Factor
4.003	4.01	150.2	-0.007	0.010	2,00
7.000	7.00	-26.1	0.000	0.015	2,06
10.003	10.01	-187.1	-0.007	0.016	2,05

Technical Note. Setting function CAL 3 point (4,7,10).

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 2,3 of 54

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q23100397

F3-011-04/01-12

page 3



CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMO-HYGROMETER
MANUFACTURER : EXTECH INSTRUMENTS
MODEL / TYPE : 445814
SERIAL NO. : PONPE5816745
CLID. NO. : 232303263
JOB CONTROL NO. : 230911100396

CUSTOMER : TNP ENVIRONMENT CO., LTD.
332/173 MOO 3 TAMBON BANG RAK PHATTANA,
AMPHOE BANG BUA THONG, NONTABURI 11110

DATE OF RECEIVED : 11 September 2023

DATE OF ISSUED : 15 September 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.



REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMO-HYGROMETER**
MANUFACTURER : **EXTECH INSTRUMENTS**
MODEL / TYPE : **445814**
SERIAL NO. : **PONPE5816745**
DATE OF CALIBRATION : **13 September 2023**

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$

Relative Humidity : $(55 \pm 10) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-11**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 36151.

Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No. 21028, Due Date 09 December 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

Certificate No. Q23100396

F3-011-04/01-12

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermo-hygrometer.

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
20.0	20.01	19.9	+0.11	0.27
25.0	25.01	25.2	-0.19	

2. CORRECTION OF HUMIDITY

STD Temperature (° C)	STD Reading (%RH)	DUC Reading (%RH)	Correction (%RH)	Uncertainty ± (%RH)
25	50.0	47	+3.0	0.8

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 49 of 54

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q23100396

F3-011-04/01-12

Certificate of Calibration

Certificate No. : 67-400049-1

Page : 1 of 2

Submitted by : TNP Environment Co., Ltd.

332/173 Moo 3 Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11110

Equipment : Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 200 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : TNP.LAB.12

Environment : Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

Date of Received : 26 January 2024

Date of Calibration : 01 February to 02 February 2024

Date of Issue : 02 February 2024

Calibrated by :

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4001 based on ASTM E77-07 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400001	TT-0016-22	07 Feb 2024	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)
400004	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)



Certificate of Calibration

Certificate No. : 67-400049-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC* reading 0 ° C Standard reading 0.8789 ° C

Standard Reading (° C)	UUC Reading (° C)	Correction (° C)	Uncertainty (± ° C)
21.2064	20	1.2	0.31
31.3084	30	1.3	0.31

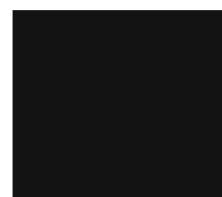
Remark

UUC : Unit Under Calibration

This result of calibration was found accurate as shown on date and place of calibration only.

This 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%

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Certificate no: H/T 670338

Date of issue : 21-Mar-24

Instrument description : Thermo-Hygrometer
Instrument model : Extech 445815
Instrument serial no. : PONPE5899554
ID no. or control no. : TNP.LAB.21
Manufacturer : Extech Instruments
Probe description : -
Probe model : -
Probe serial : -
Customer name : TNP ENVIRONMENT CO.,LTD.
Customer address : 332/173 Moo 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong, Nonthaburi 11110

Total pages of certificate : 2 Pages
Receiving no. : L-241004-1
Receiving date. : 08-Mar-24
Parameter of calibration : Temperature Calibration
Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
 Temperature : 23 ± 5 °C
 Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : This instrument was calibrated by comparison of indication with the Standard Thermo- hygrometer according to calibration Work Instruction no .WI-CL-11-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.

This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 20-Mar-24

Certificate no: H/T 670338

Standard references

Standard	Reference No.	Vendor	Due Date
ARALAB 300ECP,Fitoclima	S2023070040-001	MIT	07-Jul-24
Thermo HygroPalm HP 23-A	SG-H-00579/66	Success Gateway	16-Aug-24

Measured room conditions

Temperature : 22.1 °C

Humidity : 55.9 %RH

Pressure : 1019.3 mbar

Calibration results (Without Adjustment)

Reference temperature : - °C

Parameter of standard	Standard values	Mean of UUC.	Error	Uncertainty (±)
Temperature (°C)	19.97	20.1	0.13	0.50
Temperature (°C)	25.02	25.2	0.18	0.50
Temperature (°C)	29.99	30.2	0.21	0.50

Remark : -

End of Report

Certificate no: H 670285

Date of issue : 21-Mar-24

Instrument description	:	Thermo-Hygrometer
Instrument model	:	Extech 445815
Instrument serial no.	:	PONPE5899554
ID no. or control no.	:	TNP.LAB.21
Manufacturer	:	Extech Instruments
Probe description	:	-
Probe model	:	-
Probe serial	:	-
Customer name	:	TNP ENVIRONMENT CO.,LTD.
Customer address	:	332/173 Moo 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong, Nonthaburi 11110
 Total pages of certificate	:	 2 Pages
Receiving no.	:	L-241004
Receiving date.	:	08-Mar-24
Parameter of calibration	:	Humidity Calibration
Condition of UUC.	:	Used
Ambient condition	:	All of the Measurement were carried out the stabilized laboratory
		Temperature : 23 ± 5 °C
		Humidity : 55 ± 15 %RH
Calibration place	:	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
 Calibration procedure no.	:	 This instrument was calibrated by comparison of indication with the Standard Thermo- hygrometer according to calibration Work Instruction no .WI-CL-11-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.

This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).

Certificate no: H 670285

Standard refereces

Standard	Reference No.	Vendor	Due Date
Thermo HygroPalm HP 23-A	SG-H-00579/66	Success Gateway	16-Aug-24
Hygrogen 2-XL	Performance	Entech	24-Mar-24

Measured room conditions

Temperature : 22.7 °C **Humidity :** 56.7 %RH **Pressure :** 1013.3 mbar.

Calibration results (Without Adjustment)

Reference temperature : 25.0 °C

Parameter of standard	Standard values	Mean of UUC.	Error	Uncertainty (±)
Humidity (%RH)	35.09	31	-4.09	1.3
Humidity (%RH)	50.03	48	-2.03	1.5
Humidity (%RH)	64.97	68	3.03	1.5

Remark : -

End of Report



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. : 23M455

Page : 1 of 2

Equipment : Standard Weight Set

Manufacturer: -

Model : Class:F1

Serial No.: 15022021-01

ID No.: TNP.LAB.25

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 04 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

Ambient Temperature: (23 $\pm$ 2) °C

Relative Humidity: (50 $\pm$ 15) %

Atmospheric Pressure: 1015.25 mbar

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.

332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong,
Nonthaburi 11110

Procedure used: Calibration were conducted using in-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m³ and a temperature of 23.4 °C material density of weight is 8000 kg/m³.

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard Weight Set (E2)	73336	20026	MM-0018-22	28 Feb 2024
2) Standard Weight Set (E2)	73338	20028	MM-0019-22	28 Feb 2024

2.This certificate is not certified for any commercial transaction.

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

4.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

B 0309848



Cert No.: 23M455

Page: 2 of 2

Result of calibration

Nominal Value	Conventional mass		Uncertainty of Measurement ($\pm$)	Maximum Permissible error ($\pm$)
	Before Adjustment	After Adjustment		
200 g	199.99986 g	-	0.30 mg	1.0 mg
100 g	100.00015 g	-	0.16 mg	0.50 mg
50 g	50.00015 g	-	0.10 mg	0.30 mg
20 g	20.000116 g	-	0.080 mg	0.25 mg
10 g	10.000041 g	-	0.060 mg	0.20 mg
5 g	5.000010 g	-	0.050 mg	0.16 mg
2 g	1.999936 g	-	0.040 mg	0.12 mg
1 g	0.999973 g	-	0.030 mg	0.10 mg
200 mg	200.059 mg	200.007 mg	0.020 mg	0.060 mg
100 mg	100.037 mg	99.981 mg	0.016 mg	0.050 mg

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 %.

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THAI CALIBRATION SERVICES CO., LTD.

19/8 Moo 9 Soi Raiking 30 Puttamonthon 5 Rd., Sampran, Nakornpatom 73210

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www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



CALIBRATION CERTIFICATE

Certificate No.S2306518S

page 1 of 2

Customer : TNP ENVIRONMENT CO., LTD.
332/173 Moo 3 Tambon Bang Rak Phatthana,
Amphoe Bang Bua Thong, Nonthaburi 11110

Equipment : Non-automatic weighing instrument (Electronic instrument)

Manufacturer : Shimadzu **Order No. :** 66S2523-1

Model : AP225WD **Ambient temperature :** $(26.9 \pm 5.0) ^\circ\text{C}$

Accuracy class : - **Relative humidity :** $(52.0 \pm 10.0) \%$

Capacity : 10 g / 220 g **Received date :** 21-Jun-2023

Resolution : 0.00001 g / 0.0001 g **Date of calibration :** 21-Jun-2023

Serial No. : D316301848 **Date of issue :** 24-Jun-2023

ID No. : TNP.LAB.30 **Condition of the balance :** Good working conditions

Place of calibration : ห้อง LAB

Calibration method

This instrument was calibrated according to the EURAMET Calibration Guide No. 18.

