

ภาคผนวก ข

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เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



**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 FAX. 0-2719-9484

**Cert.No.:** 23TW41

**Page.:** 1 of 2

## **Certificate of Testing**

<b>Equipment :</b>	DO Meter
<b>Manufacturer :</b>	Hanna
<b>Model :</b>	HI98193
<b>Serial No. :</b>	03030056991
<b>ID No. :</b>	LB-Eq-014
<b>Received Date :</b>	16 February 2023
<b>Test Date :</b>	17 February 2023
<b>Reference :</b>	2302-0616WN-1
<b>Submitted by :</b>	Special Lab Envi And Consultant Co.,Ltd 47/91 Moo 3 Thambon Tha-it, Pakkret, Nonthaburi 11120
<b>Laboratory Condition :</b>	Temperature ( $25 \pm 5$ ) °C Humidity ( $50 \pm 20$ ) %
<b>Test Procedure :</b>	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
<b>Tested by :</b>	Walalak Sirithean

**Approved by :**

*Malee*

Approved Signatory

- ( ☒ ) Malee Butkruea  
( ☐ ) Saithip Meangmai  
( ☐ ) Warakorn Lergagtrakul

**Issue Date :** 20 February 2023

**B 0307483**





Cert.No.: 23TW41

Page.: 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

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

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: KC1N20CDJ

<b>Titration Method (Azide Modification Method)</b> (mg/L)	<b>DO Meter Reading</b> (mg/L)	<b>Standard Deviation</b> (mg/L)
8.12	8.13	0.0045

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

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## Certificate of Calibration

**Certificate No. :** 66-400220-2

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120

**Equipment :** Air Chamber (Incubator)  
Manufacturer : Lovibond Model : FKU 1800  
Range : N/A °C Resolution : 0.1 °C  
Serial No. : 0914643-01 ID No. : LB-Eq-004

**Environment :** On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.  
Ambient Temperature : (29.0 to 29.6) °C  
Relative Humidity : (40 to 45) %  
Line Voltage : (226.0 to 226.5) V

**Date of Received :** 24 April 2023

**Date of Calibration :** 24 April 2023

**Date of Issue :** 26 April 2023

**Calibrated by :** Permpoon Chanpu

**Calibration Method :** CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

**Reference Standard Instruments :** This certification is traceable to the International System of Units  
Standard Digital Thermometer with RTD Probe

ID No.	Cert. No.	Due Date	Traceability
400046 & 400042	66-400066-1	02 Aug 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



( Bunjerd Masri )

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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www.calibratech.co.th



## Certificate of Calibration

Certificate No. : 66-400220-2

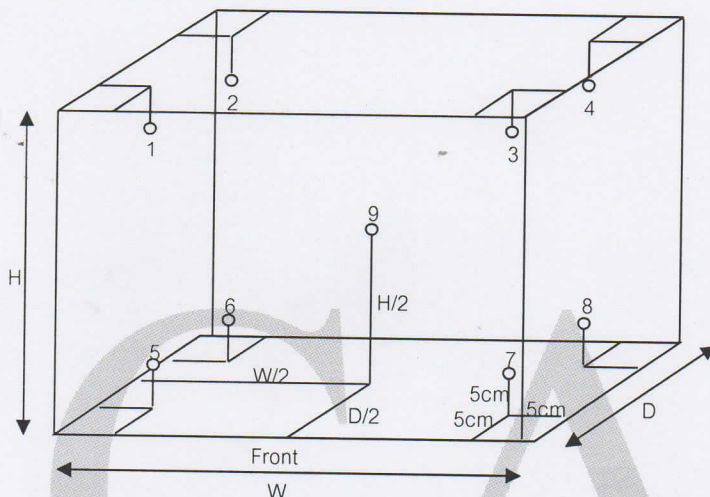
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



Inside of Chamber

W = 0.55 m

D = 0.73 m

H = 0.50 m

Capacity = 0.20 m<sup>3</sup>

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
20.0	19.9	19.9	20.35	20.35	20.23	20.25	20.12	20.12	20.14	20.28	20.08	0.42

