

Certificate No.: T/O 670240

Date of issue : 9-Oct-2024

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 Thailand
Total pages of certificate : 2 pages
Instrument Receiving Date : 7-Oct-2024
Receiving No. : O-240290
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 Thailand
Calibration Procedure No. : This instrument was calibrated by comparison of indication with the Standard Resistance
thermometer according to calibration TLAS G20, work instruction 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 : 7-Oct-2024



Mr. Kittipong Kaewsai
Calibration Engineer



Ms. Nongluck Wongsettee
Technical Manager

Certificate No. : T/O 670240

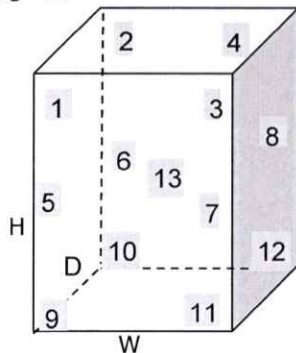
The Reference Standard Instrument :-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert No.</u>	<u>Due date</u>
1) Data logger with RTD Probe	Agilent 34972A	MY41187730	PSL-T 0484-1/67	19-Feb-2025
		MY60008352	PSL-T 0484-3/67	19-Feb-2025

Measured room conditions

Temperature : Minimum: 24.1 °C Maximum: 25.8 °C
Humidity : Minimum: 43.5 %RH Maximum: 46.8 %RH
Voltage : Minimum: 219.8 VAC Maximum: 223.3 VAC
Fresh Air Setting: off

Sensor Position :



Working Space of chamber :

(Inside Dimensions) W x D x H : 1565 mm x 500 mm x 1450 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	10	11	12	13
3.0	3.3	2.93	2.63	3.23	2.69	4.03	3.44	3.57	3.44	4.53	4.39	3.78	3.85	2.99

UUC* Setting	UUC* Reading	Temperature Uniformity	Temperature Stability	Overall Variation	Uncertainty of Measurement	Coverage Factor
(°C)	(°C)	(°C)	(± °C)	(°C)	(± °C)	K
3.0	3.3	2.65	1.99	4.75	2.5	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



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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-001

Issue Date : 7 September 2024

Work Order No. : 24/1179

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

Date of Received : 6 September 2024

Date of Calibration : 6 September 2024

Instrument Details : Description : pH meter
Manufacturer : HORIBA
Model : LAQUA-PH1100
Serial No. : B80A0042
ID No. : TNP.LAB.02
Resolution : 0.01 pH
Location : Laboratory

Calibration Method : This instrument was calibrated by in-house calibration procedure no. CWI-C-02 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

Environmental Condition

Temperature : Area Monitoring between 15°C to 40°C

Humidity : Area Monitoring between 30%RH to 85%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

Calibrated by : Mr. Kritsada Kaewwangpa
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-001

Issue Date : 7 September 2024

Work Order No. : 24/1179

Details of Calibration

1. Certified Reference Material / Certified of Instrument

Certified Reference Material	CRM Code	Lot no.	Expire Date
1.1 Buffer Solution pH 4.00	TRM-S-2027	150823	1 July 2025
1.2 Buffer Solution pH 7.00	TRM-S-2034	230524	1 July 2025
1.3 Buffer Solution pH 10.00	TRM-S-2031	160823	1 July 2025

Instrument	Certificate no.	Serial No. / ID No.	Due Date
1.4 DC Source Calibrator	23E3042	9791008	14 September 2024
1.5 Digital Thermometer with sensor	24-0002-013	316A14010055 / RTD-PH-02	8 January 2025

2. This certificate traceable to the international unit (SI)

Buffer solution no. 1.1 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.2 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.3 traceable to : Nation Institute of Metrology (Thailand)
Instrument no. 1.4 traceable to : Technology Promotion Association (Thailand-Japan) NAC Calibration No. 0008
Instrument no. 1.5 traceable to : Crystal Calibration sales and service Co., Ltd., NAC Calibration No. 0260

3. Condition of item : Used
4. Calibration location : On-site

Result of Calibration

Measurement Function : mV Measurement
Performing : Standard curve by Voltage calibrator at pH (4, 7, 10)

Normal value pH	Applied DC voltage mV	Average indicator reading		Uncertainty ($\pm$) mV	Coverage Factor k
		mV	pH		
0	414.1	414.0	0.03	0.083	2.00
2	295.8	295.8	2.02	0.083	2.00
4	177.5	177.5	4.01	0.083	2.00
7	0.0	-0.1	7.00	0.083	2.00
9	-118.3	-118.3	9.00	0.083	2.00
10	-177.5	-177.6	10.01	0.083	2.00
12	-295.8	-295.9	12.01	0.083	2.00
14	-414.1	-414.2	14.02	0.083	2.00



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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-001

Issue Date : 7 September 2024

Work Order No. : 24/1179

Result of calibration

Measurement Function : pH Measurement with electrode

Performing : Three buffer standard curve using buffer nominal pH (4, 7, 10)

STD buffer solution pH @ 25 °C	Average indicator reading			Uncertainty (±) pH	Coverage factor k
	pH	mV	pH correction		
4.01	3.99	155.6	0.02	0.012	2.00
7.00	6.99	-21.4	0.01	0.012	2.00
10.01	10.02	-197.0	-0.01	0.012	2.00

Descriptions of electrode :

Electrode Type : Glass electrode

Manufacturer : HORIBA

Serial no. : 9XB0575

Model : 9615S

ID No. : N/A

Detail of % slope form calculation

pH range	% Slope value	% Slope recommend
4 pH to 7 pH	100.1	95% - 105%
7 pH to 10 pH	98.6	

Note : Calibrate items it good condition and this report customer request and accepted in certificate

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

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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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-002

Work Order No. : 24/1179

Issue Date : 7 September 2024

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

Date of Received : 6 September 2024

Date of Calibration : 6 September 2024

Instrument Details : Description : Digital Thermometer with probe
Manufacturer : HORIBA
Model : LAQUA-PH1100
Serial No. : B80A0042
ID No. : TNP.LAB.02
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Thermometer into calibration bath temperature controller according to calibration procedure no. CWI-T-09

Environmental Condition

Temperature : Area Monitoring between 15°C to 40°C

Humidity : Area Monitoring between 30%RH to 85%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Kritsada Kaewwangpa
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-002

Issue Date : 7 September 2024

Work Order No. : 24/1179

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No. / ID No.	Certification	Due Date
Thermometer Readout	316A14010055	24-0002-001	5-Jan-2025
Standard Thermometers (RTD)	4706698-001	24-0002-001	5-Jan-2025

2. Certificate traceable : This certificate traceable to The International System of Unit (SI unit)

3. Condition of equipment : Used

4. Calibration site : On-Site

Result of Calibration

Calibration result : Without Adjustment

Calibration point (°C)	STD. Value (°C)	UUC Reading (°C)	Correction value (°C)	Uncertainty ± (°C)
25	25.00	25.0	+ 0.00	0.11

Note : Calibrate items it good condition and this report customer request and accepted in certificate

Electrode Type : Combination Electrode

Manufacturer : HORIBA

Model : 9615S

Serial no. : 9XB0575

ID No. : N/A

UUC : Unit Under Calibration.

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

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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Statements of conformity report

Refer to Certificate No. : 24-1179-002

Issue Date : 7 September 2024

Work Order No. : 24/1179

Detail of Equipment

Description : Digital Thermometer with probe

Manufacturer : HORIBA

Serial no. : B80A0042

Model : LAQUA-PH1100

ID No. : TNP.LAB.02

Result of Calibration

This result of calibration : Without adjustment

Tolerance	1	°C
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Resolution : 0.1 °C

Calibration point	STD value	UUC reading	Correction	Uncertainty	Uncertainty + Absolute correc.	Evaluation
25	25.00	25.0	0.00	0.11	0.11	Pass

The conformity certificate documents validity following ISO/IEC Guide 98-4 : Role of measurement uncertainty in conformity assessment based on statement with guard band refer to specification tolerance limit of customer consider expanded measurement uncertainty (k=95%)

The tolerance and decision rules ;

MPE of Customer = Measurement uncertainty + Absolute error ; $\leq$ MPE is pass , $>$ MPE is Fail

Statements of conformity decision by :


(Mr. Anuwat Yaklermjit)
Laboratory Manager

-- END --



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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-007

Issue Date : 11 September 2024

Work Order No. : 24/1179

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

Date of Received : 5 September 2024

Date of Calibration : 10 September 2024

Instrument Details : Description : Digital Thermo hygrometer
Manufacturer : EXTECH
Model : 445814
Serial No. : PONPE5816745
ID No. : TNP.LAB.04
Location : Humidity and Temperature Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Chilled Mirror Hygrometer and Standard Thermometer into Temperature and Humidity Chamber controller according to calibration procedure no. CWI-H-01

Environmental Condition

Temperature : Laboratory Control at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Humidity : Laboratory Control at $55\%\text{RH} \pm 20\%\text{RH}$

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Miss Phiraya Prawabut
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : 24-1179-007

Issue Date : 11 September 2024

Work Order No. : 24/1179

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No.	Certification	Due Date
1.1 Chilled Mirror Hygrometer	157151 / 157152	TH-0069-23	24 February 2025
1.2 Digital Thermometer with RTD	15000016 / RTD-11	23-1415-003	16 October 2024

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
No. 1.1 National Institute of Metrology (Thailand), NAC Calibration No. 0144
No. 1.2 Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260

3. Condition of item : Used

4. Calibration location : Permanent

Result of Calibration

1. Temperature Measurement : Without Adjustment

Resolution of UUC : 0.1 °C

Calibration Point (°C)	Average Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
17	17.066	17.0	+ 0.066	0.30
23	23.050	23.3	- 0.250	0.30
30	30.050	30.5	- 0.450	0.30

2. Humidity Measurement : Without Adjustment

Resolution of UUC : 1 %RH

Calibration Point (%RH)	Calculated Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty ± (%RH)
40	40.46	36	+ 4.46	1.6
50	50.05	45	+ 5.05	1.6
65	65.63	59	+ 6.63	1.7

Note : 1. Process calibration humidity measurement Reference temperature control at 25°C

2. Calculated STD humidity refer to dew-point temperature and convert to humidity by magnus's Equation

3. Calibrate items it good condition and this report customer request and accepted in certificate

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

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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Statements of conformity report

Refer to Certificate No. : 24-1179-007

Issue Date : 11 September 2024

Work Order No. : 24/1179

Detail of Equipment

Description : Digital Thermo hygrometer

Manufacturer : EXTECH

Serial no. : PONPE5816745

Model : 445814

ID No. : TNP.LAB.04

Result of Calibration

This result of calibration : Without adjustment

MPE part Temp. 3 °C

Resolution : 0.1 °C

Calibration point	STD value	UUC reading	Correction	Uncertainty	Uncertainty + Absolute correc.	Evaluation
17	17.066	17.0	0.066	0.30	0.366	Pass
23	23.050	23.3	-0.250	0.30	0.550	Pass
30	30.050	30.5	-0.450	0.30	0.750	Pass

MPE part Humid 15 %RH

Resolution : 1 %RH

Calibration point	STD value	UUC reading	Correction	Uncertainty	Uncertainty + Absolute correc.	Evaluation
40	40.46	36	4.46	1.6	6.06	Pass
50	50.05	45	5.05	1.6	6.65	Pass
65	65.63	59	6.63	1.7	8.33	Pass

The conformity certificate documents validity following ISO/IEC Guide 98-4 : Role of measurement uncertainty in conformity assessment based on statement with guard band refer to specification tolerance limit of customer consider expanded measurement uncertainty (k=95%)

The tolerance and decision rules ;

MPE of Customer = Measurement uncertainty + Absolute error ; $\leq$ MPE is pass , $>$ MPE is Fail

Statements of conformity decision by :

(Mr. Anuwat Yaklermjit)

Laboratory Manager



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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL / TYPE : UF75
SERIAL NO. : B320.0251
CLID. NO. : 332402706
JOB CONTROL NO. : 241212132142
CALIBRATION SERVICE : ☐ IN-LABORATORY ☒ ON-SITE

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

DATE OF RECEIVED : 12 December 2024

DATE OF ISSUED : 23 December 2024

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Calibrated By :

Wenick Inchaisri

Calibration Engineer



Approved By :

Mongkol Yotsoontorn

Authorized Signatory

23 December 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the
International System of Units (SI)

Certificate No. Q24132142

F3-011-05/12-23

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL / TYPE : UF75
SERIAL NO. : B320.0251
LOCATION SITE : LABORATORY ROOM 2 FLOOR 3
DATE OF CALIBRATION : 17 December 2024

ENVIRONMENT CONDITIONS :

Temperature : 25 °C to 26 °C

Relative Humidity : 52% to 54 %

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPTH-07 based on TLAS G-20 as calibration guidelines.

The calibration was performed by using Hydra Data Logger which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Hydra Data Logger, Fluke Model 2635A S/N. 5499551.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.

Certificate No. Q24099493, Due Date 25 September 2025.

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. Q24132142

F3-011-05/12-23

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CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring hot air oven.

