

ภาคผนวก ข

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

Certificate of Calibration

Certificate No. : 63-400281-1

Page : 1 of 2

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

Equipment : Digital Thermometer with TC probe
Temperature Indicator
Manufacturer : Thermo Scientific Model : TEMP 10K
Range : -250 °C to 1372 °C Resolution : 0.1 °C
Serial No. : 4008958 ID No. : SL-38

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Received : 30 May 2020

Date of Calibration : 04 June 2020

Date of Issue : 04 June 2020

Calibrated by : Bunjerd Masri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003
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-0016-20	04 Mar 2022	National Institute of Metrology Thailand (NIMT)
400016	TT-0058-19	07 May 2021	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	19E134	06 Jun 2021	National Institute of Metrology Thailand (NIMT)
400004	19E134	06 Jun 2021	National Institute of Metrology Thailand (NIMT)

Approved by :



(Surachai Promthong)
Laboratory Manager

Certificate of Calibration

Certificate No. : 63-400281-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement with Thermocouple probe Type K

Model : Type K Sheath Material : Teflon
Diameter : 2 mm. Length : 1500 mm.
Serial No. : N/A ID No. : SL-39

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	4.0024	4.6	-0.6	0.18
130	104.0005	104.2	-0.2	0.45
130	150.0033	150.0	0.0	0.58
130	180.0009	179.8	0.2	0.65

Model : AD-1218-230 Sheath Material : Stainless
Diameter : 3.5 mm. Length : 230 mm.
Serial No. : N/A ID No. : SL-40

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
124	250.0027	250.3	-0.3	1.2
124	380.0030	379.0	1.0	1.5

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. : 62-400577-1

Page : 1 of 2

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

Equipment : Digital Thermometer with TC probe
Temperature Indicator
Manufacturer : Thermo Scientific Model : TEMP 10K
Range : -250 °C to 1372 °C Resolution : 0.1 °C
Serial No. : 4008958 ID No. : SL-38

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Calibration : 07 December 2019

Date of Issue : 09 December 2019

Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003
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
400016	TT-0058-19	07 May 2021	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	19E134	06 Jun 2021	National Institute of Metrology Thailand (NIMT)
400004	19E134	06 Jun 2021	National Institute of Metrology Thailand (NIMT)

Approved by :

(Surachai Promthong)

Laboratory Manager

Certificate of Calibration

Certificate No. : 62-400577-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Model : Type K Sheath Material : Teflon
Diameter : 2 mm. Length : 1500 mm.
Serial No. : N/A ID No. : SL-39

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	150.0005	150.1	-0.1	0.58

Temperature measurement

Model : AD-1218-230 Sheath Material : Stainless
Diameter : 3.5 mm. Length : 230 mm.
Serial No. : N/A ID No. : SL-40

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
124	380.0026	379.2	0.8	1.6

Remark

UUC : Unit Under Calibration

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. : 63-200136-1

Page : 1 of 2

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

Equipment : Electronic Balance
Manufacturer : AND Model : GR-200
Serial No. : 14245322
Capacity : 210 g Resolution : 0.0001 g

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

Ambient Temperature : (27.0 to 27.4) °C
Relative Humidity : (51.1 to 53.0) %
Air Pressure : 1011.0 mbar

Date of Received : 04 May 2020

Date of Calibration : 04 May 2020

Date of Issue : 15 May 2020

Calibrated by : Akaradath Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 5, July 2015

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02192873	14 Nov 2020	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. : 63-200136-1

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 \pm (g)
0.001	0.0001	0.00011
0.01	0.0001	0.00011
0.1	0.0001	0.00011
0.5	-0.0001	0.00011
2	0.0000	0.00011
5	-0.0001	0.00012
10	0.0000	0.00012
50	0.0000	0.00014
100	0.0000	0.00020
200	-0.0001	0.00038

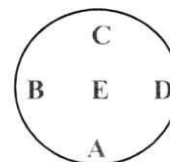
This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.11$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

