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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

## Certificate of Calibration

Certificate No. : 67-400217-1

Page : 1 of 2

Submitted by : Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120Equipment : Temperature controlled enclosure(Incubator)  
Manufacturer : Lovibond Model : FKU 1800  
Range : N/A °C Resolution : 0.1 °C  
Serial No. : 0925481-19 ID No. : LB-Eq-005Environment : On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.  
Ambient Temperature : (24.0 to 25.0) °C  
Relative Humidity : (50 to 55) %  
Line Voltage : (226.0 to 226.5) V

Date of Received : 20 April 2024

Date of Calibration : 20 April 2024

Date of Issue : 26 April 2024

Calibrated by : Kittisak Kokaco

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 ProbeID No. Cert. No. Due Date Traceability  
400046 & 400047 67-400047-2 26 Jul 2024 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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CAL-F0031-03

## Certificate of Calibration

Certificate No. : 67-400217-1

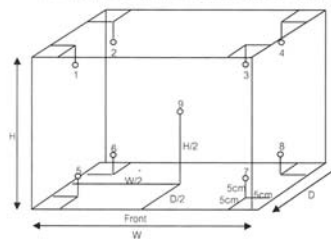
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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

Inside of Chamber  
W = 0.55 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	
30.0	30.0	30.0	30.09	30.21	30.18	30.17	30.52	30.49	30.13	30.32	30.13	0.31
35.0	35.0	35.0	34.95	35.17	35.13	35.14	35.62	35.67	35.04	35.40	35.19	0.32
37.0	37.0	37.0	36.94	37.16	37.13	37.11	37.60	37.64	37.02	37.37	37.16	0.33

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
30.0	30.0	30.0	0.42	0.03	0.46
35.0	35.0	35.0	0.50	0.04	0.77
37.0	37.0	37.0	0.51	0.06	0.79

Remark The uncertainty is not combine uniformity of the air chamber

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

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

- o0o -

CAL-F0031-03

## Certificate of Calibration

Certificate No. : 67-400217-2

Page : 1 of 2

Submitted by : Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120Equipment : Temperature controlled enclosure(Incubator)  
Manufacturer : Lovibond Model : FKU 1800  
Range : N/A °C Resolution : 0.1 °C  
Serial No. : 0914643-01 ID No. : LB-Eq-004Environment : On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.  
Ambient Temperature : (26.0 to 27.0) °C  
Relative Humidity : (45 to 50) %  
Line Voltage : (226.0 to 226.5) V

Date of Received : 20 April 2024

Date of Calibration : 20 April 2024

Date of Issue : 26 April 2024

Calibrated by : Kittisak Kokaco

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 ProbeID No. Cert. No. Due Date Traceability  
400046 & 400042 67-400047-1 25 Jul 2024 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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CAL-F0031-03

## Certificate of Calibration

Certificate No. : 67-400217-2

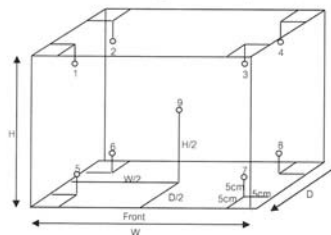
Page : 2 of 2

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	20.27	20.24	20.07	20.06	20.15	20.14	20.21	20.03	20.12	0.44

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	19.9	19.9	0.24	0.20	0.54

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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CAL-F0031-03

## Certificate of Calibration

Certificate No. : 67-200136-1

Page : 1 of 2

Submitted by : Special Lab Envi and Consultant Co., Ltd.  
47/91-93 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120Equipment : Electronic Balance  
Manufacturer : AND Model : GR-200  
Serial No. : 14245322 ID No. : LB-Eq-016  
Capacity : 210 g Resolution : 0.0001 gEnvironment : On site calibration was carried out at the Laboratory,  
Special Lab Envi and Consultant Co., Ltd.  
Ambient Temperature : (27.3 to 27.7) °C  
Relative Humidity : (42.5 to 44.0) %  
Air Pressure : 1006.0 mbar

Date of Received : 20 April 2024

Date of Calibration : 20 April 2024

Date of Issue : 24 April 2024


Calibrated by : Akaradath Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14  
Edition 7 - November 2022

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02232088	08 Nov 2024	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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CAL-F0011-03

## Certificate of Calibration

Certificate No. : 67-200136-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.001	0.0000	0.00012
0.01	0.0000	0.00012
0.1	0.0000	0.00012
0.5	0.0000	0.00013
2	0.0000	0.00013
5	-0.0001	0.00013
10	0.0000	0.00013
50	0.0000	0.00015
100	0.0000	0.00020
200	0.0001	0.00038

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 = 2.06 ,  
providing a level of confidence of approximately 95%Eccentric error Load test : 50 g  
A B C D E  
-0.0003 0.0000 0.0006 -0.0001 0.0000 gRepeatability Load test : 200 g  
Stdev. : 0.00005 g