CALIBRATION DATA

1. HOT AIR OVEN PERFORMANCE

DUC		Measured Uniformity (°C)	Measured Stability (°C)	Measured Overall Variation (°C)
Setting (°C)	Indicating (°C)			
85.0	85.0	0.33	0.07	0.53
104.0	104.0	0.38	0.10	0.62
180.0	180.0	0.58	0.17	0.98

Certificate No. Q24132142

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CALIBRATION LABORATORY Co., LTD.

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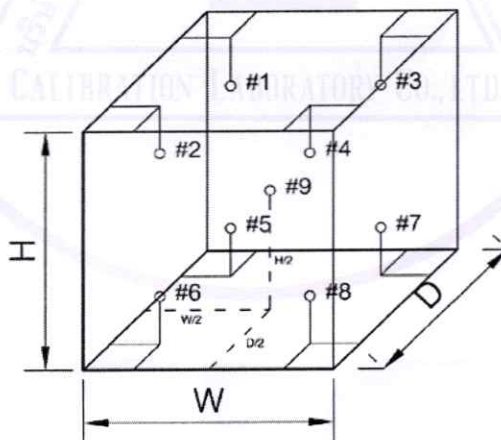
CALIBRATION DATA

2. TEMPERATURE DISTRIBUTION

DUC		Measured Temperature (°C)@Probe No.9 is Ref.									Uncertainty $\pm$ (°C)	Coverage factor <i>k</i>
Setting (°C)	Indicating (°C)	1	2	3	4	5	6	7	8	9		
85.0	85.0	84.77	85.05	84.96	84.74	84.81	84.84	85.04	84.64	84.77	0.25	2,00
104.0	104.0	103.64	104.00	103.85	103.60	103.77	103.83	104.05	103.61	103.72	0.43	2,00
180.0	180.0	179.20	179.83	179.33	179.09	179.56	179.67	179.93	179.41	179.45	0.47	2,00

Technical Note : W = 40 cm, D = 33 cm, H = 56 cm.

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 58 of 67



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

End of Certificate

Certificate No. Q24132142

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@clccalibration

Certificate No. T/O 670239

Date of issue : 9-Oct-2024

Equipment Description : Incubator
Equipment Model : Smart i250-DS
Equipment Serial No. : 0410-0121-0003
I.D. No. or Control No. : TNP.LAB.08
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 : 7-Oct-2024
Receiving No. : O-240289
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 indication with the Standard Resistance thermometer according to calibration TLAS G20, work instruction 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 and The results relate only to the items tested/calibrated.

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 : 7-Oct-2024


Mr. Kittipong Kaewsai
Calibration Engineer


Ms. Nongluck Wongsettee
Technical Manager

Certificate No. : T/O 670239

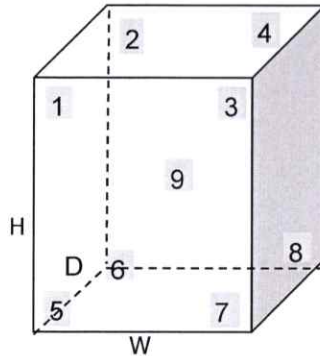
The Reference Standard Instrument :-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert No.</u>	<u>Due date</u>
1) Data logger with RTD Probe	Agilent 34972A	MY60008352	PSL-T 0484-3/67	19-Feb-2025

Measured room conditions

Temperature :	Minimum: 22.1 °C	Maximum: 23.2 °C
Humidity :	Minimum: 45.8 %RH	Maximum: 56.5 %RH
Voltage :	Minimum: 219.9 VAC	Maximum: 223.1 VAC
Fresh Air Setting:	off	

Sensor Position :



Working Space of chamber :

(Inside Dimensions) W x D x H : 500 mm x 480 mm x 1100 mm

Sensor Installation Details :

- Sensor Number 1 to 8 installed approximately 50 mm From each wall.
- Sensor Number 9 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								
		Sensor Position								
(°C)	(°C)	1	2	3	4	5	6	7	8	9
20.0	20.0	20.34	20.28	20.09	20.13	20.04	20.04	19.84	19.95	19.90

UUC* Setting	UUC* Reading	Temperature Uniformity	Temperature Stability	Overall Variation	Uncertainty of Measurement	Coverage Factor
(°C)	(°C)	(°C)	(± °C)	(°C)	(± °C)	K
20.0	20.0	0.53	0.48	1.26	0.70	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



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

45/48 Soi Salathammasop31, Salathammasop Rd.,

Salathammasop, Thawewatthana, Bangkok 10170 Thailand

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CERTIFICATE OF CALIBRATION

Certificate No. : 25-0753-025

Work Order No. : 25/0753

Issue Date : 12 June 2025

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

Date of Received : 12 June 2025

Date of Calibration : 12 June 2025

Instrument Details : Description : Electronic Balance
Manufacturer : SHIMADZU
Model : AP225WD
Serial No. : D316301848
ID No. : TNP.LAB.30
Resolution : 0.00001 g / 0.0001 g
Capacity : 102 g / 220 g
Location : ห้องปฏิบัติการ 2 ชั้น 3

Calibration Method : This calibration was conducted by using in-house method according to calibration procedure no. CWI-B-01 based on UKAS LAB14 edition 6, October 2019

Environmental Condition

Temperature : Maximum 25.5°C / Minimum 25.2°C

Humidity : Maximum 48%R.H. / Minimum 45%R.H.

Air Pressure : Maximum 999.2hPa / Minimum 999.1hPa

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

Calibrated by : Mr. Itsara Sawanbancha
Calibration Engineer

Approved by : 
(Mr. Thichakorn Srisupob)
Asst. Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

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Phone : 0-2408-8474 Fax : 0-2408-8477 <http://www.crystalcal.com> Email : info@crystalcal.com





CERTIFICATE OF CALIBRATION

Certificate No. : 25-0753-025

Issue Date : 12 June 2025

Work Order No. : 25/0753

Details of Calibration

1. Reference Standards Instrument

Instrument	Capacity of Weight	Serial No. / ID No.	Certificate No.	Due date
Weight Set E2	1mg to 200g	B744909236	22-130801	6 December 2025

2. Certificate traceable : This certificate traceable to The International System of Unit refer to Asia Medical and Agricultural Laboratory and Research center Co., Ltd. , NSC-ONSC Calibration No. 0152

3. Condition of item : Used

4. Calibration site : On-site

Result of Calibration

1. Calibration result : Check performance before calibration

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty ($\pm$) g	Coverage Factor (k)
50.00005	50.00009	-0.00004	0.000080	2.00
99.99996	100.00004	-0.00008	0.00016	2.00
200.0000	200.0007	-0.0007	0.00032	2.00

2. The result of check performance in first step has to Reset span

3. Calibration result : After set span by External Reset span by weight 100 g ID No. WE2-02

3.1 Repeatability number of repeatability is 10 times

Normal Value (g)	Standard Deviation of Reading (g)
50	0.00000480
100	0.00000480
200	0.0000422

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

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%.



CERTIFICATE OF CALIBRATION

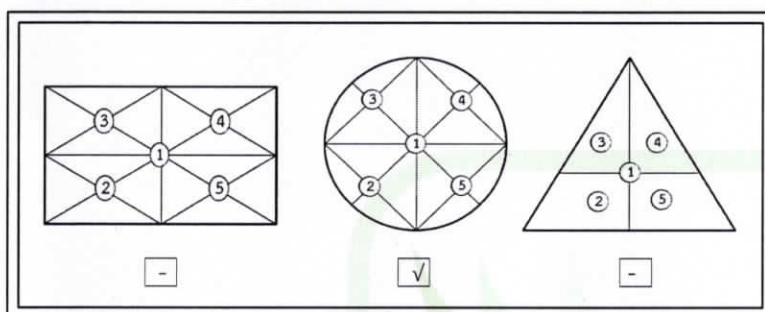
Certificate No. : 25-0753-025

Issue Date : 12 June 2025

Work Order No. : 25/0753

3. Calibration result : After set span by External Reset span by weight 100 g ID No. WE2-02 (continued)

3.2 Eccentric or Off-center Error A mass of 100 g was placed and moved to various position on pan.



Result of Eccentric Error		
Position 1	99.99997	g
Position 2	100.00001	g
Position 3	100.00002	g
Position 4	99.99999	g
Position 5	99.99998	g
(Maximum Difference)	0.00005	g

3.3 Departure of indication from nominal value

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (±) g	Coverage Factor (k)
Unload	0.00000	0.00000	0.000020	2.00
0.10001	0.10001	0.00000	0.000020	2.00
0.50001	0.50003	-0.00002	0.000020	2.00
1.00001	1.00000	0.00001	0.000020	2.00
5.00002	5.00001	0.00001	0.000020	2.00
10.00001	10.00001	0.00000	0.000040	2.00
19.99999	19.99997	0.00002	0.000050	2.00
50.00005	50.00005	0.00000	0.000080	2.00
99.99996	99.99997	-0.00001	0.00016	2.00
200.0000	200.0000	0.0000	0.00032	2.00

Note

Calibrate items it good condition and this report customer request and accepted in certificate

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

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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Statements of conformity report

Refer to Certificate No. : 25-0753-025

Issue Date : 12 June 2025

Work Order No. : 25/0753

Detail of Equipment

Description : Electronic Balance

Manufacturer : SHIMADZU

ID No. : TNP.LAB.30

Model : AP225WD

Resolution : 0.00001 g / 0.0001 g

Serial no. : D316301848

Capacity : 102 g / 220 g

Result of Calibration

This result of calibration : Adjustment

Unit : g

Applied Weight	Balance Reading	Correction Value	Uncertainty	Uncertainty + Correction	Limit of performance	Evaluation
0.10001	0.10001	0.00000	0.000020	0.000020	0.000051	Pass
0.50001	0.50003	-0.00002	0.000020	0.000040	0.000051	Pass
1.00001	1.00000	0.00001	0.000020	0.000030	0.000051	Pass
5.00002	5.00001	0.00001	0.000020	0.000030	0.000051	Pass
10.00001	10.00001	0.00000	0.000040	0.000040	0.000071	Pass
19.99999	19.99997	0.00002	0.000050	0.000070	0.000081	Pass
50.00005	50.00005	0.00000	0.000080	0.000080	0.00011	Pass
99.99996	99.99997	-0.00001	0.00016	0.00017	0.00019	Pass
200.0000	200.0000	0.0000	0.00032	0.00032	0.00035	Pass

The conformity certificate documents validity following ISO/IEC Guide 98-4 : Role of measurement uncertainty in conformity assessment based on statement with guard band refer to NATA User checks and maintenance of laboratory balances consider expanded measurement uncertainty (k=95%)

The tolerance and decision rules ;Limit of performance (LoP) = $2.26 \text{ sw} + |\text{Corr}| + U(\text{Cal})$ Evaluation of decision = Measurement uncertainty + Absolute correction ; $\leq \text{LoP}$ is pass , $> \text{LoP}$ is Fail

Statements of conformity decision by :

(Mr. Thichakorn Srisupob)

Asst. Laboratory Manager



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

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CERTIFICATE OF CALIBRATION

Issue Date : 12 June 2025
Certificate No. : 25-0753-026
Work Order No. : 25/0753

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

Date of Received : 12 June 2025

Date of Calibration : 12 June 2025

Instrument Details : Description : Electronic Balance
Manufacturer : sartorius
Model : SECURA224-1S
Serial No. : 0041305301
ID No. : TNP.LAB.31
Resolution : 0.0001 g
Capacity : 220 g
Location : ห้องปฏิบัติการ 2 ชั้น 3

Calibration Method : This calibration was conducted by using in-house method according to calibration procedure no. CWI-B-01 based on UKAS LAB14 edition 6, October 2019

Environmental Condition

Temperature : Maximum 25.6°C / Minimum 25.2°C
Humidity : Maximum 48%R.H. / Minimum 44%R.H.
Air Pressure : Maximum 999.3hPa / Minimum 999.2hPa

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

Calibrated by : Mr. Itsara Sawanbancha
Calibration Engineer

Approved by : 
(Mr. Thichakorn Srisupob)
Asst. Laboratory Manager

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PAGE 1/3

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CERTIFICATE OF CALIBRATION

Certificate No. : 25-0753-026

Issue Date : 12 June 2025

Work Order No. : 25/0753

Details of Calibration

1. Reference Standards Instrument

Instrument	Capacity of Weight	Serial No. / ID No.	Certificate No.	Due date
Weight Set E2	1mg to 200g	B744909236	22-130801	6 December 2025

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
Asia Medical and Agricultural Laboratory and Research center Co., Ltd. , NSC-ONSC Calibration
No. 0152

3. Condition of item : Used

4. Calibration site : On-site

Result of Calibration

1. Calibration result : Check performance before calibration

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty ($\pm$) g	Coverage Factor (k)
100.0000	100.0000	0.0000	0.00019	2.00
200.0000	200.0000	0.0000	0.00032	2.00

2. The result of check performance in first step has to Reset span

3. Calibration result : After set span by Internal Calibration

3.1 Repeatability number of repeatability is 10 times

Normal Value (g)	Standard Deviation of Reading (g)
100	0.0000316
200	0.0000316

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

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%.