A B C D E
-0.0005 0.0001 0.0004 -0.0002 0.0000 g



Repeatability

Load test : 200 g

Stdev. : 0.00005 g

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Certificate of Calibration

Certificate No. : 63-400218-3

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. : N/A

Environment : On site calibration was carried out at the Laboratory,
Special Lab Envi and Consultant Co., Ltd.
Ambient Temperature : (27.4 to 28.0) °C
Relative Humidity : (45 to 55) %
Line Voltage : (226.0 to 226.5) V

Date of Received : 04 May 2020

Date of Calibration : 04 May 2020

Date of Issue : 04 May 2020

Calibrated by : Bunjerd Masri

Calibration Method : CAL-M4004, TLAS G-20
The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400022 & 400028	63-400107-1	29 Aug 2020	National Institute of Metrology Thailand (NIMT)

Approved by :



(Bunjerd Masri)

Supervisor

Certificate of Calibration

Certificate No. : 63-400218-3

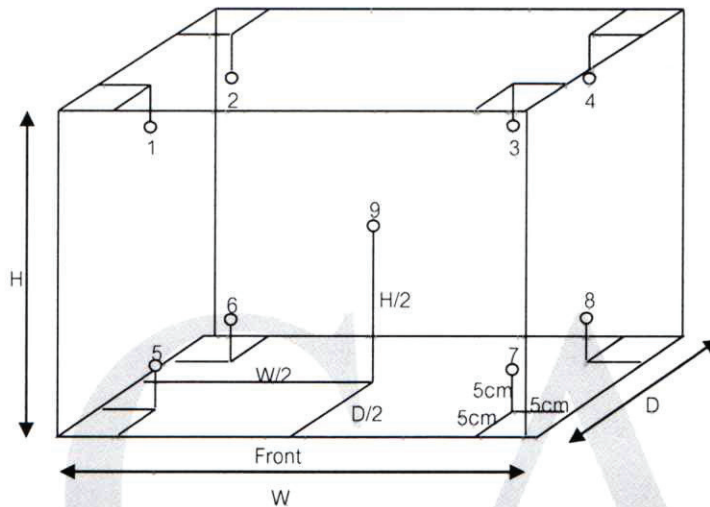
Page : 2 of 2

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 m³

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Temperature (° C) @ Sensor No.									Uncertainty (± ° C)
			1	2	3	4	5	6	7	8	9	
20.0	20.0	20.0	20.0	19.8	20.0	20.0	20.0	19.9	20.2	20.2	20.1	0.77

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Uniformity (° C)	Measured Stability (° C)	Overall Variation (° C)
20.0	20.0	20.0	0.5	0.5	1.3

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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MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwaek Rd. Bangpai Bangkae Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 http://www.mit.in.th



CALIBRATION CERTIFICATE

Certificate No. : AD2006-146-0001

Date Issued : 15-Jun-20

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

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UN30

Serial No. : B120.0284

ID No./Tag No. : -

Date Received : 12-Jun-20

Date Calibrated : 13-Jun-20

Calibrated by : Mr. Surat Aumarb

Calibration Method or Calibration Procedure Used

Standard method : CP-05 TLAS G-20.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

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Approved by :

(Mr. Tassanai Suksukon)
Technical Manager



Page 1 of 2

Certificate No. : AD2006-146-0001

Environment : Ambient Temperature : $(25 \pm 2)^{\circ}\text{C}$
Relative Humidity : $(50 \pm 15)\%\text{RH}$

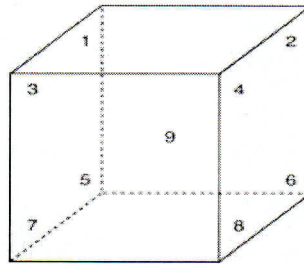
Calibration Temperature ($^{\circ}\text{C}$)	Setting Temperature ($^{\circ}\text{C}$)	Indicating Temperature ($^{\circ}\text{C}$)	Measured Stability ¹ ($^{\circ}\text{C}$)	Measured Uniformity ² ($^{\circ}\text{C}$)	Overall Variation ³ ($^{\circ}\text{C}$)
104	104.0	104.0	0.18	0.42	0.92
150	150.0	150.0	0.35	0.45	1.11
180	180.0	180.0	0.44	0.47	0.88