Condition of reference standard weight

<u>Instrument</u>	<u>Nominal value</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due-date</u>	<u>Density (kg/m³)</u>
1 Standard weight set	1 mg to 2 kg	15885+15849	M2210001S	8-Oct-2023	7950

Traceability of the reference standard weight

This certificate is traceable to SI unit through Mass Calibration Laboratory Thai Calibration Services Co., Ltd., NSC-ONSC accredited no. Calibration 0189.



THAI CALIBRATION SERVICES CO., LTD.

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www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



CALIBRATION CERTIFICATE

Certificate No.S2306518S

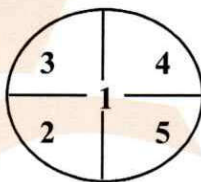
page 2 of 2

The repeatability of indication

Nominal Value (g)	Standard Deviation of reading (g)	Maximum difference between susccessive reading (g)	n
100	0.000005	0.00001	5
200	0.00005	0.0001	5

The effect of eccentric application of a load on the indication (test load : 100 g)

Position	Balance Reading (g)
Point 1	100.0000
Point 2	100.0002
Point 3	100.0001
Point 4	100.0000
Point 5	100.0001
Eccentric Value	0.0002



The error of indication

Nominal Value (g)	Value of Reference Standard Weight (g)	Balance Reading (g)	Correction (g)	Uncertainty (±) (g)	k
Unload	0.00000	0.00000	0.00000	0.000016	2.32
0.1	0.10000	0.10003	-0.00003	0.000019	2.10
0.5	0.50000	0.50001	-0.00001	0.000023	2.04
1	1.00001	1.00000	+0.00001	0.000026	2.00
5	5.00000	5.00001	-0.00001	0.000038	2.00
10	9.99999	10.00001	-0.00002	0.000046	2.00
20	20.0000	20.0000	0.0000	0.000085	2.00
50	50.0000	50.0001	-0.0001	0.00011	2.00
100	100.0000	100.0000	0.0000	0.00018	2.00
200	200.0000	200.0004	-0.0004	0.00034	2.00

Remark : Adjustment, External weight nominal value 100 g, Standard weight of Lab

Uncertainty of measurement

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor (k), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

This report will certify of the calibrated equipment only.

--End--



THAI CALIBRATION SERVICES CO., LTD.

19/8 Moo 9 Soi Raiking 30 Puttamonthon 5 Rd., Sampran, Nakhon Pathom 73210

Tel. 0-3439-7682-5 Fax: 0-3439-7687

www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



CALIBRATION CERTIFICATE

Certificate No.S2306519S

page 1 of 2

Customer : TNP ENVIRONMENT CO., LTD.

332/173 Moo 3 Tambon Bang Rak Phatthana,

Amphoe Bang Bua Thong, Nonthaburi 11110

Equipment : Non-automatic weighing instrument (Electronic instrument)

Manufacturer : Sartorius

Order No. : 66S2523-2

Model : SECURA224-1S

Ambient temperature : $(26.8 \pm 5.0) ^\circ\text{C}$

Accuracy class : -

Relative humidity : $(52.0 \pm 10.0) \%$

Capacity : 220 g

Received date : 21-Jun-2023

Resolution : 0.0001 g

Date of calibration : 21-Jun-2023

Serial No. : 0041305301

Date of issue : 24-Jun-2023

ID No. : TNP.LAB.31

Condition of the balance : Good working conditions

Place of calibration : ห้อง LAB

Calibration method

This instrument was calibrated according to the EURAMET Calibration Guide No. 18.

Condition of reference standard weight

<u>Instrument</u>	<u>Nominal value</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due-date</u>	<u>Density (kg/m³)</u>
1 Standard weight set	1 mg to 2 kg	15885+15849	M2210001S	8-Oct-2023	7950

Traceability of the reference standard weight

This certificate is traceable to SI unit through Mass Calibration Laboratory Thai Calibration Services Co., Ltd., NSC-ONSC accredited no. Calibration 0189.



THAI CALIBRATION SERVICES CO., LTD.

19/8 Moo 9 Soi Raiking 30 Puttamonthon 5 Rd., Sampran, Nakornpatom 73210

Tel. 0-3439-7682-5 Fax: 0-3439-7687

www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



CALIBRATION CERTIFICATE

Certificate No.S2306519S

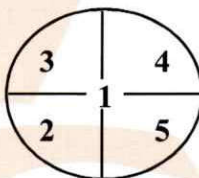
page 2 of 2

The repeatability of indication

Nominal Value (g)	Standard Deviation of reading (g)	Maximum difference between successive reading (g)	n
200	0.00000	0.0000	5

The effect of eccentric application of a load on the indication (test load : 100 g)

Position	Balance Reading (g)
Point 1	100.0000
Point 2	100.0000
Point 3	100.0000
Point 4	99.9998
Point 5	99.9998
Eccentric Value	0.0002



The error of indication

Nominal Value (g)	Value of Reference Standard Weight (g)	Balance Reading (g)	Correction (g)	Uncertainty (±) (g)	k
Unload	0.0000	0.0000	0.0000	0.000082	2.00
0.1	0.1000	0.1000	0.0000	0.000083	2.00
0.5	0.5000	0.5000	0.0000	0.000084	2.00
1	1.0000	0.9999	+0.0001	0.000085	2.00
5	5.0000	5.0000	0.0000	0.000090	2.00
10	10.0000	10.0000	0.0000	0.000094	2.00
20	20.0000	20.0001	-0.0001	0.00011	2.00
50	50.0000	50.0001	-0.0001	0.00013	2.00
100	100.0000	100.0000	0.0000	0.00019	2.00
200	200.0000	199.9998	+0.0002	0.00033	2.00

Remark : Without adjustment

Uncertainty of measurement

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor (k), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

This report will certify of the calibrated equipment only.

--End--

CERT.No.: HS-U039F

Harikul Science Co.,Ltd.

694 Soi Ratchadanivet 24, Pracharatbamphen,

Samsaennok, Huaikhwang, Bangkok 10310

Tel: 0-2274-2456 Fax: 0-2274-2443

Email: info@harikul.com www.harikul.com

Certificate of Calibration

Calibration Date : 20 Jun 23

Submitted by : TNP ENVIRONMENT COMPANY LIMITED.

332/173 Moo. 3, Tambon Bang Rak Phatthana,

Amphoe Bang Bua Thong, Nonthaburi 11110

Avg Room Temp : 20 °C

Avg Water Temp : 20 °C

Air Pressure : 757.00 mmHg

Salinity : 0 ppt

Model : YSI 4010-2W

S/N : 22051520

Probe : YSI 4100

S/N : 22C102711

ID NO. : -

Air Temp ref : S/N. E00522

Barometric ref : S/N. E00522

Water Temp ref : S/N. 11431

Technician : Kittipong M.

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.05	(PASS)	-
Measurement 2 (mg/l)	9.05	(PASS)	-
Measurement 3 (mg/l)	9.04	(PASS)	-
Measurement 4 (mg/l)	9.03	(PASS)	-
Measurement 5 (mg/l)	9.04	(PASS)	-
Measurement 6 (mg/l)	9.04	(PASS)	-
Measurement 7 (mg/l)	9.04	(PASS)	-
Measurement 8 (mg/l)	9.03	(PASS)	-
Measurement 9 (mg/l)	9.03	(PASS)	-
Measurement 10 (mg/l)	9.03	(PASS)	-

Mean Measurement	9.04	mg/l	-	-
Inaccuracy	0.05	mg/l	-	-

Overall Status (PASS)

Manufacturer Specification

Accuracy = +/- 0.2 mg/l

1) This certificate is issued based on the result that are found as shown on date and place of test only.