CERTIFICATE OF CALIBRATION

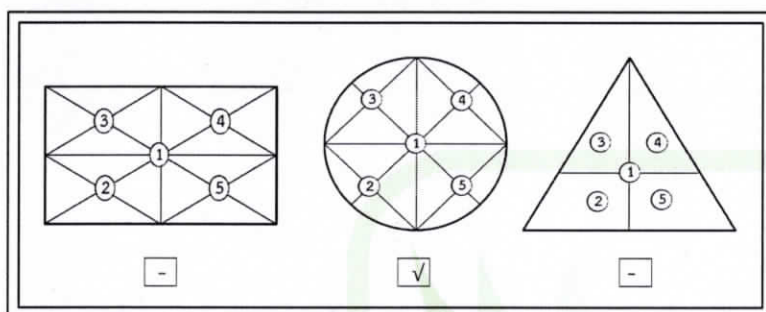
Certificate No. : 25-0753-026

Issue Date : 12 June 2025

Work Order No. : 25/0753

3. Calibration result : After set span by Internal Calibration (continued)

3.2 Eccentric or Off-center Error A mass of 100 g was placed and moved to various position on pan.



Result of Eccentric Error		
Position 1	100.0000	g
Position 2	100.0000	g
Position 3	100.0000	g
Position 4	99.9999	g
Position 5	100.0000	g
(Maximum Difference)	0.0001	g

3.3 Departure of indication from nominal value

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (±) g	Coverage Factor (k)
Unload	0.0000	0.0000	0.000090	2.00
0.1000	0.1000	0.0000	0.000090	2.00
0.5000	0.5000	0.0000	0.000090	2.00
1.0000	1.0000	0.0000	0.000090	2.00
5.0000	5.0000	0.0000	0.000090	2.00
10.0000	10.0000	0.0000	0.00010	2.00
20.0000	20.0000	0.0000	0.00010	2.00
50.0000	50.0000	0.0000	0.00012	2.00
100.0000	100.0000	0.0000	0.00019	2.00
200.0000	200.0000	0.0000	0.00032	2.00

Note

Calibrate items it good condition and this report customer request and accepted in certificate

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

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%.

**CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.**

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Statements of conformity report

Refer to Certificate No. : 25-0753-026

Issue Date : 12 June 2025

Work Order No. : 25/0753

Detail of Equipment

Description : Electronic Balance

Manufacturer : sartorius

ID No. : TNP.LAB.31

Model : SECURA224-1S

Resolution : 0.0001 g

Serial no. : 0041305301

Capacity : 220 g

Result of Calibration

This result of calibration : Adjustment

Unit : g

Applied Weight	Balance Reading	Correction Value	Uncertainty	Uncertainty + Correction	Limit of performance	Evaluation
0.1000	0.1000	0.0000	0.000090	0.000090	0.00016	Pass
0.5000	0.5000	0.0000	0.000090	0.000090	0.00016	Pass
1.0000	1.0000	0.0000	0.000090	0.000090	0.00016	Pass
5.0000	5.0000	0.0000	0.000090	0.000090	0.00016	Pass
10.0000	10.0000	0.0000	0.00010	0.00010	0.00017	Pass
20.0000	20.0000	0.0000	0.00010	0.00010	0.00017	Pass
50.0000	50.0000	0.0000	0.00012	0.00012	0.00019	Pass
100.0000	100.0000	0.0000	0.00019	0.00019	0.00026	Pass
200.0000	200.0000	0.0000	0.00032	0.00032	0.00039	Pass

The conformity certificate documents validity following ISO/IEC Guide 98-4 : Role of measurement uncertainty in conformity assessment based on statement with guard band refer to NATA User checks and maintenance of laboratory balances consider expanded measurement uncertainty ($k=95\%$)

The tolerance and decision rules ;Limit of performance (LoP) = $2.26 \text{ sw} + |\text{Corr}| + U(\text{Cal})$ Evaluation of decision = Measurement uncertainty + Absolute correction ; $\leq \text{LoP}$ is pass , $> \text{LoP}$ is Fail

Statements of conformity decision by :

(Mr. Thichakorn Srisupob)

Asst. Laboratory Manager

-- END --

CERT.No.: HS-V050G

Calibration Date : 17 Jul 25
Submitted by : TNP ENVIRONMENT COMPANY LIMITED
332/173 Moo.3, Tambon Bang Rak Phatthana,
Amphoe Bang Bua Thong, Nonthaburi 11110

Model : HI 5421
S/N : 07210004101
Probe : HI 76408W
S/N : KC1N32W9P
ID NO. :
Air Temp ref : S/N. F8065C26
Barometric ref : S/N. F8065C26
Water Temp ref : -
HS001
Technician : Kittipong M.

Avg Room Temp : 20 °C
Avg Water Temp : 20 °C
Air Pressure : 760.00 mmHg
Salinity : 0 ppt

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.08 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.05	(PASS)	-
Measurement 2 (mg/l)	9.04	(PASS)	-
Measurement 3 (mg/l)	9.04	(PASS)	-
Measurement 4 (mg/l)	9.05	(PASS)	-
Measurement 5 (mg/l)	9.06	(PASS)	-
Measurement 6 (mg/l)	9.05	(PASS)	-
Measurement 7 (mg/l)	9.06	(PASS)	-
Measurement 8 (mg/l)	9.07	(PASS)	-
Measurement 9 (mg/l)	9.05	(PASS)	-
Measurement 10 (mg/l)	9.05	(PASS)	-
Mean Measurement	9.05	mg/l	-
Inaccuracy	0.03	mg/l	-
Overall Status	(PASS)		

Manufacturer Specification

Accuracy = +/- 0.15 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.
- 3) This result shall not be used for advertising purpose.



Technician Signature
(Kittipong Maekwong)



Laboratory Manager
(Natenapha Pisatkunchon)

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : WATER QUALITY METER
MANUFACTURER : DIGICON
MODEL / TYPE : WA-48SD
SERIAL NO. : T.075714/TF43846/T.075695/11-05[TNP.LAB.46]
CLID. NO. : 272500210
JOB CONTROL NO. : 250127009952
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE

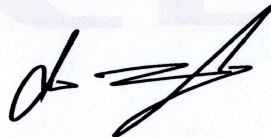
CUSTOMER : TNP ENVIRONMENT CO., LTD.
332/173 MOO 3 TAMBON BANG RAK PHATTANA,
AMPHOE BANG BUA THONG, NONTHABURI 11110

DATE OF RECEIVED : 27 January 2025

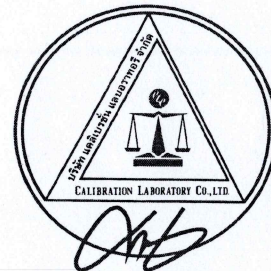
DATE OF ISSUED : 01 March 2025

The report of calibration shall not be reproduced except in full without approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sukgasem Seehanart
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
01 March 2025



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to
the International System of Units (SI)

Certificate No. Q25009952

F3-011-05/12-23

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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



REPORT OF CALIBRATION FOR

NOMENCLATURE : **WATER QUALITY METER**
MANUFACTURER : **DIGICON**
MODEL / TYPE : **WA-48SD**
SERIAL NO. : **T.075714/TF43846/T.075695/11-05[TNP.LAB.46]**
DATE OF CALIBRATION : **29 January 2025**

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** [pH Meter]. The calibration was performed by direct measurement with Certified Reference Material (CRM).

This instrument was calibrated under procedure No. **CLC-CPCH-02** [Conductivity Meter].

The calibration was performed by direct measurement with Certified Reference Material (CRM).

This instrument [Sodium chloride] was calibrated by direct measurement with Sodium chloride which maintained by the Calibration Laboratory Co., Ltd.

This instrument was calibrated under procedure No. **CLC-CPCH-06** [Oxygen Meter].

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 CC788789.
3. Potassium Chloride Solution (nominal 0.147 mS/cm , nominal 1.41 mS/cm , nominal 12.8 mS/cm)
4. Sodium chloride, Code 82089719 Lot Number 948692.
5. Dissolved Oxygen, Sigma-Alorich Product ID QC3077-500ML .

Certificate No. Q25009952

F3-011-05/12-23

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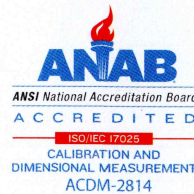
@clccalibration



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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).

Lot Number. 040822 , 120124. Due Date 04 March 2025.

2. The measurements are traceable to International System of Units (SI) , through Control Company.

Certificate No. 4288-14548619 , Due Date 17 October 2025.

3. The measurements are traceable to International System of Units (SI) , through Sigma-Aldrich Canada Co.

Certificate No. HC31089557, HC30595403, HC20111554. Due Date 31 January 2026 , 31 January 2026, 30 September 2025.

4. The measurements are traceable to International System of Units (SI), through CPA chem Ltd.

Ref. No. PSNACLC.50G, Due Date 12 January 2027.

5. The measurements are traceable to International System of Units (SI) , through Merck Co., Ltd.

Lot LRAD8571 , Due Date April 2026.

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. Q25009952

F3-011-05/12-23

page 3 of 4



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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

1. 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	4.00	-	+0.003	0.013	2,15
7.005	7.00	-	+0.005	0.015	2,06
10.015	10.02	-	-0.005	0.016	2,05

Technical Note. Setting function CAL 1 point (4).

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 014 Page 4 of 68

2. CONDUCTIVITY SOLUTION TEST @ 25 °C

Standard Conductivity Solution	DUC Reading	Uncertainty of Measurement	k Factor
146.00 μ S/cm	146.1 μ S/cm	$\pm$ 2.10 μ S/cm	2,00
1.414 mS/cm	1.415 mS/cm	$\pm$ 0.021 mS/cm	2,00
12.83 mS/cm	12.84 mS/cm	$\pm$ 0.19 mS/cm	2,00

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 014 Page 4 of 68

*3. SODIUM CHLORIDE RESULT

STD Applied (%NaCl)	Nominal Value (Pcnt)	DUC Reading (Pcnt)	Correction (Pcnt)	Uncertainty $\pm$ (Pcnt)	Coverage factor k
5.00	5.00	5.01	-0.01	0.010	2,05

Note. * means Calibrations marked " Not ANAB Accredited " in this Certificate have been included for completeness.

4. OXYGEN SOLUTION RESULT @ 25°C

Nominal Value (mg/L)	DUC Reading (mg/L)	Correction (mg/L)	Uncertainty (mg/L)	Coverage factor k
8.18	8.20	-0.02	$\pm$ 0.38	2,00

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 014 Page 5 of 68

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

End of Certificate

Certificate No. Q25009952

F3-011-05/12-23

page 4 of 4



@clccalibration



SCIMET Co., Ltd.
818/124 Udomsuk Rd., Bangna-Nuea,
Bangna, Bangkok 10260 Thailand
Email:scimet2022@gmail.com, Tel: 02 460 9239
https://www.scimet.co.th



Certificate No. C07250018

Calibration Certificate

Equipment: SPECTROPHOTOMETER
Model: T6U
Serial No.(or ID): 31-1654-01-1055 (TNP.LAB.48)
Manufacturer: PG Instrument
Condition: In Condition

Job No.: KSMT2500582
Received Date: 17 February 2025
Issued Date: 17 February 2025
Page: 1 of 3

Customer

TNP ENVIRONMENT CO., LTD.
332/173 Village No. 3, Bangrak Phatthana Subdistrict,
Bang Bua Thong District, Nonthaburi Province 11110

Calibration Place

TNP ENVIRONMENT CO., LTD. (ห้องปฏิบัติการ 2)
332/173 Village No. 3, Bangrak Phatthana Subdistrict,
Bang Bua Thong District, Nonthaburi Province 11110

Calibration Date

17 February 2025

Environment Condition

Temperature: 27.1 °C $\pm$ 0.3 °C
Humidity: 50.3 %RH $\pm$ 2.9 %RH

The Method used

In-house method, WI07, based 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. 125472 and 125471

The standard for Photometric Certificate No. 125567 and 125517

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

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

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 SCIMET Co., Ltd.