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	19.9	19.9	0.37	0.16	0.6

**Remark** The uncertainty is not combine uniformity of the air chamber

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

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

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## Certificate of Calibration

**Certificate No. :** 65-400202-2

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120

**Equipment :** Liquid in Glass Thermometer

Manufacturer : N/A

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : LB-Eq-020

**Environment :** Ambient Temperature :  $(23 \pm 2)$  °C

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

Line Voltage :  $(220 \pm 22)$  VAC

**Date of Received :** 27 April 2022

**Date of Calibration :** 29 April 2022

**Date of Issue :** 29 April 2022

**Calibrated by :** Chortip Samchusri

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

The temperature scale used was based on ITS-90

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

1. Platinum Resistance Thermometer (PRT)

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

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)
400004	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



( Bunjerd Masri )  
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-400202-2

**Page :** 2 of 2

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement

Ice point check : UUC\* reading 0 ° C Standard reading 0.5983 ° C

Standard Reading ( ° C )	UUC Reading ( ° C )	Correction ( ° C )	Uncertainty ( ± ° C )
24.9211	25	-0.1	0.31

Remark

UUC : Unit Under Calibration

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

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

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## Certificate of Calibration

**Certificate No. :** 65-400202-1

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120

**Equipment :** Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : LB-Eq-021

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

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

**Date of Received :** 27 April 2022

**Date of Calibration :** 29 April 2022

**Date of Issue :** 29 April 2022

**Calibrated by :** Chortip Samchusri

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

The temperature scale used was based on ITS-90

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

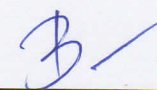
1. Platinum Resistance Thermometer (PRT)

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

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)
400004	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



( Bunjerd Masri )

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-400202-1

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement

Ice point check : UUC\* reading 0 ° C Standard reading -0.4378 ° C

Standard Reading ( ° C )	UUC Reading ( ° C )	Correction ( ° C )	Uncertainty ( ± ° C )
24.2179	25	-0.8	0.31
29.0694	30	-0.9	0.31
39.2676	40	-0.7	0.31

Remark

UUC : Unit Under Calibration

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

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

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## Certificate of Calibration

**Certificate No. :** 65-400451-1

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120

**Equipment :** Water Bath

Manufacturer : Memmert

Model : WNB22

Range : N/A °C

Resolution : 0.1 °C

Serial No. : L520.0201

ID No. : LB-Eq-041

**Environment :** On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (45 to 500) %

Line Voltage : (226.0 to 226.5) V

**Date of Received :** 24 August 2022

**Date of Calibration :** 24 August 2022


**Date of Issue :** 31 August 2022

**Calibrated by :** Permpon Chanpu

**Calibration Method :** This instrument was calibrated by In-house method CAL-M4006 based on ASTM E715-80  
The temperature scale used was based on ITS-90

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

ID No.	Cert. No.	Due Date	Traceability
400029 & 400031	65-400273-1	23 Nov 2022	National Institute of Metrology Thailand (NIMT)

Approved by :   
( Surachai Promthong )  
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