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
CAL-F0011-03

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. 0-2719-9484Cert.No.: 24TW29  
Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : Hanna  
Model : HI98193  
Serial No. : 03030056991  
ID No. : LB-Eq-014  
Received Date : 05 February 2024  
Test Date : 06 February 2024  
Reference : 2402-0129WN-1  
Submitted by : Special Lab Envi And Consultant Co.,Ltd  
47/91-93, 96 Moo 3, Thambon Tha-It,  
Pakkret, Nonthaburi 11120  
Laboratory Condition : Temperature ( 25 ± 5 ) °C  
Humidity ( 50 ± 20 ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirinthean

Approved by :   
Approved Signatory(✓) Sathip Meangmai  
( ) Warakorn Lemgagatrakul  
( ) Ponpan Paipim

Issue Date : 7 February 2024

B 0333618

Cert.No.: 24TW29  
Page.: 2 of 2

## Condition of this result of calibration

## 1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1. Burette	-	130BU10	23CG1172	22 Mar 2025
2. Balance	1124013382	140RC006	23MM18	20 Feb 2024

## 2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %  
Dissolved Oxygen Probe No.: KC1N20CDJ

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.18	8.18	0.0084

This report was certified only for the instrument we tested. It is allowable to use for study  
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced  
other in full, without written approval of the laboratory

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

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E-mail: bkk@becthai.com Website: www.becthai.com



Page : 1 of 3

Certificate No. : CAL-24-099

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  
Date of Receipt : 30 April 2024  
Date of Calibration : 2 May 2024  
Date of Issue : 2 May 2024  
Ambient Temperature : (25±10) °C  
Relative Humidity : (60±20) %  
Condition As-Received : Used Item

Calibrated by

Ms. Bussayamas Noppakhun

Calibration Engineer

Approved by

( Ms. Jintana Sangthajaroenlap )

Calibration Manager

The reported expanded uncertainty of measurement was based on a combined standard uncertainty multiplied by a coverage factor k 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.

ISSUE: 6 REV:5

FM-CAL-33/2

20/02/24



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

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E-mail: bkk@becthai.com Website: www.becthai.com



Page : 2 of 3

Certificate No. : CAL-24-099

CALIBRATION REPORT

Conditions of this result of calibration

1. Reference Standard Material :

Material	Model	Serial No.	Cert.No.	Due date
Holmium Glass Filter	RM-HG	12705	117342	13 December 2025
Neutral Density Filter	RM-1N2N3N	8323	117341	13 December 2025

2. Traceability : This certification is traceable to the International System of Unit maintained at :  
The Sarna 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 :	8	nm
Data Interval :	1	nm
Scan Speed :	N/A	nm/min

ISSUE: 6 REV:5

FM-CAL-33/2

20/02/24



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

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E-mail: bkk@becthai.com Website: www.becthai.com



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Certificate No. : CAL-24-099

CALIBRATION REPORT

Wavelength Calibration

Certified Values of Reference Material	Nominal Value (nm)	UUC*Reading (nm)	Error (nm)	Uncertainty of Measurement (± nm)	k Factor
418.40	418	418	-0.40	0.59	2.00
537.00	537	537	0.00	0.59	2.00
638.00	638	639	1.00	0.59	2.00

Photometric Calibration for Visible

Wavelength (nm)	Certified Values of Reference Material (A)	UUC* Reading (A)	Error (A)	Uncertainty of Measurement (± A)	k Factor
420.0	Zero	0.000	0.0000	0.0028	2.00
	0.5703	0.573	0.0027	0.0045	2.00
	0.7336	0.734	0.0004	0.0045	2.00
	1.0709	1.075	0.0041	0.0045	2.00
440.0	Zero	0.000	0.0000	0.0028	2.00
	0.5592	0.557	-0.0022	0.0045	2.00
	0.7116	0.717	0.0010	0.0045	2.00
	1.0454	1.044	-0.0014	0.0045	2.00
465.0	Zero	0.000	0.0000	0.0028	2.00
	0.5094	0.511	0.0016	0.0045	2.00
	0.6601	0.664	0.0039	0.0045	2.00
	0.963	0.966	0.0030	0.0045	2.00
546.1 (546.0)	Zero	0.000	0.0000	0.0028	2.00
	0.5206	0.523	0.0024	0.0045	2.00
	0.6677	0.665	-0.0027	0.0045	2.00
	0.9763	0.979	0.0027	0.0045	2.00
590.0	Zero	0.000	0.0000	0.0028	2.00
	0.5522	0.555	0.0028	0.0045	2.00
	0.6966	0.699	0.0024	0.0045	2.00
	1.0201	1.022	0.0019	0.0045	2.00
635.0	Zero	0.000	0.0000	0.0028	2.00
	0.5377	0.538	0.0003	0.0045	2.00
	0.6649	0.667	0.0021	0.0045	2.00
	0.9736	0.977	0.0034	0.0045	2.00