(Mr. Hattapong Pumnil)

Person in charge



(Mr. Thalerngkeat Pongngam)

Authorized signatory

Condition of reference standards Instruments / CRM:

<u>Instruments</u>	<u>Set No.</u>	<u>Certificate No.</u>	<u>Due date</u>
Didymium Oxide Glass Reference	131033	125472	16-Sep-26
Holmium Oxide Glass Reference	136650	125471	16-Sep-26
Neutral Density Filter Reference	45329	125567	17-Sep-26
Potassium Dichromate Solution References	45328	125517	17-Sep-26

Calibration Results:
Without Adjustment

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

Standard Wavelength (nm)	Unit Under Calibration (nm)	Correction (nm)	Uncertainty of Measurement (± nm)
219.30	219.8	-0.50	0.14
241.29	241.8	-0.51	0.14
287.62	287.8	-0.18	0.14
360.43	360.4	0.03	0.14
417.72	418.4	-0.68	0.14
431.57	431.0	0.57	0.14
472.47	473.0	-0.53	0.14
513.41	513.8	-0.39	0.14
528.83	528.6	0.23	0.14
537.13	537.2	-0.07	0.14
573.33	573.6	-0.27	0.14
585.29	585.6	-0.31	0.14
640.94	641.0	-0.06	0.14
684.49	684.8	-0.31	0.14
740.18	739.8	0.38	0.14
748.48	748.8	-0.32	0.14
807.03	806.6	0.43	0.14
879.27	879.4	-0.13	0.14

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance (Abs)	Unit Under Calibration (Abs)	Correction (Abs)	Uncertainty of Measurement(± Abs)
235 nm	0.0000	0.000	0.0000	0.0080
	0.7328	0.733	-0.0002	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8537	0.852	0.0017	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2855	0.287	-0.0015	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6338	0.633	0.0008	0.0080

Calibration Results:

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance (Abs)	Unit Under Calibration (Abs)	Correction (Abs)	Uncertainty of Measurement($\pm$ Abs)
420 nm	0.0000	0.000	0.0000	0.0045
	0.2352	0.236	-0.0008	0.0045
	0.5716	0.573	-0.0014	0.0045
	0.7146	0.716	-0.0014	0.0045
	1.0179	1.020	-0.0021	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2314	0.232	-0.0006	0.0045
	0.5566	0.558	-0.0014	0.0045
	0.7028	0.703	-0.0002	0.0045
	1.0016	1.003	-0.0014	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2107	0.212	-0.0013	0.0045
	0.5192	0.521	-0.0018	0.0045
	0.6638	0.664	-0.0002	0.0045
	0.9447	0.944	0.0007	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2187	0.220	-0.0013	0.0045
	0.5207	0.522	-0.0013	0.0045
	0.7002	0.700	0.0002	0.0045
	1.0001	1.000	0.0001	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2430	0.243	0.0000	0.0045
	0.5546	0.555	-0.0004	0.0045
	0.7756	0.775	0.0006	0.0045
	1.1117	1.112	-0.0003	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2635	0.264	-0.0005	0.0045
	0.5622	0.563	-0.0008	0.0045
	0.7651	0.765	0.0001	0.0045
	1.0974	1.097	0.0004	0.0045

The End of Certificate

Statements of conformity:

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of temperature determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, ASTM E 275-08 and ASTM E 387-04. Therefore, those parameters have not been assessed separately.

Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :** ☐ Choice A Binary Statement for Simple Acceptance Rule ($w = 0$), Specific Risk $< 50\%$ PFA.
- ☒ Choice B Non-binary statement with guard band ($w = 1 U$), Pass or Fail Specific Risk $< 2.5\%$ PFA and Condition Pass or Condition Fail Specific Risk $< 50\%$ PFA.
- ☐ Choice C Customer defined, Customers may define arbitrary multiple of r to have applied as guard band ($w = r U$).
- ; PFA – Probability of False Accept



(Mr. Thalerngkeat Pongngam)

Authorized signatory

Without Adjustment

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

Unit Under Calibration	Correction	Guard Band (w)	Tolerance ($\pm$)	Conformity
219.8	-0.50	0.14	1.5	Pass
241.8	-0.51	0.14	1.5	Pass
287.8	-0.18	0.14	1.5	Pass
360.4	0.03	0.14	1.5	Pass
418.4	-0.68	0.14	1.5	Pass
431.0	0.57	0.14	1.5	Pass
473.0	-0.53	0.14	1.5	Pass
513.8	-0.39	0.14	1.5	Pass
528.6	0.23	0.14	1.5	Pass
537.2	-0.07	0.14	1.5	Pass
573.6	-0.27	0.14	1.5	Pass
585.6	-0.31	0.14	1.5	Pass
641.0	-0.06	0.14	1.5	Pass
684.8	-0.31	0.14	1.5	Pass
739.8	0.38	0.14	1.5	Pass
748.8	-0.32	0.14	1.5	Pass
806.6	0.43	0.14	1.5	Pass
879.4	-0.13	0.14	1.5	Pass

Photometric Accuracy (Absorbance)

Wavelength	Unit Under Calibration	Correction	Guard Band (w)	Tolerance ($\pm$)	Conformity
235 nm	0.000	0.0000	0.0080	0.02	Pass
	0.733	-0.0002	0.0080	0.02	Pass
257 nm	0.000	0.0000	0.0080	0.02	Pass
	0.852	0.0017	0.0080	0.02	Pass
313 nm	0.000	0.0000	0.0080	0.02	Pass
	0.287	-0.0015	0.0080	0.02	Pass
350 nm	0.000	0.0000	0.0080	0.02	Pass
	0.633	0.0008	0.0080	0.02	Pass

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Unit Under Calibration	Correction	Guard Band (w)	Tolerance ($\pm$)	Conformity
420 nm	0.000	0.0000	0.0045	0.015	Pass
	0.236	-0.0008	0.0045	0.015	Pass
	0.573	-0.0014	0.0045	0.015	Pass
	0.716	-0.0014	0.0045	0.015	Pass
	1.020	-0.0021	0.0045	0.02	Pass
440 nm	0.000	0.0000	0.0045	0.015	Pass
	0.232	-0.0006	0.0045	0.015	Pass
	0.558	-0.0014	0.0045	0.015	Pass
	0.703	-0.0002	0.0045	0.015	Pass
	1.003	-0.0014	0.0045	0.015	Pass
465 nm	0.000	0.0000	0.0045	0.015	Pass
	0.212	-0.0013	0.0045	0.015	Pass
	0.521	-0.0018	0.0045	0.015	Pass
	0.664	-0.0002	0.0045	0.015	Pass
	0.944	0.0007	0.0045	0.015	Pass
546.1 nm	0.000	0.0000	0.0045	0.015	Pass
	0.220	-0.0013	0.0045	0.015	Pass
	0.522	-0.0013	0.0045	0.015	Pass
	0.700	0.0002	0.0045	0.015	Pass
	1.000	0.0001	0.0045	0.015	Pass
590 nm	0.000	0.0000	0.0045	0.015	Pass
	0.243	0.0000	0.0045	0.015	Pass
	0.555	-0.0004	0.0045	0.015	Pass
	0.775	0.0006	0.0045	0.015	Pass
	1.112	-0.0003	0.0045	0.015	Pass
635 nm	0.000	0.0000	0.0045	0.015	Pass
	0.264	-0.0005	0.0045	0.015	Pass
	0.563	-0.0008	0.0045	0.015	Pass
	0.765	0.0001	0.0045	0.015	Pass
	1.097	0.0004	0.0045	0.015	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

The End of Statements of Conformity



ใบตรวจสอบสภาพเครื่อง Spectrophotometer

เลขที่ใบงาน: KSMT2500582

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: T6U

หมายเลขเครื่อง: 31-1654-01-1055

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
17 Feb 2025			17 Feb 2025		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
☒	☐	1. ความสมบูรณ์เครื่อง	☒	☐	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☒	☐	
☒	☐	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth)	☒	☐	
☒	☐	4. ปุ่มกด (Keypad)	☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	☐	
☒	☐	6. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☒	☐	
☒	☐	7. ความยาวคลื่น (Wavelength Check)	☒	☐	
☒	☐	8. แหล่งกำเนิดแสง (UV < 3,000 hour)	☒	☐	
☒	☐	9. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☒	☐	
☒	☐	10. ช่องวัดหลายตัวอย่าง (Carousel Module)	☒	☐	

เพิ่มเติม/ข้อแนะนำ :

Mr. Hattapong Pumnil

Service Engineer

Calibration Certificate

Certificate No.: 2502859-003-01
Client name: TNP ENVIRONMENT CO., LTD.
Address: 332/173 Moo 3 Tambon Bang Rak Phatthana,
Amphone Bang Bua Thong, Nonthaburi 11110

Page 1 of 3

Equipment: pH Meter
Manufacturer: EUTECH INSTRUMENTS
Model: pH 700
Serial No.: 3178920
ID No.: TNP.LAB.57
Order No.: 2502859
Operation No.: 2502859-003
Date of Receipt: 8 May 2025
Date of Calibration: 8 May 2025

Calibrated by Mr.Manas Somsak
Specialist

Approved by 
(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 13 May 2025

Responsible for the Technical Management Team

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 standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502859-003-01

Equipment: pH Meter
Resolution: 0.01 pH ; 0.1 mV
Manufacturer: EUTECH INSTRUMENTS
Model: pH 700
Serial No.: 3178920
Type: Bench top
ID No.: TNP.LAB.57

Date of Calibration: 8 May 2025 Page 2 of 3

Location: Laboratory 1, TNP ENVIRONMENT CO., LTD.

Environment Condition: **Ambient Temperature:** (23.4 ± 1.5) °C **Relative Humidity:** (55 ± 3) %

Condition of Equipment: Good Condition

Condition of this Results of Calibration

1. Calibration Method W-CC-002 : In house method based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

2. Reference Standards / Certified Reference Material

<u>Instruments</u>	<u>Serial / ID No.</u>	<u>Manufacturer</u>	<u>Certificate No.</u>	<u>Due Date</u>
2.1 DC Voltage Calibrator	2709007	Fluke	24E1752	30 May 2025
2.2 Digital Thermometer	2709007	Fluke	2500376-002-01	29 October 2025
2.3 Thermo-Hygro Meter	NFI.BTH 013/23	testo	CC 670420-01	21 May 2025
<u>Certified Reference Material</u>	<u>Lot. No.</u>	<u>Manufacturer</u>	<u>Ref N</u>	<u>Expire Date</u>
2.4 pH buffer 4.008 (Primary pH buffer Solution)	1016435	CPAchem	PH216.L5	25 July 2026
2.5 pH buffer 6.865 (Primary pH buffer Solution)	949186	CPAchem	PH217.L5	30 November 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	1016437	CPAchem	PH220.L5	25 July 2025
2.7 pH buffer 7.00 (Standard pH buffer Solution)	C03109	HACH LANGE GmbH	S11M004	16 October 2025

3. This certification is traceable to The International System of Unit (SI Unit)

3.1 Instruments No. 2.1	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No. 2.2 to 2.3	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.4 Certified Reference Material No. 2.7	traceable to	PTB Certificate Nr. PTB-PHOA-563/30504/23 and Certificate Nr. PTB-PHOB-555/30620/22 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany)

4. This certificate was certified only for the instrument we calibrated.

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



F-CS-012 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502859-003-01

Equipment: pH Meter
Resolution: 0.01 pH ; 0.1 mV
Manufacturer: EUTECH INSTRUMENTS **Model:** pH 700
Serial No.: 3178920 **Type:** Bench top
ID No.: TNP.LAB.57

Date of Calibration: 8 May 2025

Page 3 of 3

Calibration Results:

1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.122	414	0.00	0.58	2.00
2	295.815	296	2.00	0.58	2.00
4	177.463	177.6	4.00	0.063	2.00
6	59.160	59.3	6.00	0.063	2.00
7	0.001	0.2	7.00	0.063	2.00
8	-59.159	-59.0	8.00	0.063	2.00
10	-177.462	-177.3	10.00	0.063	2.00
12	-295.813	-296	12.00	0.58	2.00
14	-414.121	-414	14.00	0.58	2.00

2. Calibration of pH Meter with Electrode (Manual Temperature Compensation at 25 °C)

Equipment: pH Electrode **Type:** Combined Electrode
Manufacturer: EUTECH INSTRUMENTS **Model:** 93X218814
Serial No.: 3231404 (ECFG7350401B) **ID.No.:** N/A

Performance of Electrode system (Three-Point Calibration at pH 4, 7 and 10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	176.2	-	0.0071	2.00
7.001	7.00	0.0	99.6	0.0086	2.00
10.010	10.01	-172.4	96.8	0.0086	2.00
6.876	6.88	8.0	-	0.0074	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 %.