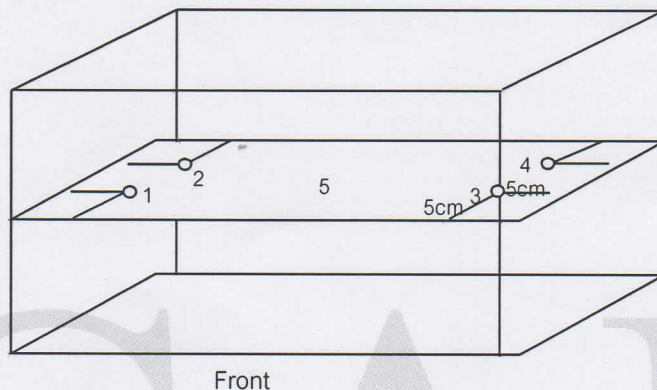
**Certificate No. : 65-400451-1**

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement



Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.					Uncertainty (± °C)	Measured Uniformity (°C)	Measured Stability (°C)
			1	2	3	4	5			
62.0	62.0	62.0	61.93	61.92	61.91	61.91	61.91	0.18	0.06	0.03
85.0	85.0	85.0	84.94	84.91	84.89	84.92	84.92	0.18	0.08	0.03
95.0	95.0	95.0	94.81	94.76	94.76	94.77	94.77	0.19	0.09	0.07
100.0	ccc	100.8	100.64	100.74	100.52	100.62	100.56	0.24	0.34	0.13

Remark The uncertainty is not combine uniformity of the water bath

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

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

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*Handwritten signature*





## Certificate of Calibration

**Certificate No. :** 65-210421-2

**Page : 1 of 2**

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd.  
47/91 Moo 3, Tambol Tha-IT, Pakkret, Nonthaburi 11120

**Equipment :** Weight  
Manufacturer : LS Material : Stainless Steel  
Weight size : 100 g  
ID No. : LB-Eq-035  
Assumed density of weight : 7950 kg / m<sup>3</sup>  
Assumed Air density : 1.2 kg / m<sup>3</sup>

**Environment :** Ambient Temperature : ( 20 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Air Pressure : 1009.8 mbar

**Date of Received :** 01 September 2022

**Date of Calibration :** 05 September 2022

**Date of Issue :** 05 September 2022

**Calibrated by :** Wuttichai Swatphong

**Calibration Method :** In-house method CAL-M2101 based on OIML R 111-1 : 2004(E)

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E221-E2210	MM-0042-22	21 Mar 2025	National Institute of Metrology (Thailand), (NIMT)

Approved by :



( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

Certificate No. : 65-210421-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

No.	Nominal Value	Id.Mark	Conventional mass Value		Measuring Uncertainty
1	100 g	none	100 g	-0.05 mg	$\pm$ 0.11 mg

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

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

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## Certificate of Calibration

**Certificate No. :** 65-210421-3

**Page : 1 of 2**

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd.  
47/91 Moo 3, Tambol Tha-IT, Pakkret, Nonthaburi 11120

**Equipment :** Weight  
Manufacturer : LS Material : Stainless Steel  
Weight size : 200 g  
ID No. : LB-Eq-036  
Assumed density of weight : 7950 kg / m<sup>3</sup>  
Assumed Air density : 1.2 kg / m<sup>3</sup>

**Environment :** Ambient Temperature : ( 20 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Air Pressure : 1009.8 mbar

**Date of Received :** 01 September 2022

**Date of Calibration :** 05 September 2022

**Date of Issue :** 05 September 2022

**Calibrated by :** Wuttichai Swatphong

**Calibration Method :** In-house method CAL-M2101 based on OIML R 111-1 : 2004(E)

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E221-E2210	MM-0042-22	21 Mar 2025	National Institute of Metrology (Thailand), (NIMT)

Approved by :



( Surachai Promthong )  
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-210421-3

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

No.	Nominal Value	Id.Mark	Conventional mass Value		Measuring Uncertainty
1	200 g	none	200 g	+0.09 mg	$\pm$ 0.17 mg

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

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

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## CALIBRATION CERTIFICATE

Date of Issue Jun 23, 2023

Cert No. 23/2342

Site Calibration

Order No. 23060302

Customer SPECIAL LAB ENVI AND CONSULTANT CO., LTD.  
47/91 Moo 3 Tha-Irt, Pak Kret, Nonthaburi, 11120.