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 -

ISSUE: 6 REV:5

FM-CAL-33/2

20/02/24

CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhaphrasang 3 Rd., Bangwood, Pakkred, Nonthaburi 11120  
Tel:(02) 964-6211 Fax:(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



Certificate of Calibration

Certificate No. : 67-300222-6

Page : 1 of 2

Submitted by

Special Lab Envi and Consultant Co., Ltd.  
47/91-93 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120

Equipment

Burette  
Manufacturer : Witeg Class : A  
Capacity : 25 ml Graduation : 0.05 ml  
ID No. : LB-Gw-001

Environment

Ambient Temperature : ( 20 ± 3 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Air Pressure : 1002.7 mbar.

Date of Received : 20 April 2024

Date of Calibration : 27 April 2024

Date of Issue : 27 April 2024

Calibrated by : Wipa Tovadee

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22

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

Electronic Balance

ID No.	Cert. No.	Due Date	Traceability
241003	66-200388-2	02 Jun 2024	National Institute of Metrology (Thailand) (NIMT)

Approved by :

( Wipa Tovadee )

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F9031-03



## Certificate of Calibration

Certificate No. : 67-300222-6

Page : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at 20 °C

UUC Condition As-Received : Good

Delivery Time : 40.01 sec.

Nominal Volume ( ml )	Measuring Volume ( ml )
10	10.0029
20	20.0018
25	25.0167

Uncertainty of measurement with in  $\pm$  0.0066 ml

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  $k = 2.00$ , providing a level of confidence of approximately 95%

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CAL-F0031-03

## CALIBRATION CERTIFICATE

Date of Issue Jun 21, 2024

Cert No. 24/2294

Site Calibration

Order No. 24060309

Customer SPECIAL LAB ENVI AND CONSULTANT CO., LTD.  
47/91 Moo 3, Tha-It, Pakkert, Nonthaburi 11120

Place of Calibration Laboratory Room

Description Oven

Model UF30

Serial No. B123.0544

ID.No. LB-Eq-047

Date of Receipt Jun 19, 2024

Date of Calibration Jun 19, 2024

Environment

Temperature (Min) 29.2 °C (Max) 33.1 °C

Relative Humidity (Min) 40.6 %RH (Max) 49.7 %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. MY59002130, Certificate No. QR24-0873, Calibrated by Quality Reborn Co., Ltd., ONAC Calibration No. 0292. Due Date Apr 18, 2025.

This certificate is traceable to SI unit.

Page 1 of 4

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

## CALIBRATION CERTIFICATE

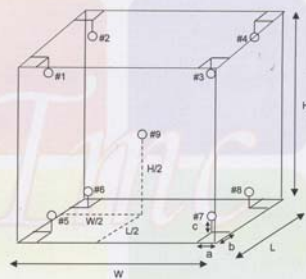
Date of Issue Jun 21, 2024

Cert No. 24/2294

Site Calibration

Order No. 24060309

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.

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## CALIBRATION CERTIFICATE

Date of Issue Jun 21, 2024

Cert No. 24/2294

Site Calibration

Order No. 24060309

Results (without adjustment)

Cal Point (°C)	UUC Setting (°C)	UUC Reading (°C)	Reference Thermometer (°C)	Stability $\pm$ (°C)	Uniformity (°C)	Uncertainty $\pm$ (°C)
104.0	104.0	104.0	Position 1	104.402	0.079	0.35
			Position 2	103.716		
			Position 3	103.784		
			Position 4	103.652		
			Position 5	104.005		
			Position 6	103.668		
			Position 7	103.555		
			Position 8	103.750		
			Position 9	103.743		

Cal Point (°C)	UUC Setting (°C)	UUC Reading (°C)	Reference Thermometer (°C)	Stability $\pm$ (°C)	Uniformity (°C)	Uncertainty $\pm$ (°C)
150.0	150.0	150.0	Position 1	151.015	0.115	0.44
			Position 2	149.798		
			Position 3	149.866		
			Position 4	149.624		
			Position 5	150.425		
			Position 6	149.715		
			Position 7	149.490		
			Position 8	150.027		
			Position 9	149.857		

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## CALIBRATION CERTIFICATE

Date of Issue Jun 21, 2024

Cert No. 24/2294

Site Calibration

Order No. 24060309

Results (without adjustment)

Cal Point (°C)	UUC Setting (°C)	UUC Reading (°C)	Reference Thermometer (°C)	Stability $\pm$ (°C)	Uniformity (°C)	Uncertainty $\pm$ (°C)
180.0	180.0	180.0	Position 1	0.102	1.491	0.49
			Position 2			
			Position 3			
			Position 4			
			Position 5			
			Position 6			
			Position 7			
			Position 8			
			Position 9			

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