----- End -----



F-CS-012 Revision: 01 Date: 20-04-65

Calibration Certificate

Certificate No.: 2502859-004-01
Client name: TNP ENVIRONMENT CO., LTD.
Address: 332/173 Moo 3 Tambon Bang Rak Phatthana,
Amphone Bang Bua Thong, Nonthaburi 11110

Page 1 of 3

Equipment: Water Bath
Manufacturer: MEMMERT
Model: WTB24
Serial No.: LD23.0297
ID No.: TNP.LAB.58
Order No.: 2502859
Operation No.: 2502859-004
Date of Receipt: 8 May 2025
Date of Calibration: 8 May 2025

Calibrated by Mr.Worapob Sookthong
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 13 May 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 standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502859-004-01
Equipment: Water Bath
 Model: WTB24 Serial No.: LD23.0297
 Resolution: 0.1 °C ID No.: TNP.LAB.58
 Manufacturer: MEMMERT
Date of Calibration: 8 May 2025

Page 2 of 3

Location: Floor 3, Laboratory, TNP ENVIRONMENT CO., LTD.
Environment Condition: Ambient Temperature (23 ± 1) °C
 Relative Humidity (40 ± 2) %
 Line Voltage (230 ± 1) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 5 standard thermometer into its liquid bath and calibration according to W-TE-011 based on ASTM E715-80 (Re-approved-2016): Standard Specification for Gravity-Convection and Forced-Circulation Water Baths.
 - The temperature scale used is ITS - 90.
 - All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No./ID No.	Certificate No.	Due Date	Through
Digital Thermometer with sensor	34972A	MY49016894	2502528-001-01	19-Apr-26	NATIONAL FOOD INSTITUTE
	RTD	RTD#201-205 / CH#201-205			

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description:

Time of Record 1 Hour 9 Minute At 44.5 °C

7. Result of Calibration :
- | | |
|---|--------------------|
| X | Without adjustment |
| | After adjustment |




Calibration Report

Certificate No.: 2502859-004-01
Equipment: Water Bath
 Model: WTB24 Serial No.: LD23.0297
 Resolution: 0.1 °C ID No.: TNP.LAB.58
 Manufacturer: MEMMERT
Date of Calibration: 8 May 2025

Page 3 of 3

Calibration point: 44.5 °C
Calibration result:

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
Min	23.0	38.5	229.3
Max	23.5	41.6	231.4

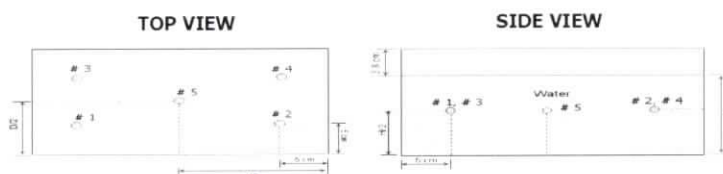


Table1 : Reporting of Temperature

Sensor Installation Location

Calibration Point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.5 is REF)					Uncertainty ± (°C)
	# 1	# 2	# 3	# 4	# 5	
44.5	44.49	44.52	44.49	44.53	44.51	0.17

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	MIN	MAX	Average			
44.5	44.5	44.5	44.5	0.050	0.022	0.15

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity)"

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

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.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Certificate

Certificate No.: 2502859-005-01
Client name: TNP ENVIRONMENT CO., LTD.
Address: 332/173 Moo 3 Tambon Bang Rak Phatthana,
Amphone Bang Bua Thong, Nonthaburi 11110

Page 1 of 3

Equipment: CHAMBER (Incubator)

Manufacturer: BIOBASE

Model: BJPX-M100B

Serial No.: BJPXM1002301016

ID No.: TNP.LAB.59

Order No.: 2502859

Operation No.: 2502859-005

Date of Receipt: 8 May 2025

Date of Calibration: 8 May 2025

Calibrated by Mr.Worapob Sookthong
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 13 May 2025

Responsible for the Technical Management Team

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 standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502859-005-01

Equipment: CHAMBER (Incubator)

Model: BJPX-M100B Serial No.: BJPXM1002301016

Resolution: 0.1 °C ID No.: TNP.LAB.59

Manufacturer: BIOBASE

Date of Calibration: 8 May 2025

Page 2 of 3

Location: Floor 3, Laboratory, TNP ENVIRONMENT CO., LTD.

Environment Condition:

Ambient Temperature (22.4 ± 1) °C

Relative Humidity (41 ± 1) %

Line Voltage (232 ± 2) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 9 standard thermometer into its chamber and calibration according to W-TE-014 Based on TLAS G-20-1/02-08 (E): Guidelines for Calibration and Checks of Temperature Controlled Enclosures.
 - The temperature scale used was based on ITS - 90.
 - All data show below were final values and the initial data may be obtained upon request.
- Reference Standard Instrument :

Instrument	Model	Serial No./ID No.	Certificate No.	Due Date	Through
Digital Thermometer with sensor	34972A	MY49016894	2502528-001-01	19 April 2026	NATIONAL FOOD INSTITUTE
	RTD	CH#101-109/ RTD#101-109			

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description :

Time of Record 1 Hour 9 Minute At 35.0, 37.0, 41.5 and 42.0 °C

Fresh air Damper

-	Open	Position	-
X	Close	Fan	100%
-	Not Available		

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment




Calibration Report

Certificate No.: 2502859-005-01

Equipment: CHAMBER (Incubator)

Model: BJPX-M100B Serial No.: BJPXM1002301016

Resolution: 0.1 °C ID No.: TNP.LAB.59

Manufacturer: BIOBASE

Date of Calibration: 8 May 2025

Page 3 of 3

Calibration point: 35.0, 37.0, 41.5 and 42.0 °C

Calibration result:

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
MIN	21.8	40.3	230.5
MAX	22.7	42.5	233.9

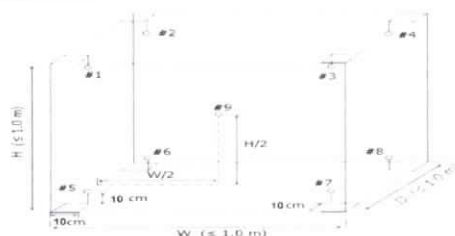


Table1 : Reporting of Temperature

Calibration point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9	
35.0	36.49	35.70	34.90	35.13	36.07	35.87	35.35	35.35	35.04	0.56
37.0	38.61	37.85	36.83	37.08	38.15	37.90	37.39	37.38	36.96	0.60
41.5	42.98	42.31	41.31	41.49	42.76	42.42	41.83	41.79	41.40	0.62
42.0	43.74	42.85	41.66	42.02	43.26	42.94	42.35	42.33	41.91	0.65

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	MIN	MAX	Average			
35.0	35.0	35.0	35.0	0.31	1.45	2.08
37.0	37.0	37.0	37.0	0.33	1.65	2.41
41.2	41.2	41.2	41.2	0.36	1.58	2.34
41.7	41.7	41.7	41.7	0.36	1.83	2.64

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

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.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----






CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

45/48 Soi Salathammasop31, Salathammasop Rd.,
Salathammasop, Thawewatthana, Bangkok 10170 Thailand
Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com



CERTIFICATE OF CALIBRATION

Certificate No. : 25-0753-006

Work Order No. : 25/0753

Issue Date : 16 June 2025

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

Date of Received : 12 June 2025

Date of Calibration : 16 June 2025

Instrument Details : Description : Volumetric flask
Manufacturer : DARAN
Model : N/A
Serial No. : N/A
ID No. : TNP-LAB-G.39
Capacity : 25 ml
Class : A
Location : Volumetric and Mass Calibration Laboratory, CCS

Calibration Method : This instrument was calibrated by Gravimetric methods for the determination of measurement error according to calibration procedure no. CWI-V-02 follow up to ASTM E542-01 (2012) Standard Practice for Calibration of Laboratory Volumetric Apparatus

Environmental Condition

Ambient Temperature : Control at $20\text{ }^{\circ}\text{C} \pm 2.5\text{ }^{\circ}\text{C}$
Relative humidity : Control at $50\text{ \%RH} \pm 10\text{ \%RH}$
Atmospheric pressure : Monitoring at $1013\text{ hPa} \pm 8\text{ hPa}$

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

Calibrated by : Miss Lalitphat Thiankaew
Calibration Engineer

Approved by : 
(Mr. Thichakorn Srisupob)
Asst. Laboratory Manager

This certificate may not be reproduced other than in full except with the prior written approval of Crystal Calibration Sales and Service co., Ltd.

Crystal Calibration Sales and Service Co., Ltd.

45/48 Salathammasop 31, Salathammasop Rd., Salathammasop, Thawewatthana, Bangkok 10170

Phone : 0-2408-8474 Fax : 0-2408-8477 <http://www.crystalcal.com> Email : info@crystalcal.com





CERTIFICATE OF CALIBRATION

Certificate No. : 25-0753-006

Issue Date : 16 June 2025

Work Order No. : 25/0753

Details of Calibration

1. Reference Standards Instrument

Instrument	ID No.	Certification	Due Date
1.1 Electronic Balance	BAL-11	25--0164-008	14 March 2026
1.2 Digital thermometer with sensor	RTD-10	25-0164-010	28 February 2026
1.3 Thermo-Hygrometer	TH-07	25-01644-016	28 February 2026
1.4 Barometer	BM-05	L202410225-0001	18 October 2025

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to

1.1 Crystal Calibration Sales and Service Co., Ltd., NSC-ONSC Calibration No. 0260

1.2-1.3 Crystal Calibration Sales and Service Co., Ltd., NSC-ONSC Calibration No. 0260

1.4 Miracle international Technology Co., Ltd., NSC-ONSC Calibration No. 0052

3. Condition of item

: Used

4. Calibration site

: Permanent

Other detail of volumetric ware

Type of calibration : To Contain

Designation of standard : N/A

Tolerance : ± 0.04 ml

Result of Calibration

Calibration result without adjustment

Norminal value	Mean Volume	Error	Standard deviation	Uncertainty	Coverage factor
(ml)	(ml)	(ml)	(ml)	($\pm$ ml)	(k)
25	25.00714	-0.00714	0.000065	0.0065	2.00

Note :

1. The result of repeat the test 10 measurements
2. The standard uncertainty of measurement has been determined in accordance with ISO/TR 20461:2000 and UKAS M3003
3. This report customer request and accepted in detail and data in certificate
4. Calibrate items it good condition and this report customer request and accepted in certificate

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

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%.



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

45/48 Soi Salathammasop31, Salathammasop Rd.,

Salathammasop, Thawewatthana, Bangkok 10170 Thailand

Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com

Statements of conformity report

Refer to Certificate No. : 25-0753-006

Issue Date : 16 June 2025

Work Order No. : 25/0753

Detail of Equipment

Description : Volumetric flask

Manufacturer : DARAN

ID No. : TNP-LAB-G.39

Model : N/A

Capacity : 25 ml

Serial no. : N/A

Sub Deviation : 1 ml

Type of calibration : To Contain

Designation of standard : N/A

Tolerance : ± 0.04 ml

Result of Calibration

This result of calibration : Without adjustment

Tolerance	0.0400	ml
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Volumetric glassware class : A

Normal volume	Mean volume	Absolute Volume Error	Uncertainty	Uncertainty + volume error	Evaluation
25	25.00714	0.0071	0.0065	0.014	Pass

The conformity certificate documents validity following ISO/IEC Guide 98-4 : Role of measurement uncertainty in conformity assessment based on statement with guard band refer to specification tolerance limit mark on glassware consider expanded measurement uncertainty ($k=95\%$)

The tolerance and decision rules ;

MPE of Glassware = Measurement uncertainty + Absolute error ; $\leq$ MPE is pass , $>$ MPE is Fail

Statements of conformity decision by :

(Mr. Thichakorn Srisupob)

Asst. Laboratory Manager



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.: 25CHO337

Page.: 1 of 3

Equipment : Spectrophotometer
Manufacturer : Hach
Model : DR3900
Serial No. : 1988383
ID No. : SPE-002
Condition As-Received: Used Item
Received Date : 08 July 2025
Calibration Date : 09 July 2025
Reference : 2507-0148OC-9
Submitted by : Environment & Laboratory Co.,Ltd
40 Soi Liangmueangnonthaburi 13
Talad Kwan, Mueang, Nonthaburi 11000
Calibration Place : Room No.304
Ambient Temperature : (25.4 to 24.8) °C (On-Site)
Relative Humidity : (62 to 61) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-08
Calibrated by : Uthen Kankawi
Approved by : _____
Approved Signatory
() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 14 July 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.