Place of Calibration 1350, 1352 Sutthisarnwinitchai Rd, Dindaeng, Bangkok 10400. (Calibration Room)

Description Oven

Model UF30

Serial No. B123.0544

ID.No. -

Date of Receipt Jun 20, 2023

Date of Calibration Jun 20, 2023

Environment

Temperature (Min) 23.1 °C (Max) 25.3 °C

Relative Humidity (Min) 46.3 %RH (Max) 78.9 %RH

### Calibration Method

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

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

### Standard

1) Data Acquisition with Sensor Model 34972A S/N. MY49007789, Certificate No. QR23-0024, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Jan 10, 2024.

This certificate is traceable to SI unit.

*D.M.*





## CALIBRATION CERTIFICATE

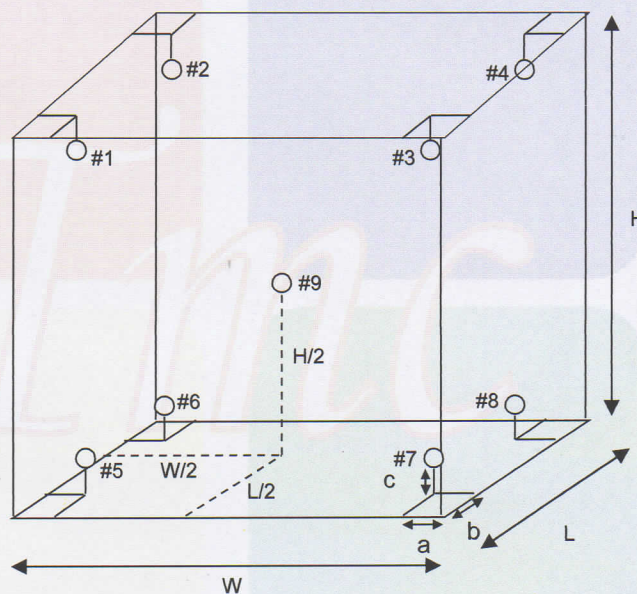
Date of Issue Jun 23, 2023

Cert No. 23/2342

Site Calibration

Order No. 23060302

Results (without adjustment)



Position of reference thermometers were placed

### Note.

- 1). Dimension (W x L x H) is 40 x 25 x 32 cm.
- 2). Stability - greatest one half of difference between max peak and min peak of each reference probe measured temperature obtained during the calibration interval.
- 3). Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady state conditions. The reference sensor should preferably be located at the geometric center of the chamber.





## CALIBRATION CERTIFICATE

Date of Issue Jun 23, 2023

Cert No. 23/2342

Site Calibration

Order No. 23060302

### Results (without adjustment)

UUC Setting ( °C )	UUC Reading ( °C )	Reference Thermometer (°C)		Stability ± ( °C )	Uniformity ( °C )	Uncertainty ± ( °C )
104.0	104.0	Position 1	104.544	0.058	0.704	0.30
		Position 2	103.789			
		Position 3	103.396			
		Position 4	103.886			
		Position 5	104.031			
		Position 6	103.886			
		Position 7	103.342			
		Position 8	103.939			
		Position 9	103.867			

UUC Setting ( °C )	UUC Reading ( °C )	Reference Thermometer (°C)		Stability ± ( °C )	Uniformity ( °C )	Uncertainty ± ( °C )
150.0	150.0	Position 1	151.388	0.052	1.248	0.41
		Position 2	150.037			
		Position 3	149.313			
		Position 4	149.849			
		Position 5	150.519			
		Position 6	150.188			
		Position 7	149.370			
		Position 8	150.383			
		Position 9	150.201			





## CALIBRATION CERTIFICATE

Date of Issue Jun 23, 2023

Cert No. 23/2342

Site Calibration

Order No. 23060302

Results (without adjustment)

UUC Setting ( °C )	UUC Reading ( °C )	Reference Thermometer (°C)		Stability $\pm$ ( °C )	Uniformity ( °C )	Uncertainty $\pm$ ( °C )
180.0	180.0	Position 1	181.507	0.059	1.693	0.49
		Position 2	179.668			
		Position 3	178.772			
		Position 4	179.371			
		Position 5	180.334			
		Position 6	179.830			
		Position 7	178.855			
		Position 8	180.323			
		Position 9	179.876			