2) The calibration procedure followed in accordance with Harikul Science Co., Ltd

Certificate of Calibration

Certificate No. : 66-400687-1

Page : 1 of 2

Submitted by : TNP Environment Co., Ltd.
332/173 Moo 3 Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11110

Equipment : Air Chamber (Oven)
Manufacturer : Memmert Model : UF75
Range : N/A °C Resolution : 0.1 °C
Serial No. : B320.0251 ID No. : N/A

Environment : On site calibration was carried out at the Laboratory, TNP Environment Co., Ltd.
Ambient Temperature : (27.0 to 28.0) °C
Relative Humidity : (45 to 50) %
Line Voltage : (228.0 to 230.0) V

Date of Received : 11 December 2023

Date of Calibration : 11 December 2023

Date of Issue : 14 December 2023

Calibrated by :

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400046 & 400023	66-400547-1	04 Apr 2024	National Institute of Metrology Thailand (NIMT)

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 Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 66-400687-1

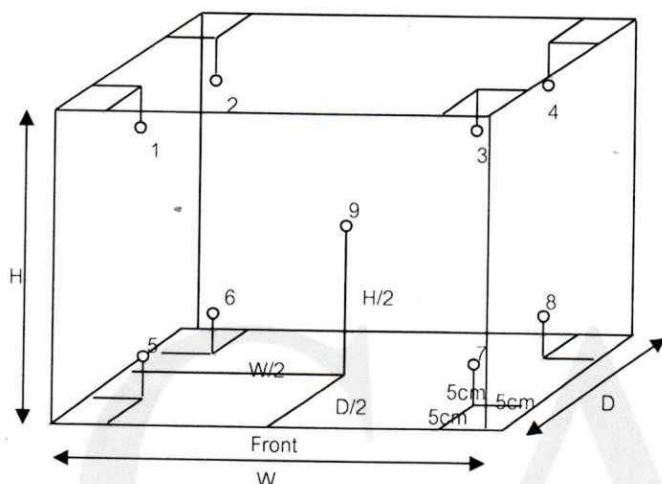
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.56 m

Capacity = 0.07 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
85.0	85.0	85.0	85.3	85.1	85.2	85.1	85.0	84.8	84.7	84.7	85.0	0.64
104.0	104.0	104.0	104.3	104.2	104.3	104.1	104.0	103.8	103.7	103.7	104.0	0.69
180.0	180.0	180.0	179.5	179.9	180.0	179.8	179.9	179.4	178.9	179.4	180.0	0.95

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
85.0	85.0	85.0	0.4	0.1	0.8
104.0	104.0	104.0	0.4	0.1	0.8
180.0	180.0	180.0	1.4	0.3	1.6

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

This 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%

- o0o -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR23110535-2

Page : 1 of 3

Customer : TNP ENVIRONMENT CO.,LTD.

332/173 Moo.3, Bang Rak Phatthana, Bang Bua Thong, Nonthaburi
11110

Equipment Name : Water Quality Meter

Manufacturer : Digicon

Model : WA-48SD

Serial Number : T.075714

ID. Number : TNP-LAB-46

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Relative Humidity : $50\% \pm 15\%$

Location of Calibration : In-Lab

Calibration Procedure : SP-CPC-04-01,
SP-CPC-04-02,

Method of Calibration : SP-CPC-04-11

Received Date : 30 Nov 2023

Calibration Date : 19 Jan 2024

Recommend Due Date : 19 Jan 2025

Date of Issue : 20 Jan 2024

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR23110535-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Zero Oxygen Solution	HI7040L	Lot S0027-23 _	21C31	21 Mar 2028
Standard pH Solution	PH016.L5	Lot No.882984	61267077	20 Mar 2024
Standard pH Solution	PH107.L5	Lot No.882985	61275614	13 Apr 2024
Standard pH Solution	PH020.L5	Lot No.882986	61268050	20 Mar 2024
Conductivity Standard 84 uS/cm	CS84M0S.L5	Lot No.882987	61247444	20 Mar 2024
Conductivity Standard 1413 uS/cm	CS1413M0S.L5	Lot No.882988	61267992	20 Mar 2024
Conductivity Standard 12880 uS/cm	CS1288P1S.L5	Lot No.882989	61247253	20 Mar 2024
Sodium Chloride Standard Solution	RM003461L25	Lot No.841770	97756699	23 Sep 2024

Traceability

This certification is traceable to the International System of Unit maintained at :

HANNA - Hanna Instruments (Thailand) Ltd.

C.P.A. Chem - ANAB#AT-1836 (ISO/IEC 17025:2017) and ANAB#AR-1835 (ISO/IEC 17034:2016)



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR23110535-2

Page : 3 of 3

pH Measurement @ 25 °C

Unit : pH

Standard Solution	UUC Reading	Error	Uncertainty (±)
4.008	3.98	-0.028	0.014
6.984	7.01	0.026	0.012
10.011	10.02	0.009	0.018

Conductivity Measurement @ 25 °C

Standard Solution	UUC Reading	Error	Uncertainty (±)
84 µS/cm	84.6 µS/cm	0.6 µS/cm	0.60 µS/cm
1.413 mS/cm	1.415 mS/cm	0.002 mS/cm	0.0082 mS/cm
12.88 mS/cm	12.89 mS/cm	0.01 mS/cm	0.075 mS/cm

* Dissolved Oxygen Permanance Test

Unit : mg/L

Actual Standard	UUC Reading	Error	Uncertainty (±)
0.0	0.0	0.0	0.13
5.0	4.9	-0.1	0.13
8.3	8.2	-0.1	0.13

Salinity Measurement

Unit : % Salinity

Actual Standard	UUC Reading	Error	Uncertainty (±)
5.0269	5.04	0.0131	0.015

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.
Calibration Marked (*) "Not ANAB Accredited " in this Certificate have been included for completeness.

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2$, providing a level of confidence approximately 95%.

- End of Certificate -



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



Cert. No.: 23TM1099

Page : 1 of 3

Certificate of Calibration

Equipment :	Autoclave
Manufacturer :	Rexall
Model :	LS-2D
Serial No. :	04131
ID No. :	AUT-01
Submitted by :	Environment & Laboratory Co.,Ltd. 40 Soi Liangmueangnonthaburi 13, Talad Kwan, Mueang, Nonthaburi 11000
Location :	Room No. 205
Received Order :	12 July 2023
Calibration Date :	12 July 2023
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %

Issue Date :

24 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0056477



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2307-0094OC-7

Cert. No.: 23TM1099

Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1) Data Acquisition	MY41021843	22LM172	TPA	27 Dec 2023

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

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

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)

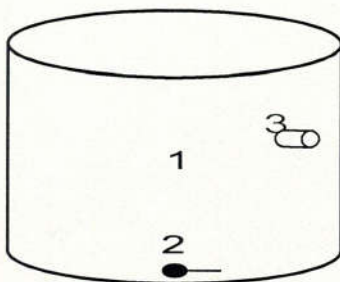
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

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



	<u>Environmental</u>		
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	30	55	220
Finished of Calibration	30	57	220

<u>Position</u>	<u>Description</u>	<u>Ref. Std. ID No.:</u>
1 =	Center of chamber	21-04TC-01
2 =	Temperature sensor	21-04TC-02
3 =	Exhaust port	21-04TC-03



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2307-0094OC-7
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 23TM1099

Page : 3 of 3

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

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (kg/cm ²)	Uncertainty (± °C)	Coverage Factor <i>k</i>
121	-	1	121.837	0.89	1.2	1.3	2
		2	121.869				
		3	121.875				

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 %.

-o0o-



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-29 FAX. 0-2719-9484

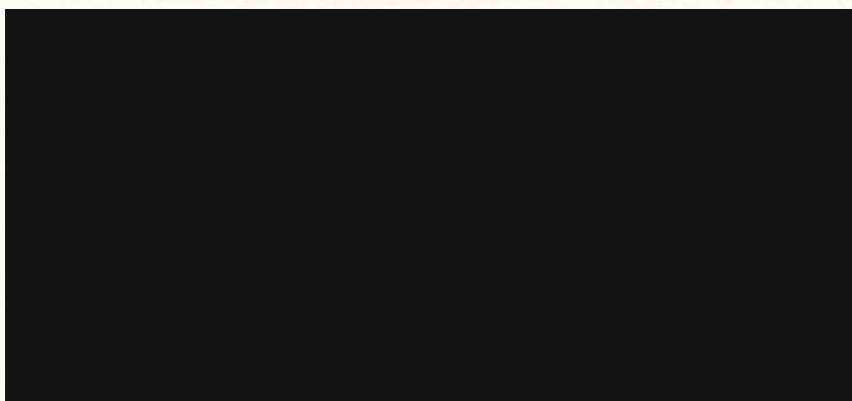


Cert. No.: 23TM1100

Page : 1 of 3

Certificate of Calibration

Equipment :	Incubator
Manufacturer :	Memmert
Model :	BM 500
Serial No. :	D593.0342
ID No. :	CHI-002
Submitted by :	Environment & Laboratory Co.,Ltd. 40 Soi Liangmueangnonthaburi 13, Talad Kwan, Mueang, Nonthaburi 11000
Location :	Room No. 204
Received Order :	12 July 2023
Calibration Date :	12 July 2023
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %



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.