Cert. No. : 25CHO337

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	43532	119613	22 Feb 2026
2. Absorbance Standard set	44487	122584	31 May 2026
3. Wavelength Standard set	29829	114509	11 Sep 2025
4. Wavelength Standard set	29829	114510	11 Sep 2025

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 : 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	447	0.59	2.00
537.00	536	0.59	2.00
638.00	638	0.59	2.00
740.51	741	0.59	2.00
807.04	807	0.59	2.00



Cert. No. : 25CHO337

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
	0.4271	0.425	0.0046	2.00
	0.6391	0.635	0.0050	2.00
440.0	Zero	0.000	0.0028	2.00
	0.5598	0.556	0.0028	2.00
	0.7037	0.700	0.0028	2.00
	1.0013	0.997	0.0028	2.00
546.1	Zero	0.000	0.0028	2.00
	0.5234	0.522	0.0028	2.00
	0.7007	0.699	0.0028	2.00
	0.9992	0.998	0.0028	2.00
635.0	Zero	0.000	0.0028	2.00
	0.5648	0.563	0.0028	2.00
	0.7654	0.763	0.0028	2.00
	1.0961	1.094	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.
- 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-

Performance Verification Certificate

Job No. WO-00043742

Equipment : AA SPECTROMETER
Manufacturer : GBC Scientific
Model Type : SavantAA
Customer : Environment & Laboratory Co.,Ltd.
40 Soi Liangmueangnonthaburi 13 Talad Kwan,Mueang, Nonthaburi 11000, Thailand

Serial No. : A8631
Verification Date : 7-Oct-2024

Result of Verification

Test Description	Criteria	Reading	Result
1. EHT Photometric Noise (if >350 V)	< 350 V Std. Dev <0.0002	318 V -	PASS
2. Wavelength Accuracy , Cu 324.75 nm	± 0.20 nm	324.83 nm	PASS
3. Wavelength Accuracy , Cs 852.10 nm	± 0.20 nm	852.04 nm	PASS
4. Slit Width 0.2 nm	± 0.02 nm	0.21 nm	PASS
5. Slit Width 0.5 nm	± 0.05 nm	0.53 nm	PASS
6. Slit Width 1.0 nm	± 0.10 nm	1.04 nm	PASS
7. Standard Gauze Screen <u>0.49</u> Abs* BC mode with gauze BC mode without gauze Difference between With gauze and without gauze	± 0.02 Abs. < 0.004 Abs.	0.4909 Abs. -0.0000 Abs. 0.0002 Abs. 0.0002 Abs.	PASS PASS
8. ABS Reading 5ppm,Cu	> 0.7 Abs.	0.842 Abs.	PASS
9. %RSD	< 0.5 %	0.39 %	PASS

* Write in the criteria column the Abs reading on the gauze screen calibration label

We hereby certify that instrument complies with GBC factory speccifications

Your satisfaction is our promise @ DKSH Technology Limited

Verification By : Mr. NIWAT SUPATANIT
Issued Date : 7-Oct-2024

Signatory : 

PREVENTIVE MAINTENANCE AND PERFORMANCE VERIFICATION REPORT

ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS)

Issued Date: 7/10/24

Customer : บริษัท เ็นไวรอนเม้นท์ แอนด์ แลบอราตอรี จำกัด	Manufacturer : GBC Scientific Equipment Pty Ltd.
Address : 40 ซอย เลี้ยวเมืองนนทบุรี 13 ตำบลตลาดขวัญ อำเภอเมือง จังหวัดนนทบุรี 11000	Model : SavantAA
Contract : คุณ อลิสา ทรงสวัสดิ์	Serial No : A8631
	Location : Laboratory

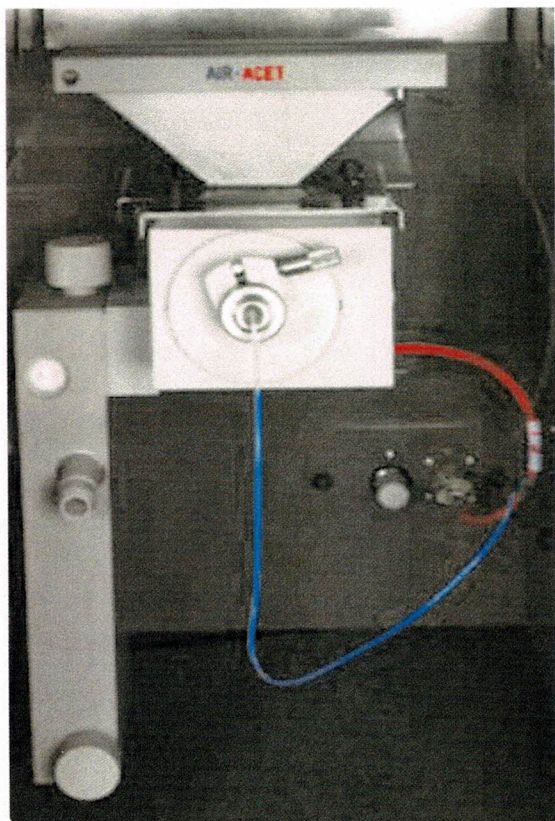
Power on switch and initial status

Instrument Ready สถานะเครื่องพร้อมใช้งาน

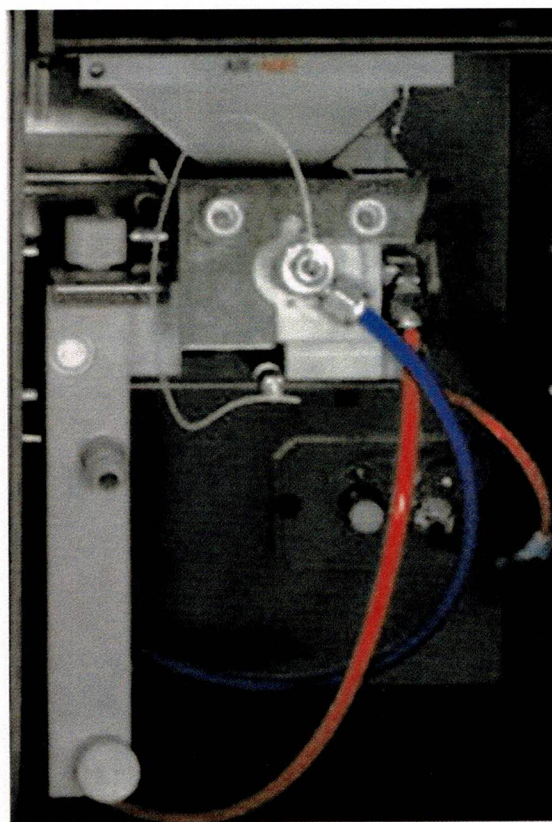
Preventive Maintenance	Pass	Fail	Remarks
Electrical Voltage			
- Main voltage (power supply check 220V $\pm$ 10V).	☒	☐	218.9 VAC
- Power indicator light (Replace if faulty).	☒	☐	N/A
- Power core (Clean or replace as appropriate).	☒	☐	N/A
- Fan (Clean or replace filter element as appropriate).	☒	☐	N/A
Environment			
- Temperature (10 to 35 deg.C)	☒	☐	22.5 C
- Humidity (8 to 80%).	☒	☐	57 %
- Air Quality (No Dust)	☒	☐	N/A
- No corrosive vapours present from laboratory sample preparation or external sources.	☒	☐	N/A
Optics			
- Windows lens (Clean or replace as appropriate).	☒	☐	Clean
- Light Source (Check operation. Replace if required).	☒	☐	Ready
- D2 Lamp (Check operation. Replace if required).	☒	☐	Ready
Gas system			
- General (Tube and Fitting /Check for leaks).	☒	☐	Ready
- Air Zero (Inlet pressure range 300-400 kPa).	☒	☐	4 Bar
- Acetylene (Inlet pressure range 55-96 kPa).	☒	☐	0.9 Bar
- Nitrous oxide (Inlet pressure range 300-400 kPa).	☐	☒	-
Computer			
- Operating system	☒	☐	Windows 10
- Software Version	☒	☐	SavantAA3.11
- Verify that all computer links and installed software operate correctly	☒	☐	Ready

Spray Chamber Type

☐ ABR Spray Chamber



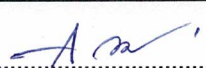
☒ Standard Spray Chamber



Preventive Maintenance	Pass	Fail	Remark
Flame system			
- Burner head (Clean the jaws using GBC Burner Cleaning Card).	☒	☐	Ready
- Burner mount (Check for wear. Replace the burner retaining plate if required).	☒	☐	Ready
- Spray chamber (Visually inspect the bead for cracks, pitting or solid deposits. Check or replace O-ring kit).	☒	☐	Ready
- Safety interlocks			
➢ Burner (Check for Interlocks connector)	☒	☐	Ready
➢ Spray chamber (Check for Interlocks connector)	☒	☐	Ready
- Pressure relief bung. (Check or replace O-ring)	☒	☐	Ready
- Nebulizer (Clean and check operation / Replace the O-ring)	☒	☐	Ready
- Gas connections (Check for leaks).	☒	☐	Ready
- Capillary tube (Check bends and clog).	☒	☐	Ready
- Liquid trap (Drain / clean and replace O-ring).	☒	☐	Ready

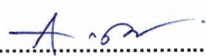
Gas Flow Optimisation	Pass	Fail	Remark
- Bleed gas lines (Relieve pressure in the spray chamber).	☒	☐	Ready
- Ignitor (Ignite the flame several times to check ignition reliability. Replace the glow plug if required).	☒	☐	Ready
- Extinguish (Check operation).	☒	☐	Ready
- Horizontal movement (Check operation for STD. Spray Chamber).	☒	☐	Ready
- Vertical movement (Check operation for STD. Spray Chamber).	☒	☐	Ready
- Burner Adjuster (Check operation for ABR Spray Chamber)			
➤ Burner Angle (° C)	☐	☐	
➤ Angle Zero (mm)	☐	☐	
➤ Work head Height (mm)	☐	☐	
➤ Work head Centre (mm)	☐	☐	

Note:

Signature	
Customer :  (<u>Alisa Songsanwad</u>)	Date : <u>7/10/24</u>
Service Engineer : <u>Niwat S.</u> (Mr. NIWAT SUPATANIT)	Maintenance Date : <u>7/oct/2024</u>

Performance Verification	Specification	Actual Value	Pass	Fail	Remarks
1. Wavelength accuracy (optic calibration check).	Cu 324.75 nm $\pm$ 0.2 nm	324.83 nm	☒	☐	N/A
	Cs 852.10 nm $\pm$ 0.2 nm	852.04 nm	☒	☐	N/A
2. Slit width accuracy (0.2 nm ,0.5 nm,1.0 nm)	0.2 nm $\pm$ 0.02 nm	324.752,46 / 324.960,46	☒	☐	0.208 nm
	0.5 nm $\pm$ 0.05 nm	324.60,50 / 325.13,50	☒	☐	0.53 nm
	1.0 nm $\pm$ 0.10 nm	324.38,46 / 325.42,46	☒	☐	1.04 nm
3. EHT	<350V	318 V	☒	☐	N/A
4. Absorbance accuracy (absorbance calibration check). ➤ Gauze 0.49 A.U.	Reading $\pm$ 10% of calibrated value.	0.4909 Abs	☒	☐	N/A
5. Background correction (optics alignment check). difference between measurement with and without 0.49 A.U. gauze for 10 samples.	SavantAA <1% SensAA/XplorAA <2%	BC on with gauze: -0.0000 Abs BC on without gauze: 0.0002 Abs	☒	☐	N/A
6. Sensitivity /noise flame test (aqueous Cu solution test under air-acetylene flame).	Cu 5 ppm >0.7 A.U.	0.8421 Abs	☒	☐	N/A
	<0.5% RSD	0.39 %RSD	☒	☐	N/A

Note:

Signature	
Customer :  (Alisa Sangsarn)	Date : 7/10/24
Service Engineer :  (Mr. NIWAT SUPATANIT)	Maintenance Date : 7/Oct/2024

This is to certify that

Niwat Supatanit

From

**DKSH Technology Limited
Thailand**

has successfully completed GBC Service
Training including hardware and software training,
installation and repair on the following instruments:

AAS Instruments and Accessories

UV-Vis Instruments and Accessories

ICP-OES Quantima and Accessories

Introduction to:

ICP-TOFMS OptiMass

High Performance Liquid Chromatography

X-ray Equipment Emma

Training conducted in Penang, Malaysia

From 22 July to 2 August 2019



Geoff Condict
CEO



GBC Scientific Equipment Pty Ltd

Certificate of Conformance

This is to certify that the gauze membrane serial number: F104

Reads a value of: 0.49 A.U. at a wavelength of **440 nm**, using a
GBC Cintra serial number V 4331 referenced to a NIST neutral
density filter: 8661/SRM 930D (1210).

Valid for 12 months from date of issue.

Date: 22/03/2024

Operator: NIWAT SUPATANIT

GBC Scientific
Equipment Pty Ltd
A.C.N. 005 472 686
A.B.N. 30 005 472 686

4 Lakewood Boulevard
PO Box 1135
Braeside VIC 3195
Australia

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(03) 9588 6666
International
+61 3 9588 6666

Visionary Technology
www.gbcsi.com
gbc@gbcsi.com



01-1295-00

Supelco

www.sigmaaldrich.com

Certified Reference Material
Reference material certificate

Copper Standard for AAS

TraceCERT
Traceable Certified Reference Materials

Product no.: 38996
Lot no.: BCCH9264
Description of CRM: Copper metal (pure material) in 2% HNO₃ (prepared with HNO₃ suitable for trace analysis and high-purity water, 18.2 MΩ·cm, 0.22 µm filtered).
Expiry date: JUN 2025
Storage: Store at 5°C-25°C
Density (certified) at 20°C: 1011.3 kg m⁻³ ± 0.5 kg m⁻³

Constituent	Certified values at 20°C and expanded uncertainties, $U = k \cdot u$ ($k = 2$) [1][2]			
Copper	989	mg kg ⁻¹	± 4	mg kg ⁻¹ 1000 mg L ⁻¹ ± 4 mg L ⁻¹

Metrological traceability: Certified values are traceable to the International System of units (SI) through a metrologically valid weighing process. Details see "Details on metrological traceability".^[3]

Measurement method: The certified value is determined by high-precision weighing of thoroughly characterized starting materials and verified by measurement against NIST SRMs or similar CRMs in accordance with ISO/IEC 17025.^[4]

Intended use: Calibration of AAS, ICP, spectrophotometry or any other analytical technique.

Instructions for handling and correct use: The bottle's temperature must be 20°C. Shake well before every use. If storage of a partially used bottle is necessary (at the user's risk), the cap should be tightly sealed and the bottle should be stored at reduced temperature (e.g. refrigerator) to minimize transpiration rate.

Health and safety information: Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.