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

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

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

APPROVED SIGNATORY :

☐ MR. PRAJUCKPETCH THONGSOOKCHOTE

☒ MR. DAMRONG MULSING

☐ MR. JATURAPAT THONGSOOKCHOTE





**BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.**  
**CALIBRATION LABORATORY**

300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-23-297

Page : 1 of 3

## CERTIFICATE OF CALIBRATION

Equipment	:	Spectrophotometer
Manufacturer	:	Thermo Scientific
Model	:	Genesys 20
Serial No.	:	3SGT041007
ID No.	:	LB-Eq-029
Customer	:	Special Lab Envi And Consultant Co., Ltd.
	:	47/91-93 Moo 3, Tambol Tait , Amphur Pakrad,
	:	Nonthaburi, 11120.
Location	:	Becthai Laboratory (Bangkok)
Date of Receipt	:	3 May 2023
Date of Calibration	:	3 May 2023
Date of Issue	:	3 May 2023
Ambient Temperature	:	(25±10) °C
Relative Humidity	:	(60±20) %
Condition As-Received	:	Used Item

Calibrated by

( Mr.Somphop Duangnguan)

Calibration Engineer

Approved by

( Ms. Jintana Sangthaijaroenlap )

Calibration Manager

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

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Indicated values are valid for the state of the Spectrophotometer at the time of calibration only.





**BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.**  
**CALIBRATION LABORATORY**

300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-23-297

Page : 2 of 3

## CALIBRATION REPORT

### Conditions of this result of calibration

#### 1. Reference Standard Material :

<u>Material</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert.No.</u>	<u>Due date</u>
Holmium Glass Filter	RM-HG	12705	98236	12 Feb 24
Didymium Glass Filter	RM-DG	13498	98233	12 Feb 24
Neutral Density Filter	RM-1N2N3N	8323	98259	13 Feb 24

2. Traceability : This certification is traceable to the International System of Unit maintained at;  
The Starna Scientific Ltd. Accredited Calibration Laboratory No. 0659.

#### 3. Method of calibration :

The calibration procedure was carried out according to ASTM E275-08 (2022) and ASTM E925-09 (2014).

#### 4. Result of calibration :

( ☒ ) without adjustment

( ☐ ) after adjustment

#### 5. Equipment Specifications:

Spectral Bandwidth :	5	nm
Data Interval :	1	nm
Scan Speed :	N/A	nm/min





**BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.**  
**CALIBRATION LABORATORY**

300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-23-297

Page : 3 of 3

## CALIBRATION REPORT

### Wavelength Calibration

Certified Values of Reference Material (nm)	Nominal Value (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty of Measurement ( $\pm$ nm)
418.40	418	418	-0.40	0.59
537.00	537	537	0.00	0.59
638.00	638	638	0.00	0.59

### Photometric Calibration for Visible

Wavelength (nm)	Certified Values of Reference Material (A)	UUC* Reading (A)	Error (A)	Uncertainty of Measurement ( $\pm$ A)
420.0	Zero	0.000	0.0000	0.0028
	0.5716	0.572	0.0004	0.0044
	0.7358	0.733	-0.0028	0.0040
	1.0713	1.073	0.0017	0.0039
440.0	Zero	0.000	0.0000	0.0028
	0.561	0.560	-0.0010	0.0042
	0.718	0.714	-0.0040	0.0037
	1.0459	1.044	-0.0019	0.0037
465.0	Zero	0.000	0.0000	0.0028
	0.5111	0.513	0.0019	0.0044
	0.6618	0.661	-0.0008	0.0035
	0.9635	0.966	0.0025	0.0034
546.1 (546.0)	Zero	0.000	0.0000	0.0028
	0.5222	0.523	0.0008	0.0036
	0.6687	0.668	-0.0007	0.0031
	0.9768	0.978	0.0012	0.0043
590.0	Zero	0.000	0.0000	0.0028
	0.5541	0.554	-0.0001	0.0035
	0.6975	0.696	-0.0015	0.0031
	1.0206	1.021	0.0004	0.0045
635.0	Zero	0.000	0.0000	0.0028
	0.5398	0.543	0.0032	0.0035
	0.6658	0.667	0.0012	0.0033
	0.9741	0.977	0.0029	0.0045

Remark : Each individual filter is measured against the empty filter holder (blank) used to zero the Spectrophotometer.