A 0056478



Equipment : Incubator
 Condition As-Received : Used Item
 Reference : 2307-0094OC-4

Cert. No.: 23TM1100
 Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY41021843	22LM172	TPA	27 Dec 2023

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

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

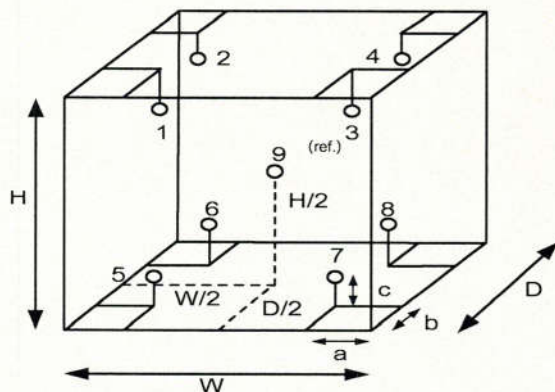
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	22	22
REL.Humid. (%)	64	66
AC Supply (Volt)	222	221



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

Probe Installation Details :

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

Dimension of Chamber :

D = 0.40 m
 W = 0.56 m
 H = 0.48 m
 Capacity = 0.11 m³



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2307-0094OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 23TM1100

Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.040	0.27	0.48	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (±°C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	35.021	34.900	35.010	35.284	34.853	34.919	34.945	34.964	35.089	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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Cert. No.: 23TM1273

Page : 1 of 3

Certificate of Calibration

Equipment : Incubator

Manufacturer : Envilab-Intiligent

Model : -

Serial No. : -

ID No. : CHI-005

Submitted by : Environment & Laboratory Co.,Ltd.
40 Soi Liangmueangnonthaburi 13,
Talad Kwan, Mueang,
Nonthaburi 11000

Location : Room No. 204

Received Order : 24 August 2023

Calibration Date : 24 August 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Issue Date :

29 August 2023

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.

A 0057741



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2308-0600OC-1

Cert. No.: 23TM1273

Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY44035217	22LM170	TPA	16 Dec 2023

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

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

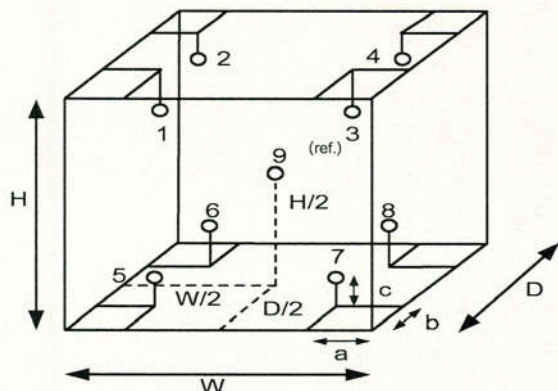
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	23
REL.Humid. (%)	50	54
AC Supply (Volt)	220	220



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

Probe Installation Details :

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

Dimension of Chamber :

D = 0.40 m
W = 0.70 m
H = 1.0 m
Capacity = 0.28 m³



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2308-0600OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 23TM1273

Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.47	1.2	1.8	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (±°C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.805	34.737	34.701	34.435	34.724	34.783	35.228	35.604	34.816	0.71

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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Cert.No.: 23CHO420

Page.: 1 of 3

Certificate of Calibration

Equipment :	Spectrophotometer
Manufacturer :	Hach
Model :	DR 3900
Serial No. :	1988383
ID No. :	SPE-002
Condition As-Received:	Used Item
Received Date :	12 July 2023
Calibration Date :	12 July 2023
Reference :	2307-0094OC-11
Submitted by :	Environment & Laboratory Co.,Ltd. 40 Soi Liangmueangnonthaburi 13 Talad Kwan, Mueang, Nonthaburi 11000
Calibration Place :	Room No. 304
Ambient Temperature :	(26.7 - 26.9) °C (On-Site)
Relative Humidity :	(57.2 - 51.2) % (On-Site)
Calibration Procedure :	In - house method : CP-OCH4 based on ASTM E 275-01

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.

A 0056486



Cert. No. : 23CHO420

Page : 2 of 3

Condition of calibration result

1. Reference Standard Material :

<u>Material</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1. Absorbance Standard set	32587	100509	28 Mar 2024
2. Absorbance Standard set	32590	100508	28 Mar 2024
3. Absorbance Standard set	8331	105939	28 Sep 2024
4. Wavelength Standard set	29829	94776	02 Sep 2023
5. Wavelength Standard set	29829	94777	02 Sep 2023

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

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

- National Physical Laboratory (NPL), The United Kingdom of Great Britain and Northern Ireland
- National Institute of Standards and Technology (NIST), The United States of America

4. Spectral BandWidth : 5 nm

Scan Speed : - nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement ($\pm$ nm)	Coverage Factor <i>k</i>
361.40	361	0.59	2.00
447.20	446	0.59	2.00
537.00	536	0.59	2.00
638.00	637	0.59	2.00
740.51	741	0.59	2.00
807.04	807	0.59	2.00



Cert. No. : 23CHO420

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement ($\pm$ Abs)	Coverage Factor <i>k</i>
350.0	Zero	0.000	0.0046	2.00
	0.4246	0.423	0.0061	2.00
	Zero	0.000	0.0050	2.00
	0.6385	0.633	0.0055	2.00
440.0	Zero	0.000	0.0028	2.00
	0.5607	0.560	0.0030	2.00
	0.7336	0.733	0.0030	2.00
	1.0636	1.063	0.0030	2.00
546.1	Zero	0.000	0.0028	2.00
	0.5224	0.522	0.0028	2.00
	0.6856	0.684	0.0029	2.00
	0.9937	0.992	0.0028	2.00
635.0	Zero	0.000	0.0028	2.00
	0.5397	0.538	0.0028	2.00
	0.6832	0.680	0.0028	2.00
	0.9886	0.985	0.0028	2.00

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer
- The Potassium Dichromate filled cells are measured against a Perchloric acid blank.

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

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



Cert. No.: 23TM1173

Page : 1 of 3

Certificate of Calibration

Equipment :	Water Bath
Manufacturer :	Memmert
Model :	WB 22
Serial No. :	I505.0053
ID No. :	WAB-01
Submitted by :	Environment & Laboratory Co.,Ltd. 40 Soi Liangmueangnonthaburi 13, Talad Kwan, Mueang, Nonthaburi 11000
Location :	Room No. 303
Received Order :	12 July 2023
Calibration Date :	12 - 13 July 2023
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %

Issue Date : 24 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0056487



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2307-0094OC-3

Cert. No.: 23TM1173
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1) Data Acquisition	MY44073381	23LM95	TPA	19 May 2024

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

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

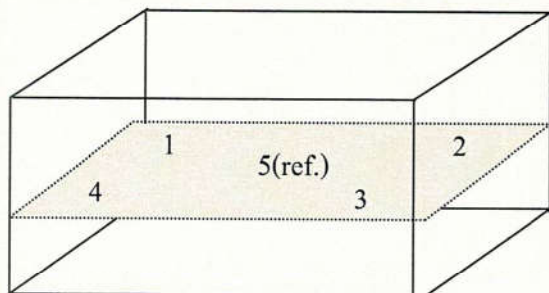
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	
Beginning of Calibration	30	47	220
Finished of Calibration	31	50	221



Front

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



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2307-0094OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 23TM1173

Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			Position					
			1	2	3	4	5 (ref.)	
44.5	44.5	44.5	44.507	44.503	44.498	44.509	44.502	0.15
60.0	60.0	60.0	59.914	59.928	59.912	59.899	59.894	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor <i>k</i>
44.5	0.039	0.023	2
60.0	0.098	0.042	2

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

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

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

UUC* : Unit Under Calibration

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

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

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CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2419

Site Calibration

Order No. 24060337

Customer Bureau Veritas AQ Lab (Thailand) Limited
111 Thailand Science Park
Moo 9 Paholyothin Rd., Klong 1, Klong Luang, Pathumthani 12120 Thailand

Place of Calibration Prepare Culture Media

Description Autoclave

Model VE-65

Serial No. 7202

ID.No. CHM000206

Date of Receipt Jun 26, 2024

Date of Calibration Jun 26, 2024

Environment

Temperature	(Min)	22.1	°C	(Max)	25.5	°C
Relative Humidity	(Min)	42.7	%RH	(Max)	56.3	%RH

Calibration Method

WI-22 : The reference thermometer was placing into the chamber and measurement based on BS-2646.
The temperature scale in use at this laboratory is the International Temperature Scale of 1990.



CALIBRATION CERTIFICATE

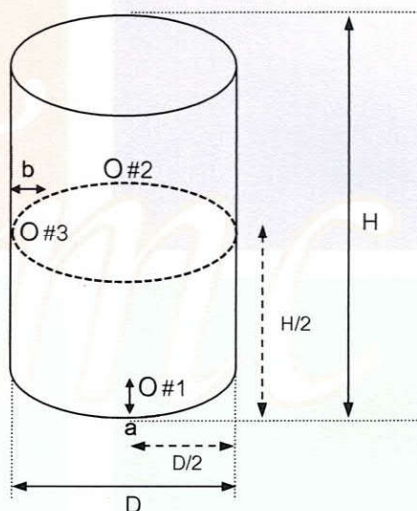
Date of Issue Jun 28, 2024

Cert No. 24/2419

Site Calibration

Order No. 24060337

Results (without adjustment)



Position of reference thermometers were placed

Note.

- 1). Duration of the holding time was 45 minutes.
- 2). Stability - greatest one half of difference between max peak and min peak of each reference probe measured temperature obtained during the calibration interval.
- 3). 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. The reference sensor should preferably be located at the geometric center of the chamber.



CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2419

Site Calibration

Order No. 24060337

Results (without adjustment)

UUC Setting (°C)	UUC Reading		Reference Thermometer (°C)		Stability ±(°C)	Uniformity (°C)	Uncertainty ±(°C)
	(°C)	(KPa)					
115.0	115.3	179.6	Position 1	115.58	0.25	0.15	0.70
			Position 2	115.58			
			Position 3	115.48			

UUC Setting (°C)	UUC Reading		Reference Thermometer (°C)		Stability ±(°C)	Uniformity (°C)	Uncertainty ±(°C)
	(°C)	(KPa)					
121.0	121.4	211.0	Position 1	121.59	0.20	0.13	0.70
			Position 2	121.60			
			Position 3	121.52			

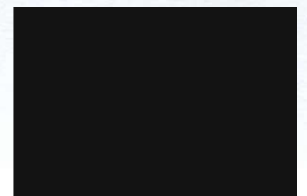
Standard

1) Standard Datalogger with RTD Model. HiTemp. 140-PT S/N. R32397, Certificate No. QR23-1962, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Aug 07, 2024.

2) Standard Datalogger with RTD Model. HiTemp. 140-PT S/N. R32398, Certificate No. QR23-1963, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Aug 07, 2024.

3) Standard Datalogger with RTD Model. HiTemp. 140-PT S/N. R32399, Certificate No. QR23-1964, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Aug 07, 2024.

This certificate is traceable to SI unit.





Thermology Co., Ltd.

96/177-96/178 Moo 6, T. La-harn, A. Bangbuathong, Nonthaburi 11110
Tel : 0 2191 6479 Fax : 0 2191 6480 website : www.thermology.co



CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Site Calibration

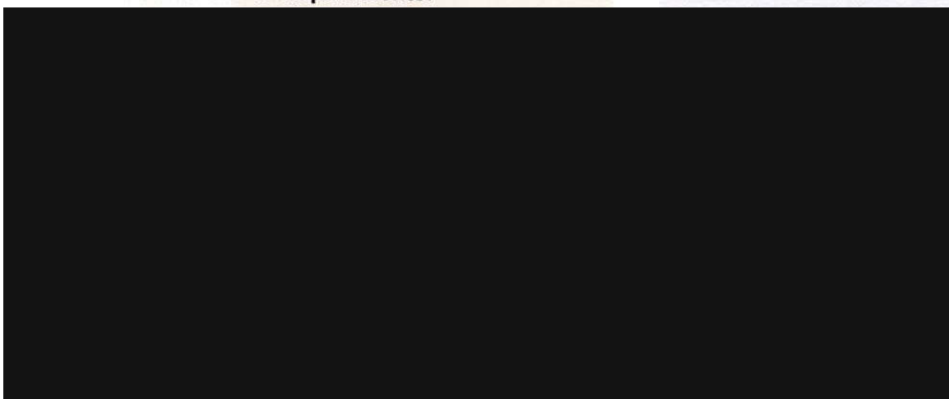
Cert No. 24/2419

Order No. 24060337

The stability and uniformity was taken into account in the measurement uncertainty stated.

The above results are valid exclusively for calibration samples as mentioned in the report.

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%. The uncertainty evaluation has been carried out in accordance with ONAC requirements.

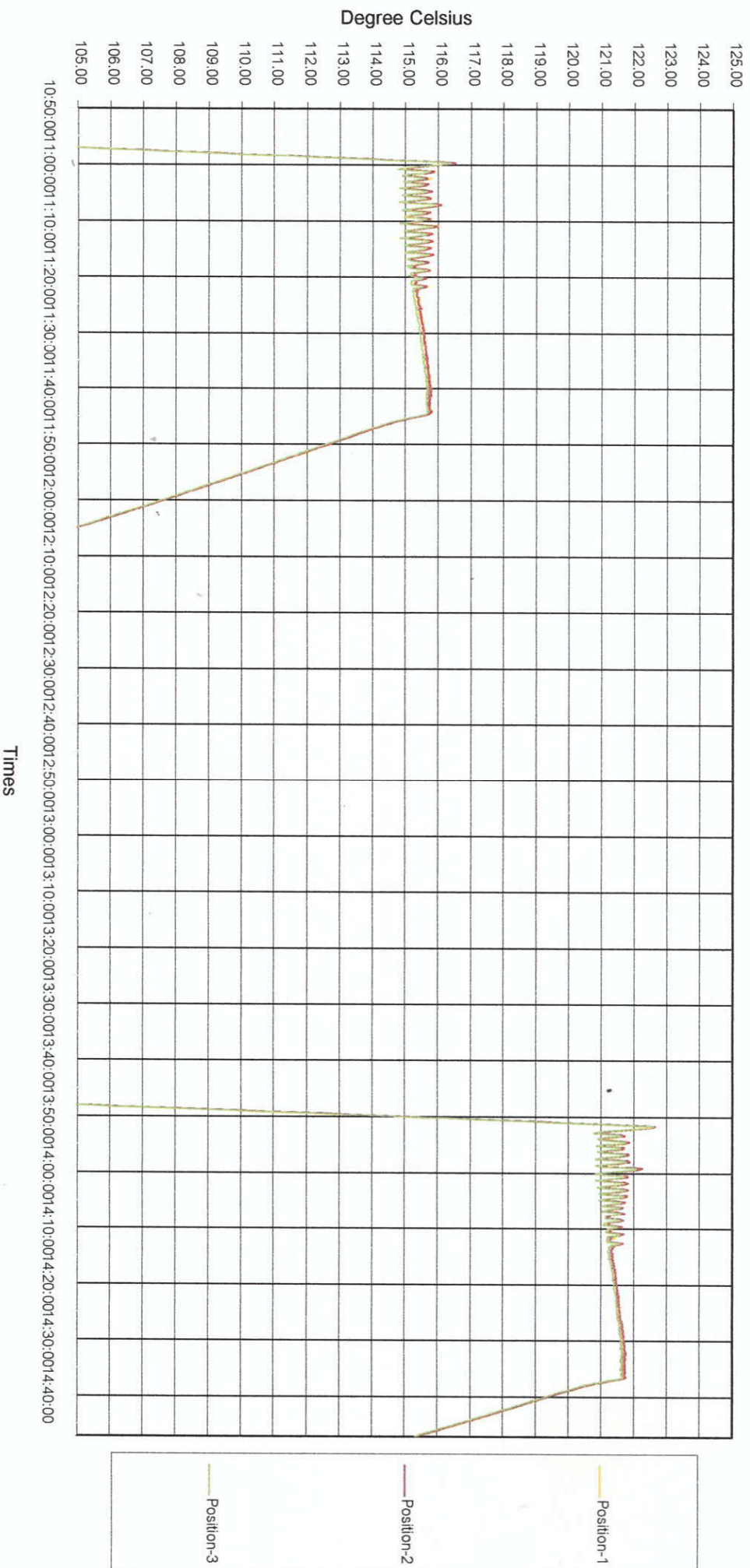


Thermology

Autoclave

Cert.No. 24/2419

Model. VE-65 S/N. 7202 ID.No. CHM000206





CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2418

Site Calibration

Order No. 24060337

Customer Bureau Veritas AQ Lab (Thailand) Limited
111 Thailand Science Park
Moo 9 Paholyothin Rd., Klong 1, Klong Luang, Pathumthani 12120 Thailand

Place of Calibration Incubation Room

Description Water Bath

Model SC100

Serial No. 0152187501160414

ID.No. CHM000205

Date of Receipt Jun 24, 2024

Date of Calibration Jun 24, 2024

Environment

Temperature	(Min)	22.8	°C	(Max)	25.2	°C
Relative Humidity	(Min)	44.1	%RH	(Max)	58.5	%RH
Line Voltage	(Min)	227.2	VAC	(Max)	229.6	VAC

Calibration Method

WI-18 : The reference thermometer was placed into the chamber and measurement was performed based on AS-2853.

The temperature scale in use at this laboratory is the International Temperature Scale of 1990.

Standard

1) Data Acquisition with Sensor Model 34972A S/N. MY49007789, Certificate No. QR24-0186, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Jan 23, 2025.

This certificate is traceable to SI unit.

Page 1 of 3

This certificate is issued in accordance with the conditions of Thermology Laboratory. The traceability to recognised national standard and the unit of measurement realised at corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of laboratory.