Packaging: 250 mL HDPE bottle

Accreditation: Sigma-Aldrich Production GmbH is accredited by the Swiss Accreditation Service SAS as reference material producer under no. SRMS 0001 in accordance with international standard ISO 17034.^[5]

Certificate issue date: 29 JUL 2022



ISO 17034
SRMS 0001

S. Matt

S. Matt - CRM Operations

Dr. P. Zell

Dr. P. Zell - Approving Officer

Sigma-Aldrich Production GmbH, Industriestrasse 25, 9471 Buchs, Switzerland;
Tel +41-81-755-2511; Fax +41-81-756-5449; www.sigmaaldrich.com
Sigma-Aldrich Production GmbH is a subsidiary of Merck KGaA, Darmstadt, Germany.

Certificate Page 1 of 3

Certificate version 01



Certification process details:

To guarantee top reliability of the values for this **TraceCERT®** certified reference material, three independent procedures were followed. The values have to agree in the range of their uncertainties, but the value from the gravimetric preparation has been chosen as certified value ^[3]:

1. Gravimetric preparation using pure materials is a practical realization of concentration units, through conversion of mass to amount of substance ^[3]. If the purity of the materials is demonstrated and if contamination and loss of material is strictly prevented this approach allows highest accuracy and small uncertainties. The certified value of this **TraceCERT®** reference material is based on this approach and directly traceable to the SI unit kilogram. Therefore comprehensively characterized materials of high purity are used. All balances are calibrated annually by an ISO/IEC 17025 accredited laboratory and certified according to DKD guidelines. Calibration is checked daily with OIML Class E2 or F2 weights.
2. The starting material is measured against a certified reference material (i.e. NIST or BAM) followed by gravimetric preparation using balances calibrated with SI-traceable weights. Consequently the value calculated by this unbroken chain of comparisons is traceable to the reference to which the starting material is compared.
3. Whenever applicable the bottled **TraceCERT®** calibration solution is compared to a second reference which is independent from the first reference.

Details on metrological traceability:

Only internationally accepted reference materials e.g. from NIST (USA) or BAM (Germany) have been carefully selected to provide the basis for traceability to the SI unit mole. When no such reference is available, an elemental metal or an adequate salt of highest available purity is used to confirm traceability to this pure material (and therefore to the SI unit kg).

To underpin the certified gravimetric value all traceability measurements are performed with the most accurate and precise analytical technique available. Therefore titrimetry measurement series are applied whenever possible (corrected for trace impurities). When no titrimetric technique is available, the traceability measurements are performed with another analytical technique, e.g. ICP-OES or AAS.

Reference and applied technique used for traceability measurements of the

starting material: NIST SRM 728 / complexometric titration

bottled solution: BAM 365 / complexometric titration

Details on starting materials:

For high purity materials ($P > 99.9\%$) the most appropriate way of purity determination is to quantify the impurities (w_i) and to subtract the sum from 100%. Impurities below the detection limit are considered with a contribution of half of the detection limit (DL_j).

$$P = 100\% - \sum_i w_i - \sum_j \left(\frac{DL_j}{2} \right)$$

Water containing materials were dried to absolute dryness by individual drying conditions (up to 600°C). When drying is impossible due to decomposition water was determined by high-precision KF-titration.

Homogeneity assessment:

Due to the production process, a homogeneous solution derives. Nevertheless a small homogeneity contribution is included into the calculation of content uncertainty of this CRM.

Density Measurement:

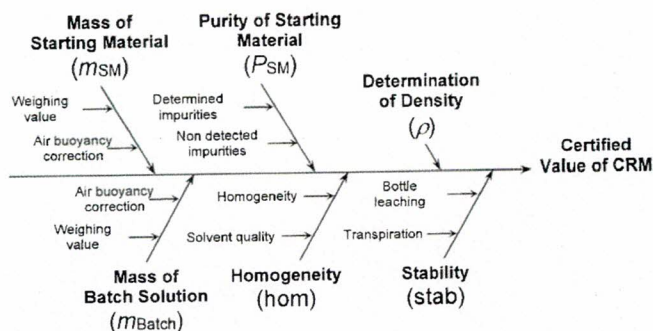
The density measurement is carried out in accordance with ISO/IEC 17025^[4] and ISO 15212-1^[6] using the digital density meter DMA 4500M from Anton Paar with an oscillating U-tube installed. The measurement uncertainty is calculated according to Eurachem/CITAC Guide and reported as combined expanded uncertainty at the 95% confidence level, using a coverage factor of $k = 2$.

Uncertainty evaluation:

The uncertainty contributions are illustrated by the following cause-effect diagram ^[7]:

Typical relative contributions are:

$u(m_{SM})$	< 0.01 %
$u(m_{Batch})$	< 0.01 %
$u(P_{SM})$	< 0.05 %
u_{hom}	< 0.03 %
u_{stab}	< 0.17 %
$u(\rho)$	< 0.05 %



The combined standard uncertainty is calculated by combination of the standard uncertainties of the input estimates according to Eurachem/CITAC Guide "Quantifying Uncertainty in Analytical Measurement" and ISO 17034.^{[2][5]}

Expanded uncertainty is then calculated to a confidence level of 95%, typically by multiplying with a confidence level factor of $k=2$.

References:

- [1] ISO Guide 35:2017, "Reference materials - Guidance for characterization and assessment of homogeneity and stability"
- [2] Eurachem/CITAC Guide, 3rd Ed. (2012), "Quantifying uncertainty in analytical measurement"
- [3] Eurachem/CITAC Guide, 2nd Ed. (2019), "Metrological Traceability in chemical measurement"
- [4] The accredited testing laboratory STS 0490 performs the measurements and weighing steps for the certification of this CRM under ISO/IEC 17025:2017, "General requirements for the competence of testing and calibration laboratories"
- [5] ISO 17034:2016, "General requirements for the competence of reference material producers"
- [6] DIN EN ISO 15212-1:1998, Oscillation-type density meters - Part 1: Laboratory instruments
- [7] Reichmuth, A., Wunderli, S., Weber, M., Meyer, V. R. (2004), "The uncertainty of weighing data obtained with electronic analytical balances", Microchimica Acta 148: 133-141.

Certificate of analysis revision history:

Certificate version	Certificate issue date	Reason for version
01	29 JUL 2022	Initial version

Disclaimer:

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The life science business of Merck KGaA, Darmstadt, Germany operates as MilliporeSigma in the US and Canada.



PREVENTIVE MAINTENANCE REPORT

Avio200

Customer : <u>Environment & Laboratory Co.,Ltd</u> Address : <u>40 Soi Liangmueangnonthaburi 13</u> <u>Talad Kwan Mueang,</u> <u>Nonthaburi 11000</u> User Name: <u>Alisa</u> Phone: _____ Fax: _____	Date Tested: <u>October 16, 2024</u> Recommendation Recertification Period <u>12</u> Recertification Due <u>October 16, 2025</u> Date Last Certified: <u>October 16, 2023</u> Visit Number: <u>1 of 1</u> PerkinElmer Phone <u>02-719-6420 ext 206</u> PerkinElmer Fax: <u>02-318-5597</u>
--	---

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>Avio200</u>	<u>079S16062402</u>	<u>Syngistix 2.0.0.2236</u>
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Mixed standard 1/10</u>	<u>N069-1579</u>	<u>JUN 30, 2025</u>
<u>Mixed standard 1/100</u>	<u>N930-0221</u>	<u>NOV 30, 2024</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		

PREVENTIVE MAINTENANCE REPORT

Avio200

SERIAL NUMBER : 079S16062402DATE TESTED : October 16, 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 six months.

☐ OK**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK

PREVENTIVE MAINTENANCE REPORT

Avio200

SERIAL NUMBER : 079S16062402

DATE TESTED : October 16, 2024

PARAMETER	SPECIFICATION			FINAL VALUE
Spectral Resolution : UV	As 193.696 nm	≤ 0.009		0.00726
	Ni 231.604 nm	≤ 0.011		0.00923
	Ni 341.476 nm	≤ 0.015		0.01321
Spectral Resolution : VIS	Ba 455.403 nm	≤ 0.020		0.01693
Precision				
	Zn 206.200 nm	% RSD ≤ 1.0		0.34
	Mg 280.271 nm	% RSD ≤ 1.0		0.32
	Mg 285.213 nm	% RSD ≤ 1.0		0.36
	Ba 455.403 nm	% RSD ≤ 1.0		0.39
Detection Limits : Axial	As 193.696 nm	3(SD) ppb		63.71
	Se 196.026 nm	3(SD) ppb		8.95
	Tl 190.801 nm	3(SD) ppb		3.13
	Pb 220.353 nm	3(SD) ppb		0.63
Detection Limits : Radial	As 193.696 nm	3(SD) ppb		10.24
	Zn 213.857 nm	3(SD) ppb		9.08
	Mn 257.610 nm	3(SD) ppb		4.98
	La 379.478 nm	3(SD) ppb		3.50
	Ba 455.403 nm	3(SD) ppb		0.70
	Ba 493.408 nm	3(SD) ppb		5.16
BEC : Axial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 30 ppb		0.88
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 30 ppb		2.08

PREVENTIVE MAINTENANCE REPORT

Avio200

SERIAL NUMBER : 079S16062402DATE TESTED : October 16, 2024**Remarks :**Commissioning follow as commissioning performance sheets.Found As, Ba, Mn, Zn, blank has high intensity with analysis air - need to replace new Injector and torch

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.

Service Department PerkinElmer Ltd.**Authorized Representative :**

(Khwanchai Siangwong)

Customer Support Engineer



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.: 25CG465

Page.: 1 of 2

Equipment : Burette
Capacity : 50 mL
Serial No. : -
ID. No. : BUR-001
Manufacturer : Witeg
Made in : Germany
Submitted by : Environment & Laboratory Co.,Ltd.
40 Soi Liangmueangnonthaburi 13
Talad Kwan, Mueang, Nonthaburi 11000
Ambient Temperature : (20 ± 2.5) °C
Relative Humidity : (50 ± 10) %
Barometric Pressure : 756 mmHg
Calibration Procedure : ASTM E 542 - 01
Calibrated by : Natcha Chayingcheiw

Approved by :

Approved Signatory

(✓) Srisuda Khamtha

() Ponpan Paipim

Issue Date :

6 February 2025

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Burette
Received Date : 4 February 2025
Condition As-Received : Used Item
Calibration Date : 6 February 2025
Reference : 2502-0076DC-6

Cert.No.: 25CG465

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID. No.</u>	<u>Certificate No.</u>	<u>Traceability</u>	<u>Due date</u>
1) Balance	XP205DR	1126143764	140RC004	24MM602/1	TPA	17 Sep 2025
2) Thermo-Hygrograph	THDX-CE	00016540	140EC001	24H1153	TPA	10 June 2025
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 (± mL)	k Factor
50	49.9874	0.010	2.00

Remark mL = cm³

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-



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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-019

Issue Date : 30 June 2023

Work Order No. : 23/0879

Customer Name : BUREAU VERITAS AQ LAB (THAILAND) COMPANY LIMITED
111 Thailand Science Park, Moo 9 Paholyotin Road,
Klong Nueng, Klong Luang, Pathumthani 12120, Thailand

Date of Received : 28 June 2023

Date of Calibration : 28 June 2023

Instrument Details : Description : Water Bath
Manufacturer : ThremoFisher
Model : N/A
Serial No. : 0152187501160414
ID No. : CHM000205
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the liquid bath according to calibration procedure CWI-T-11 in-house methods based on ASTM E715-80 (Reapproved 2006)

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC $\pm$ 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Thichakorn Srisupob
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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PAGE 1/3

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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-019

Issue Date : 30 June 2023

Work Order No. : 23/0879

Details of calibration

1. Reference Standards Instrument

Instrument	Model	Serial No. / ID No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY59002085	22-1146-021	22 November 2023
Sensor type	RTD	Channel 101 to 106	22-1146-021	22 November 2023

2. Certificate traceble

: This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260

3. Condition of item

: Used

4. Calibration site

: On-site

5. Result of Calibration

: Without Adjustment

6. Evaluate Condition

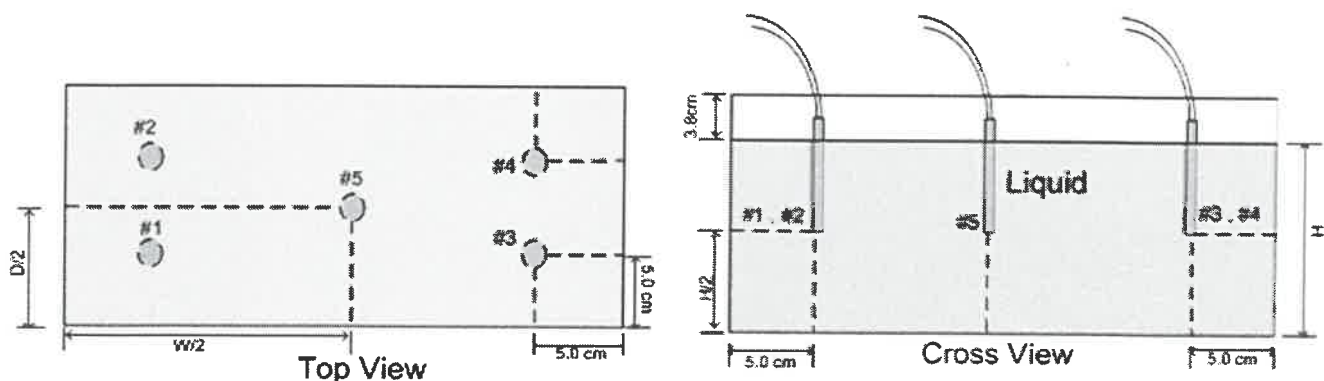
: Time Constant : - Hour 33 Minute At Cal. point 44.5 °C
Type of Control : PID Control

Testing liquid bath use media is Water

7. Calibration note

: The results reported in this certificate refer to the condition of instrument on
the process into the standby state of Liquid Bath

8. Sensors Installation Diagram



Position Diagrams

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CERTIFICATE OF CALIBRATION

Issue Date : 30 June 2023

Certificate No. : 23-0879-019

Work Order No. : 23/0879

Result of Temperature Distribution and Performance Check

Table 1 : Reporting of Temperature

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.5 is REF)					Uncertainty ± (°C)
	#1	#2	#3	#4	#5	
44.5	44.50	44.50	44.50	44.50	44.51	0.13

Table 2 : Reporting of Characterization Result

Indicator Set point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
44.4	44.4	44.4	44.4	0.04	0.07	0.07

Note :

Calibrate items in good condition and this report customer request and accepted in certificate

The reference sensor is preferably located at the center of bath

The measured temperature data readout by software "Benchlink Datalogger 3"

The quoted uncertainty includes "Stability" and excludes "Loading effect (20% of Temp Uniformity)"

Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

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 bath under steady state conditions.