Note:

UUC\* : Unit Under Calibration

- End of Report -



## Certificate of Calibration

**Certificate No. :** 65-400451-1

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120

**Equipment :** Water Bath

Manufacturer : Memmert

Model : WNB22

Range : N/A °C

Resolution : 0.1 °C

Serial No. : L520.0201

ID No. : LB-Eq-041

**Environment :** On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (45 to 500) %

Line Voltage : (226.0 to 226.5) V

**Date of Received :** 24 August 2022

**Date of Calibration :** 24 August 2022

**Date of Issue :** 31 August 2022

**Calibrated by :** Permpon Chanpu

**Calibration Method :** This instrument was calibrated by In-house method CAL-M4006 based on ASTM E715-80  
The temperature scale used was based on ITS-90

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

ID No.	Cert. No.	Due Date	Traceability
400029 & 400031	65-400273-1	23 Nov 2022	National Institute of Metrology Thailand (NIMT)

Approved by :

( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.





## Certificate of Calibration

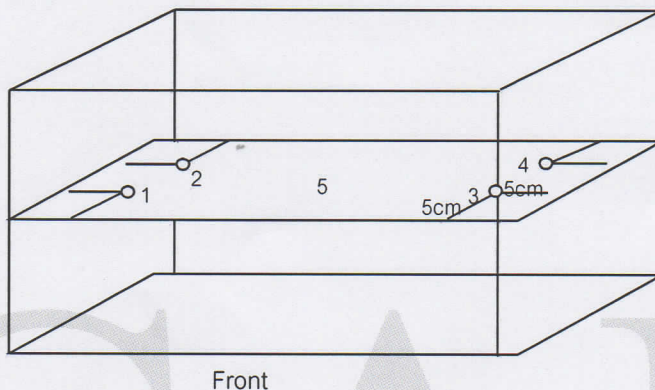
**Certificate No. : 65-400451-1**

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement



Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.					Uncertainty (± °C)	Measured Uniformity (°C)	Measured Stability (°C)
			1	2	3	4	5			
62.0	62.0	62.0	61.93	61.92	61.91	61.91	61.91	0.18	0.06	0.03
85.0	85.0	85.0	84.94	84.91	84.89	84.92	84.92	0.18	0.08	0.03
95.0	95.0	95.0	94.81	94.76	94.76	94.77	94.77	0.19	0.09	0.07
100.0	ccc	100.8	100.64	100.74	100.52	100.62	100.56	0.24	0.34	0.13

Remark The uncertainty is not combine uniformity of the water bath

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

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

- o0o -

*Handwritten signature*





# PinAAcle 900F Preventive Maintenance Report

Company Name: SPECIAL LAB ENVI & CONSULTANT

Instrument Location: PAKKRET NONTABURI 11120

Instrument Serial No.: PFBS17082303

Date: 03-Sep-2021



## ***PinAAcle 900F Preventive Maintenance (PM)***

<b>Company Name:</b>	SPECIAL LAB ENVI & CONSULTANT		
<b>Address (Instrument Location):</b>	PAKKRET NONTHABURI 11120		
<b>Serial Number:</b>	PFBS17082303	<b>PM Number:</b>	1 of 1
<b>Customer Name (if applicable):</b>	K. Fhatiha	<b>Telephone Number:</b>	(092) 283-9054
<b>Customer Support Engineer Name:</b>	K. Weerayoot keadpon	<b>Service Order Number:</b>	WO-00925451
<b>Date PM Performed: (DD-MMM-YYYY)</b>	03-Sep-2021	<b>Next PM Due Date: (DD-MMM-YYYY)</b>	03-Sep-2022
<b>Standard Labor Hours to Complete PM :</b>		<b>5 hours</b>	

<b>Part Number</b>	<b>Release</b>	<b>Publication Date</b>	
09370145 Rev.9	A	January 2018	

### **Scope**

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900F by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

### **General Instructions:**

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM.

Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files.

The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer.

Update the PM sticker and instrument logbook as required.

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## Component List

Component / Specific Model	Serial #	Configuration Notes

## Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	1
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	2
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	2

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	25-20CUY1	30-Jan-2022

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO <sub>3</sub>	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	5503530856
N1013002	1.0A Neutral density filter	1	5503555491
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	021913-020070
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190



# Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

## 1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

## 2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

## 3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas lines for leaks and/or wear. Replace if needed.
- ☒ Clean exterior of the instrument.
- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C<sub>2</sub>H<sub>2</sub> and N<sub>2</sub>O-C<sub>2</sub>H<sub>2</sub> flames (if applicable).

## 4. Electrical:

- ☒ Inspect PC boards. Clean if necessary.
- ☒ Carefully check all internal and external cable connections.
- ☒ Check instrument firmware revisions upgrade to current levels (if necessary)
- ☒ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

## 5. Optics:

- ☒ Inspect and clean the sample compartment windows, if needed.
- ☒ Inspect optics. Clean or replace if necessary,

## 6. Gasses:

- ☒ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SDB.
- ☒ Verify that the acetylene filter and air filter element is dry. Replace if necessary.

## 7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

## 8. After PM Performance tests:

### 8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.9766	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.1989	Passed

### 8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0015	Passed

### 8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0002	Passed



#### 8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0079	Passed

#### 8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0004	Passed

#### 8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0011	Passed

#### 8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3221	Passed

#### 10. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

## Additional Comments

### Additional Comments Regarding the PM

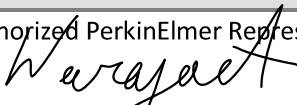
## Review

*The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.*

*This PinAAcle 900F Passes ☒ Fails ☐ the preventive maintenance.*

### Review of Preventive Maintenance:

Authorized PerkinElmer Representative:



Date:

03-Sep-2021

(DD-MMM-YYYY)

Authorized Customer Representative:

Date:

(DD-MMM-YYYY)





**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 FAX. 0-2719-9484

**Cert.No.:** 23TW41

**Page.:** 1 of 2

## **Certificate of Testing**

<b>Equipment :</b>	DO Meter
<b>Manufacturer :</b>	Hanna
<b>Model :</b>	HI98193
<b>Serial No. :</b>	03030056991
<b>ID No. :</b>	LB-Eq-014
<b>Received Date :</b>	16 February 2023
<b>Test Date :</b>	17 February 2023
<b>Reference :</b>	2302-0616WN-1
<b>Submitted by :</b>	Special Lab Envi And Consultant Co.,Ltd 47/91 Moo 3 Thambon Tha-it, Pakkret, Nonthaburi 11120
<b>Laboratory Condition :</b>	Temperature ( $25 \pm 5$ ) °C Humidity ( $50 \pm 20$ ) %
<b>Test Procedure :</b>	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
<b>Tested by :</b>	Walalak Sirithean

**Approved by :**

*Malee*

Approved Signatory

- ( ☒ ) Malee Butkruea  
( ☐ ) Saithip Meangmai  
( ☐ ) Warakorn Lergagtrakul

**Issue Date :** 20 February 2023

**B 0307483**





Cert.No.: 23TW41

Page.: 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

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

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: KC1N20CDJ

<b>Titration Method (Azide Modification Method)</b> (mg/L)	<b>DO Meter Reading</b> (mg/L)	<b>Standard Deviation</b> (mg/L)
8.12	8.13	0.0045

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*Malu*

**a 1148751**