CALIBRATION CERTIFICATE

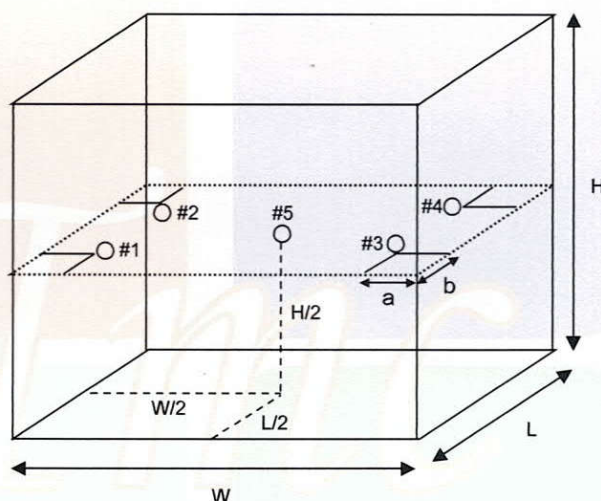
Date of Issue Jun 28, 2024

Site Calibration

Cert No. 24/2418

Order No. 24060337

Results (without adjustment)



Position of reference thermometers were placed

Note.

- 1). Dimension (W x L x H) is 30 x 34 x 20 cm.
- 2). Stability - greatest one half of difference between max peak and min peak of each reference probe measured temperature obtained during the calibration interval.
- 3). 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. The reference sensor should preferably be located at the geometric center of the chamber.





CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2418

Site Calibration

Order No. 24060337

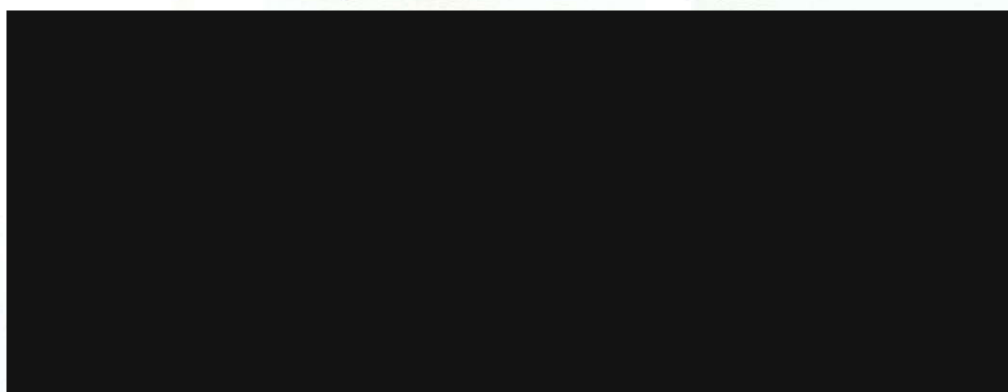
Results (without adjustment)

Cal Point (°C)	UUC Setting (°C)	UUC Reading (°C)	Reference Thermometer (°C)		Stability $\pm$ (°C)	Uniformity (°C)	Uncertainty $\pm$ (°C)
44.5	44.5	44.5	Position 1	44.490	0.020	0.043	0.13
			Position 2	44.494			
			Position 3	44.491			
			Position 4	44.499			
			Position 5	44.503			

The stability and uniformity was taken into account in the measurement uncertainty stated.

The above results are valid exclusively for calibration samples as mentioned in the report.

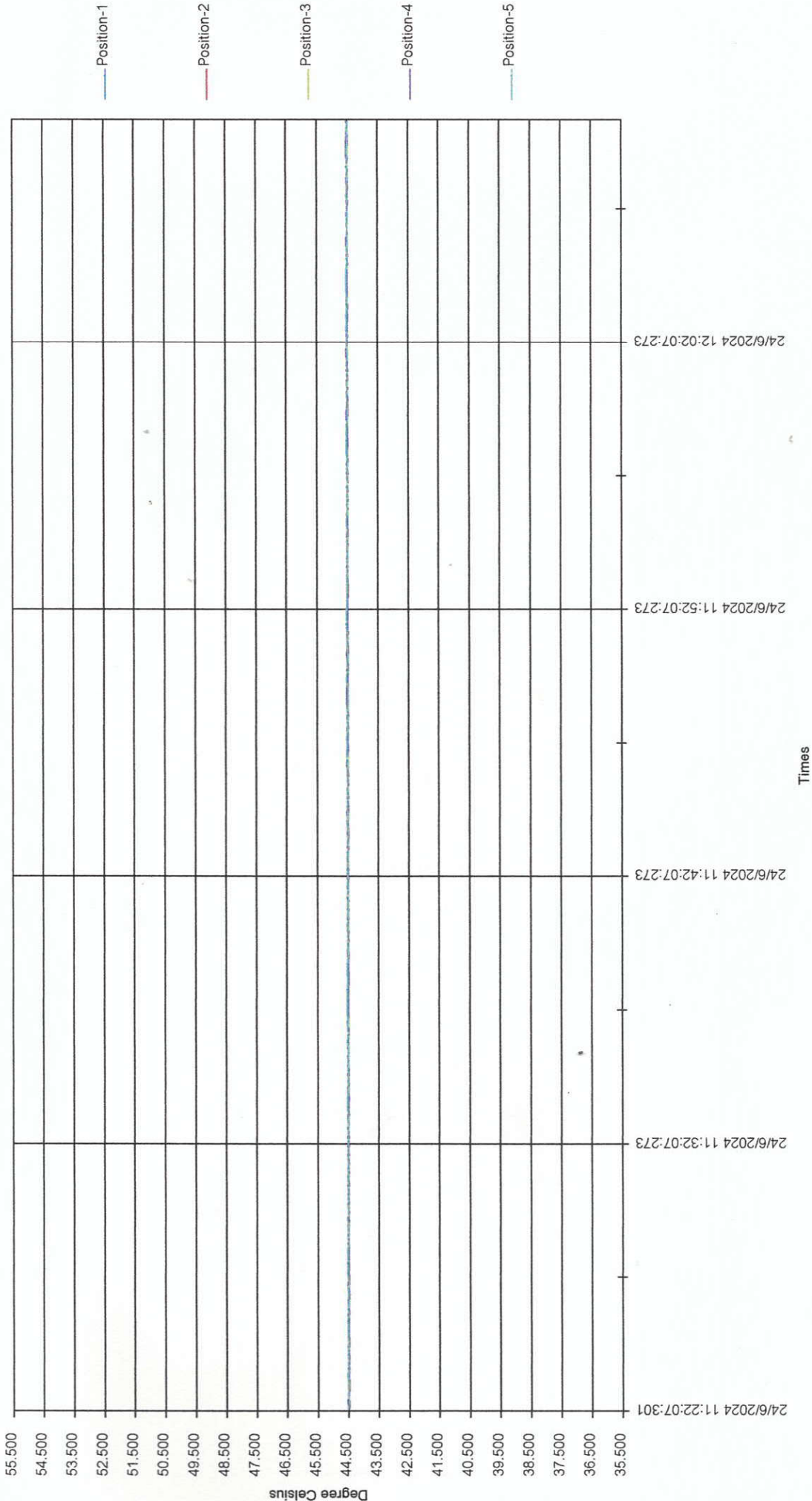
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with ONAC requirements.



Cert.No. 24/2418

Water Bath

Model. SC100 S/N. 0152187501160414 ID.No. CHM000205





CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2415

Site Calibration

Order No. 24060337

Customer Bureau Veritas AQ Lab (Thailand) Limited
111 Thailand Science Park
Moo 9 Paholyothin Rd., Klong 1, Klong Luang, Pathumthani 12120 Thailand

Place of Calibration Incubation Room

Description Incubator

Model IN110

Serial No. D415.0797

ID.No. CHM000181

Date of Receipt Jun 24, 2024

Date of Calibration Jun 24, 2024

Environment

Temperature (Min) 22.8 °C (Max) 25.2 °C

Relative Humidity (Min) 44.1 %RH (Max) 58.5 %RH

Calibration Method

WI-17 : The reference thermometer was placed into the chamber and measurement was performed based on AS-2853.

The temperature scale in use at this laboratory is the International Temperature Scale of 1990.

Standard

1) Data Acquisition with Sensor Model 34972A S/N. MY49010059, Certificate No. QR24-0874, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Apr 24, 2025.

This certificate is traceable to SI unit.



CALIBRATION CERTIFICATE

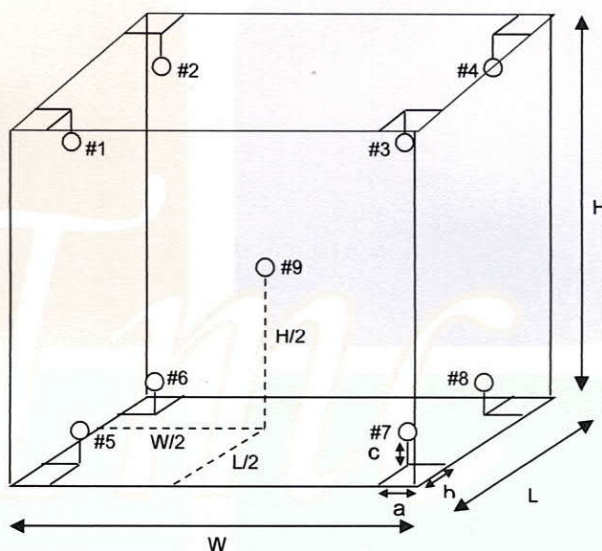
Date of Issue Jun 28, 2024

Cert No. 24/2415

Site Calibration

Order No. 24060337

Results (without adjustment)



Position of reference thermometers were placed

Note.