Overall Variation - The difference of the maximum and minimum measured temperatures throughout observation time.

Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.

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

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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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-008

Issue Date : 30 June 2023

Work Order No. : 23/0879

Customer Name : BUREAU VERITAS AQ LAB (THAILAND) COMPANY LIMITED

111 Thailand Science Park, Moo 9 Paholyotin Road,
Klong Nueng, Klong Luang, Pathumthani 12120, Thailand

Date of Received : 26 June 2023

Date of Calibration : 26 June 2023

Instrument Details : **Description** : Temperature Controlled Enclosures [Incubator]
Manufacturer : memmert
Model : INE 500
Serial No. : E512.0738
ID No. : CHM000151
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWI-T-10 follow up to TLAS G-20-1/02-08 (E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC $\pm$ 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Wuttinun Yindeepot
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-008

Issue Date : 30 June 2023

Work Order No. : 23/0879

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY59002085	22-1146-021	22 November 2023
Sensor type	RTD	RTD# 101-109	22-1146-021	22 November 2023

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260
3. Condition of item : Used
4. Calibration site : On - Site
5. Result of Calibration : Without adjustment
6. Evaluate Condition : Time Constant : - Hour 33 Minute At cal. point 41.5 °C
Air vent : Off
Fan speed status : None Fan Speed
7. Calibration note : The results reported in this certificate refer to the condition of instrument on
the process into the steady state of chamber
8. Sensors Installation Diagram : When ; Sensor installation location in Chamber @ Working Space
A = Distance between sensor and wall of chamber is 5 cm
9. Dimensions of chamber : W = 0.56 m ; D = 0.4 m ; H = 0.48 m

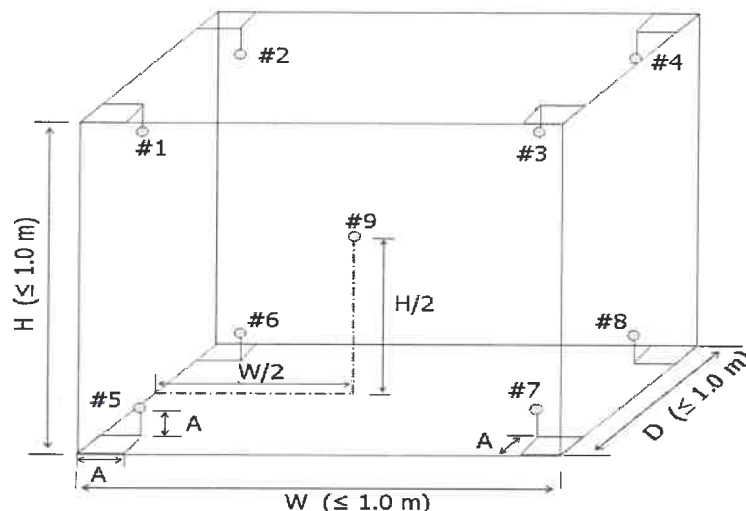


Diagram of Chamber

Signature



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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-008

Issue Date : 30 June 2023

Work Order No. : 23/0879

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
41.5	41.91	41.99	41.77	41.86	41.62	42.18	41.66	41.76	41.80	0.29
42.0	42.46	42.52	42.29	42.39	42.16	42.66	42.19	42.27	42.33	0.26

Table 2 : Reporting of Performance check

Indicator Set Point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
41.5	41.5	41.5	41.5	0.14	0.51	0.74
42.0	42.0	42.0	42.0	0.10	0.44	0.64

Note

Calibrate items it good condition and this report customer request and accepted in certificate

The reference sensor is preferably located of the geometric center of chamber

The measured temperature data readout by software "Benchlink Datalogger 3"

The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

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 througout observation time.

Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.

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

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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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-010

Issue Date : 30 June 2023

Work Order No. : 23/0879

Customer Name : BUREAU VERITAS AQ LAB (THAILAND) COMPANY LIMITED
111 Thailand Science Park, Moo 9 Paholyotin Road,
Klong Nueng, Klong Luang, Pathumthani 12120, Thailand

Date of Received : 26 June 2023

Date of Calibration : 26 June 2023

Instrument Details : **Description** : Temperature Controlled Enclosures [Incubator]
Manufacturer : memmert
Model : IN110
Serial No. : D415.0797
ID No. : CHM000181
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWI-T-10 follow up to TLAS G-20-1/02-08 (E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC $\pm$ 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Wuttinun Yindeepot
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : 23-0879-010

Issue Date : 30 June 2023

Work Order No. : 23/0879

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY49024826	22-1485-003	20 November 2023
Sensor type	RTD	RTD# 301-308, 310	22-1485-003	20 November 2023

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260

3. Condition of item

: Used

4. Calibration site

: On - Site

5. Result of Calibration

: Without adjustment

6. Evaluate Condition

: Time Constant : - Hour 33 Minute At cal. point 35 °C
Air vent : Off
Fan speed status : None Fan Speed

7. Calibration note

: The results reported in this certificate refer to the condition of instrument on
the process into the steady state of chamber

8. Sensors Installation Diagram

: When ; Sensor installation location in Chamber @ Working Space
A = Distance between sensor and wall of chamber is 5 cm

9. Dimensions of chamber

: W = 0.56 m ; D = 0.4 m ; H = 0.48 m

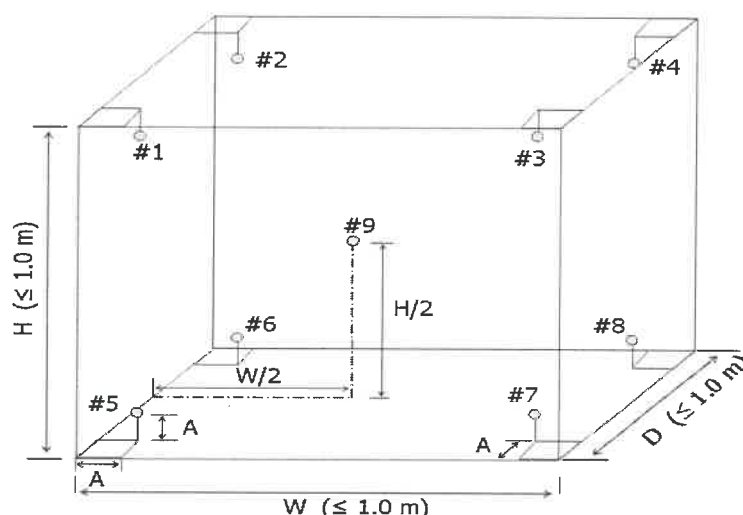


Diagram of Chamber

**CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.**

45/48 Soi Salathammasop31, Salathammasop Rd.,
 Salathammasop, Thawewatthana, Bangkok 10170 Thailand
 Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com

**CERTIFICATE OF CALIBRATION**

Certificate No. : 23-0879-010

Issue Date : 30 June 2023

Work Order No. : 23/0879

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.05	35.03	35.04	35.07	34.80	34.87	34.78	34.86	35.07	0.26

Table 2 : Reporting of Performance check

Indicator Set Point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
34.8	34.8	34.8	34.8	0.11	0.33	0.48

Note

Calibrate items it good condition and this report customer request and accepted in certificate

The reference sensor is preferably located of the geometric center of chamber

The measured temperature data readout by software "Benchlink Datalogger 3"

The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

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 througout observation time.

Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.

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

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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NSC-TISI-TIS 17025
CALIBRATION 0260

CERTIFICATE OF CALIBRATION

Certificate No. : 23-0420-001

Issue Date : 21 March 2023

Work Order no.: 23/0420

Customer Name : BUREAU VERITAS AQ LAB (THAILAND) COMPANY LIMITED

111 Thailand Science Park, Moo 9 Paholyotin Road,

Klong Nueng, Klong Luang, Pathumthani 12120, Thailand

Date of Received : 21 March 2023

Date of Calibration : 21 March 2023

Instrument Details : Description : Autoclave
Manufacturer : HIRAYAMA
Model : HV-110 II
Serial No. : 34819080032
ID No. : CHM000199
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert Temperature data logger into the chamber of autoclave according to calibration procedure CWI-T-12 in-house methods based on BS 2646 : 1993 part 5 clause 3.1

Environmental Conditions

Temperature : Area Monitoring between 15°C to 40°C

Humidity : Area Monitoring between 30%RH to 85%RH

Line Voltage : Area Monitoring 220 VAC $\pm$ 10%

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Kritsada Kaewwangpa
Calibration Engineer

Approved by : 
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Issue Date : 21 March 2023

Certificate No. : 23-0420-001

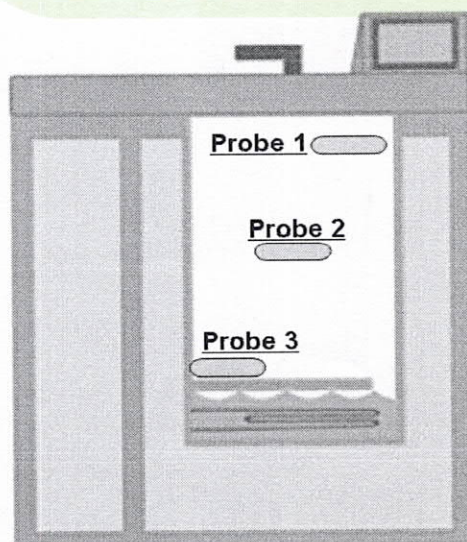
Work Order No. : 23/0420

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No.	Certificate No.	Due Date
Temperature Data Logger Type RTD	R14466	22-1388-001	11 October 2023
	R14467	22-1388-001	11 October 2023
	R14469	22-1388-001	11 October 2023

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260
3. Condition of item : Used
4. Calibration site : On-site
5. Result of Calibration : Without Adjustment
6. Evaluate Condition : Time Constant : 20 Minutes At cal. point 115 °C
Calibration process record temperature data at sterilization time
7. Calibration note : The results reported in this certificate refer to the condition of instrument on
the process into the standby state of chamber
8. Sensors Installation Diagram : Probe 1 : Installation Attached to the load temperature probe, within 20 mm
Probe 2 : Installation in the half of upper the Chamber autoclave
Probe 3 : Installation in the Chamber drain, within 100 mm



Position Diagrams

Av

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**CERTIFICATE OF CALIBRATION**

Certificate No. : 23-0420-001

Issue Date : 21 March 2023

Work Order No. : 23/0420

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature within chamber autoclaves

Calibration point (°C)	Sterilization time (Minutes)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.2 is REF)			Uncertainty ± (°C)
		#1	#2	#3	
115.0	20	115.46	115.44	115.49	0.45
118.0	15	118.52	118.51	118.55	0.45
121.0	15	121.55	121.52	121.57	0.45

Table 2 : Reporting of Characterization within chamber autoclaves

Indicator Set point (°C)	Indicator Reading (°C)				Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average	MPa			
115.0	115.7	115.6	115.7	0.071	0.29	0.09	0.60
118.0	118.8	118.7	118.8	0.089	0.21	0.06	0.45
121.0	121.8	121.7	121.8	0.108	0.20	0.08	0.45

Note :

Calibrate items it good condition and this report customer request and accepted in certificate

Temperature Data Logger has setting interval time is 5 seconds per record data

The measured temperature data readout by software "Madgetech Data Logger Software"

The quoted uncertainty include " Stability " and Loading effect (20% of Temp Uniformity) "

Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.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 bath under steady state conditions.Overall Variation - The difference of the maximum and minimum measured temperatures througout observation time.Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.

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

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%.