- 1). Dimension ($W \times L \times H$) is 56 x 40 x 48 cm.
- 2). Stability - greatest one half of difference between max peak and min peak of each reference probe measured temperature obtained during the calibration interval.
- 3). 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. The reference sensor should preferably be located at the geometric center of the chamber.



CALIBRATION CERTIFICATE

Date of Issue Jun 28, 2024

Cert No. 24/2415

Site Calibration

Order No. 24060337

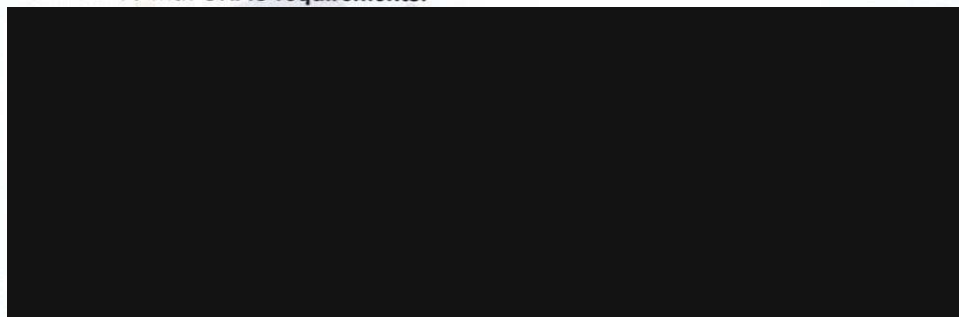
Results (without adjustment)

Cal Point (°C)	UUC Setting (°C)	UUC Reading (°C)	Reference Thermometer (°C)		Stability $\pm$ (°C)	Uniformity (°C)	Uncertainty $\pm$ (°C)
35.0	35.0	35.0	Position 1	35.138	0.067	0.253	0.30
			Position 2	35.099			
			Position 3	35.075			
			Position 4	35.187			
			Position 5	35.173			
			Position 6	34.988			
			Position 7	34.878			
			Position 8	34.965			
			Position 9	34.970			

The stability and uniformity was taken into account in the measurement uncertainty stated.

The above results are valid exclusively for calibration samples as mentioned in the report.

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%. The uncertainty evaluation has been carried out in accordance with ONAC requirements.



Cert.No. 24/2415

Model. IN110

S/N. D415.0797

ID.No. CHM000181





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



Cert.No.: 23CHO565

Page.: 1 of 3

Certificate of Calibration

Equipment :	Spectrophotometer
Manufacturer :	Merck
Model :	Prove 100
Serial No. :	1904113676
ID No. :	S2019025
Condition As-Received:	Used Item
Received Date :	21 September 2023
Calibration Date :	21 September 2023
Reference :	2309-0483OC-2
Submitted by :	SGS (Thailand) Limited 1/209, 1/211 Moo 1, Ban Chang, Ban Chang, Rayong 21130
Calibration Place :	Spectrophotometry Lab
Ambient Temperature :	(23.8 - 20.9) °C (On-Site)
Relative Humidity :	(50.1 - 50.2) % (On-Site)
Calibration Procedure :	In - house method :

01

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 0058836



Cert. No. : 23CHO565

Page : 2 of 3

Condition of calibration result

1. Reference Standard Material :

<u>Material</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1. Absorbance Standard set	39130	106269	10 Oct 2024
2. Wavelength Standard set	36730	98330	19 Jan 2024
3. Wavelength Standard set	36730	98331	19 Jan 2024

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

3. This certificate is traceable to the International System of Unit maintained through :
- Starna Scientific Ltd.

4. Spectral BandWidth : 4 nm
Scan Speed : - nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement ($\pm$ nm)	Coverage Factor <i>k</i>
418.48	418.5	0.15	2.00
513.70	513.1	0.14	2.00
536.90	536.3	0.14	2.00
637.94	637.6	0.14	2.00
879.70	878.8	0.15	2.00



Cert. No. : 23CHO565

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement ($\pm$ Abs)	Coverage Factor <i>k</i>
440.0	Zero	0.000	0.0028	2.00
	0.5645	0.563	0.0028	2.00
	0.6988	0.698	0.0028	2.00
	1.0017	1.001	0.0028	2.00
546.1	Zero	0.000	0.0028	2.00
	0.5281	0.527	0.0028	2.00
	0.6962	0.696	0.0028	2.00
	0.9984	0.998	0.0028	2.00
635.0	Zero	0.000	0.0028	2.00
	0.5699	0.569	0.0028	2.00
	0.7606	0.760	0.0028	2.00
	1.0927	1.092	0.0028	2.00

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer

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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Verification COD Reactor

Equipment Name	Dri-Block Heater-Digital	Temperature Ver	150±2 °C
Serial No.	000827-A	Model	DB 200/3
Reference Standard	Thermocouple Type K	Certificate No.	21/4272
Calibration Date	10/03/2023	Next Cal. Date	10/03/2024

Left											
Hole 1				Hole 2				Hole 3			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.1	-0.36	150.7	1	150.6	-0.36	150.2	1	151.4	-0.36	151.0
2	150.8	-0.36	150.4	2	151.7	-0.36	151.3	2	151.3	-0.36	150.9
3	151.2	-0.36	150.8	3	151.1	-0.36	150.7	3	151.7	-0.36	151.3
		Mean	150.67			Mean	150.77			Mean	151.11
		SD	0.208			SD	0.551			SD	0.208
		%RSD	0.138			%RSD	0.365			%RSD	0.138
Hole 4				Hole 5				Hole 6			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.7	-0.36	151.3	1	150.5	-0.36	150.1	1	151.5	-0.36	151.1
2	151.6	-0.36	151.2	2	151.3	-0.36	150.9	2	151.4	-0.36	151.0
3	151.5	-0.36	151.1	3	150.6	-0.36	150.2	3	150.5	-0.36	150.1
		Mean	151.24			Mean	150.44			Mean	150.77
		SD	0.100			SD	0.436			SD	0.551
		%RSD	0.066			%RSD	0.290			%RSD	0.365
Hole 7				Hole 8				Hole 9			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.3	-0.36	150.9	1	151.7	-0.36	151.3	1	150.5	-0.36	150.1
2	151.0	-0.36	150.6	2	150.5	-0.36	150.1	2	151.2	-0.36	150.8
3	151.3	-0.36	150.9	3	151.4	-0.36	151.0	3	150.8	-0.36	150.4
		Mean	150.84			Mean	150.84			Mean	150.47
		SD	0.173			SD	0.624			SD	0.351
		%RSD	0.115			%RSD	0.414			%RSD	0.233
Hole 10				Hole 11				Hole 12			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.6	-0.36	151.2	1	151.5	-0.36	151.1	1	150.7	-0.36	150.3
2	151.6	-0.36	151.2	2	151.2	-0.36	150.8	2	151.6	-0.36	151.2
3	150.8	-0.36	150.4	3	151.5	-0.36	151.1	3	151.2	-0.36	150.8
		Mean	150.97			Mean	151.04			Mean	150.81
		SD	0.462			SD	0.173			SD	0.451
		%RSD	0.306			%RSD	0.115			%RSD	0.299

Verification COD Reactor

Equipment Name Dri-Block Heater Digital
 Serial No. 000827-A
 Reference Standard Thermocouple Type K
 Calibration Date 10/03/2023

Temperature Ver 150±2 °C
 Model DB 200/3
 Certificate No. 21/4272
 Next Cal. Date 10/03/2024

Middle

Hole 1				Hole 2				Hole 3			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.2	-0.36	150.8	1	150.7	-0.36	150.3	1	151.1	-0.36	150.7
2	151.5	-0.36	151.1	2	151.7	-0.36	151.3	2	151.6	-0.36	151.2
3	151.6	-0.36	151.2	3	150.8	-0.36	150.4	3	150.9	-0.36	150.5
Mean			151.07	Mean			150.71	Mean			150.84
SD			0.208	SD			0.551	SD			0.361
%RSD			0.138	%RSD			0.365	%RSD			0.239

Hole 4				Hole 5				Hole 6			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.5	-0.36	151.1	1	151.6	-0.36	151.2	1	150.5	-0.36	150.1
2	150.7	-0.36	150.3	2	151.2	-0.36	150.8	2	150.6	-0.36	150.2
3	151.6	-0.36	151.2	3	151.2	-0.36	150.8	3	151.2	-0.36	150.8
Mean			150.91	Mean			150.97	Mean			150.41
SD			0.493	SD			0.231	SD			0.379
%RSD			0.327	%RSD			0.153	%RSD			0.252

Hole 7				Hole 8				Hole 9			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151.5	-0.36	151.1	1	151.5	-0.36	151.1	1	151.2	-0.36	150.8
2	150.5	-0.36	150.1	2	151.7	-0.36	151.3	2	150.9	-0.36	150.5
3	150.8	-0.36	150.4	3	151.1	-0.36	150.7	3	151.4	-0.36	151.0
Mean			150.57	Mean			151.07	Mean			150.81
SD			0.513	SD			0.306	SD			0.252
%RSD			0.341	%RSD			0.202	%RSD			0.167

Hole 10				Hole 11				Hole 12			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	151	-0.36	150.6	1	151.5	-0.36	151.1	1	151.2	-0.36	150.8
2	150.6	-0.36	150.2	2	150.6	-0.36	150.2	2	150.5	-0.36	150.1
3	151.5	-0.36	151.1	3	151.0	-0.36	150.6	3	151.1	-0.36	150.7
Mean			150.67	Mean			150.67	Mean			150.57
SD			0.451	SD			0.451	SD			0.379
%RSD			0.299	%RSD			0.299	%RSD			0.251

Verification COD Reactor

Equipment Name Dri-Block Heater Digital
 Serial No. 000827/A
 Reference Standard Thermocouple Type K
 Calibration Date 10/03/2023

Temperature Ver 150±2 °C
 Model DB 200/3
 Certificate No. 21/4272
 Next Cal. Date 10/03/2024

Right

Hole 1				Hole 2				Hole 3			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	149.9	-0.36	149.5	1	150.3	-0.36	149.9	1	151.0	-0.36	150.6
2	151.1	-0.36	150.7	2	151.0	-0.36	150.6	2	151.0	-0.36	150.6
3	150.9	-0.36	150.5	3	149.9	-0.36	149.5	3	150.4	-0.36	150.0
		Mean	150.27			Mean	150.04			Mean	150.44
		SD	0.643			SD	0.557			SD	0.346
		%RSD	0.428			%RSD	0.371			%RSD	0.230

Hole 4				Hole 5				Hole 6			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	150.8	-0.36	150.4	1	150.0	-0.36	149.6	1	150.5	-0.36	150.1
2	151.0	-0.36	150.6	2	150.0	-0.36	149.6	2	150.8	-0.36	150.4
3	150.9	-0.36	150.5	3	150.7	-0.36	150.3	3	149.8	-0.36	149.4
		Mean	150.54			Mean	149.87			Mean	150.01
		SD	0.100			SD	0.404			SD	0.513
		%RSD	0.066			%RSD	0.270			%RSD	0.342

Hole 7				Hole 8				Hole 9			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	150.8	-0.36	150.4	1	151.1	-0.36	150.7	1	150.2	-0.36	149.8
2	150.9	-0.36	150.5	2	150.7	-0.36	150.3	2	150.2	-0.36	149.8
3	151.0	-0.36	150.6	3	151.1	-0.36	150.7	3	149.9	-0.36	149.5
		Mean	150.54			Mean	150.61			Mean	149.74
		SD	0.100			SD	0.231			SD	0.173
		%RSD	0.066			%RSD	0.153			%RSD	0.116

Hole 10				Hole 11				Hole 12			
NO.	Result			NO.	Result			NO.	Result		
	temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.		temp. °C	Corr.	temp+Corr.
1	150.6	-0.36	150.2	1	150.5	-0.36	150.1	1	150.9	-0.36	150.5
2	150.5	-0.36	150.1	2	150.9	-0.36	150.5	2	150.0	-0.36	149.6
3	149.9	-0.36	149.5	3	151.1	-0.36	150.7	3	150.5	-0.36	150.1
		Mean	149.97			Mean	150.47			Mean	150.11
		SD	0.379			SD	0.306			SD	0.451
		%RSD	0.252			%RSD	0.203			%RSD	0.300

สรุปผลการ Verify

ปรับอุณหภูมิ 154.0 °C แต่ค่าควบคุมมีอุณหภูมิ 150 ± 2 °C ทุกครั้ง



ARCHEMICA

Certificate of Calibration

Aquion RFIC : Anion System (ID#1054)

**This certificate is to verify that instrument below are calibrated
by**

Archemica Lab Co.,Ltd.

Aquion

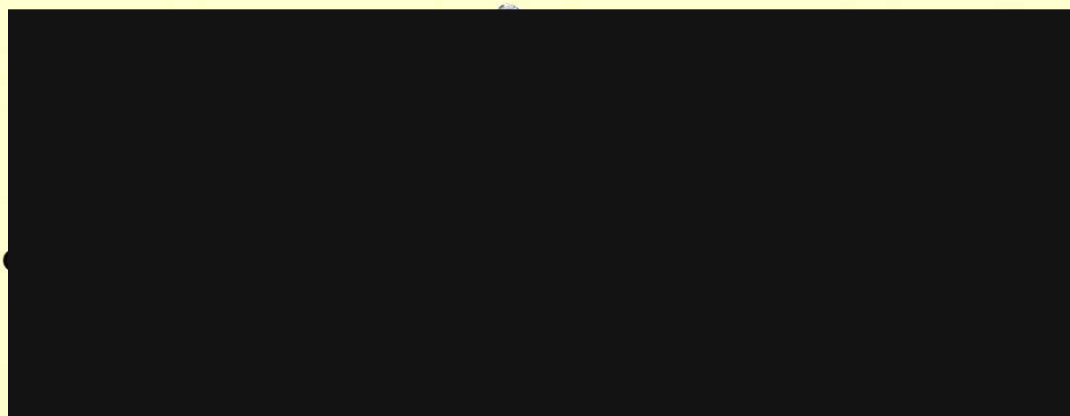
S/N 220380025

AS-DV

S/N 2203880170

For

SGS (Thailand) Limited (Rayong Branch).





MAINTENANCE AND TEST CERTIFICATE MODEL

Avio220 Max

C A U P E		Date Tested:	January 10, 2024
		Recommendation Recertification	
		Period	6 Months
		Recertification Due:	July 10, 2024
		Date Last Certified:	N/A
		Visit Number:	1052 W
		PerkinElmer Phone	
		PerkinElmer Fax:	

CONFIGURATION TESTED		
MODEL	SERIAL NUMBER	SOFTWARE
AVIO200 MAX	M79S2304111	Syngristix V5
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
IPV Methods		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
Multielement Standard	N069-1579	30-Dec-24
Instrument Cal. STD4	N930-0221	30-Nov-24
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
2 % HNO3		
10 % HNO3		



MAINTENANCE AND TEST CERTIFICATE MODEL
Avio220 Max

SERIAL NUMBER M79S2304111**DATE TESTED** January 10, 2024**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

B. Inspect and replace as necessary, all torch components including the RF coil.

☐ OK

C. Inspect all tubing for sign of clacking or leaking.

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgebfilters.

☐ OK

C. Recheck optical alignment.

☐ OK**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ OK**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL
Avio220 Max

SERIAL NUMBER <u>M79S2304111</u>		DATE TESTED <u>January 10, 2024</u>	
PARAMETER	SPECIFICATION		FINAL VALUE
Spectral Resolution : UV			
As 193.696 nm	≤ 0.009 nm		<u>0.00864</u> nm
Ni 231.604 nm	≤ 0.011 nm		<u>0.01009</u> nm
Ni 341.476 nm	≤ 0.015 nm		<u>0.01169</u> nm
Spectral Resolution : VIS			
Ba 455.403 nm	≤ 0.020 nm		<u>0.01776</u> nm
Precision			
Zn 206.200 nm	% RSD ≤ 1.0 %		<u>0.28</u> %
Mg 280.271 nm	% RSD ≤ 1.0 %		<u>0.73</u> %
Mg 285.213 nm	% RSD ≤ 1.0 %		<u>0.61</u> %
Ba 455.403 nm	% RSD ≤ 1.0 %		<u>0.54</u> %
Detection Limits : Axial			
Tl 190.801 nm	3(sd)		<u>1.52</u> ppb
As 193.696 nm	3(sd)		<u>1.4</u> ppb
Se 196.026 nm	3(sd)		<u>1.53</u> ppb
Pb 220.353 nm	3(sd)		<u>1.72</u> ppb
Detection Limits : Radial			
As 193.696 nm	3(sd)		<u>1.69</u> ppb
Zn 213.857 nm	3(sd)		<u>0.42</u> ppb
Mn 257.610 nm	3(sd)		<u>0.1</u> ppb
La 379.478 nm	3(sd)		<u>0.61</u> ppb
Ba 455.403 nm	3(sd)		<u>0.13</u> ppb
Ba 493.408 nm	3(sd)		<u>0.1</u> ppb
BEC : Axial (IB X 1000)/(IS-IB)			
Mn 257.610 nm	≤ 30 ppb		<u>7.83</u> ppb
BEC : Radial (IB X 1000)/(IS-IB)			
Mn 257.610 nm	≤ 30 ppb		<u>17.57</u> ppb



MAINTENANCE AND TEST CERTIFICATE MODEL
Avio220 Max

SERIAL NUMBER M79S2304111

DATE TESTED January 10, 2024

Remarks :

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested

☒

meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,
including warranty terms.

Cus