Without adjustment

Calibration Temperature ($^{\circ}\text{C}$)	STD No. 1 ($^{\circ}\text{C}$)	STD No. 2 ($^{\circ}\text{C}$)	STD No. 3 ($^{\circ}\text{C}$)	STD No. 4 ($^{\circ}\text{C}$)	STD No. 5 ($^{\circ}\text{C}$)	STD No. 6 ($^{\circ}\text{C}$)	STD No. 7 ($^{\circ}\text{C}$)	STD No. 8 ($^{\circ}\text{C}$)	STD No. 9 ($^{\circ}\text{C}$)	Uncertainty ⁴ $\pm^{\circ}\text{C}$
104	104.32	104.12	103.80	104.33	103.98	103.93	104.01	104.42	104.13	0.95
150	149.93	149.62	149.49	149.80	149.63	149.41	149.48	149.91	149.71	1.0
180	179.45	179.35	179.45	179.18	179.42	179.44	179.32	179.32	179.35	1.1

Note : Probe No. 9 is Reference Probe

Setting Air Fresh No. 0



Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. L2002-197 for Digital Thermometer with Probe (Agilent) Module 2 (08) TC Serial No. MY44000197,
Due 26-Sep-20

Notes : 1. The temperature stability is the one-half of greatest maximum difference of measured temperatures at any one probe.

2. The temperature uniformity is the maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time.

3. Overall variation is the difference of maximum and minimum measured temperatures throughout observation time.

4. The uncertainty of measurement is included temperature stability.

5. The temperature uniformity, stability, overall variation and indicating temperature is applicable to all air or gas filled temperature controlled enclosures at atmospheric pressure.

End of Certificate

Page 2 of 2



Certificate of Calibration

Certificate No. : 20T1897

Page : 1 of 2

Equipment : pH Meter With Sensor

Manufacturer: Eutech

Model : pH 700

Serial No.: 2858459

ID No.: SL-33

Condition As-Received: Used Item

Received Date: 25 August 2020

Calibration Date: 27 August 2020
to 28 August 2020

Reference: 2008-0964WN

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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

Submitted by: Special Lab Envi And Consultant Co.,Ltd

47/91 Moo 3 Thambon Tha-it, Pakkret Nonthaburi 11120

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with
Platinum Resistance Thermometer (PRT) into liquid bath temperature controller.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Digital Thermometer	1529	A66176	1911397	01 Nov 2020
2) Platinum Resistanc Temperature	162 P	3683	1911397	01 Nov 2020

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Theerapong Ameen

Issue Date : 01 September 2020

Approved Signatory : _____

[] Phalinee Prabpaipal

[✓] Chatchawan Khunpiluek

[] Wanlop Larpkurn



Cert. No.: 20T1897

Page.: 2 of 2

Result of Calibration:-

Without Adjustment

Function:

Temperature measurement

This equipment was connected with Temperature Sensor ID No. SL-33/1

Dimension of probe : Diameter 3.5 mm., Length 115 mm. Sheath material : Stainless Steel

Immersion	Standard	UUC*		Uncertainty
<u>Depth</u>	<u>Temperature</u>	<u>Reading</u>	<u>Error</u>	<u>of Measurement</u>
(mm.)	(°C)	(°C)	(°C)	(±°C)
100	25.0097	25.0	-0.0097	0.12

UUC* : Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 20CH1254

Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Eutech
Model : pH 700
Serial No. : 2858459
ID No. : SL-33
Condition As-Received: Used Item
Received Date : 25 August 2020
Calibration Date : 26 August 2020
Reference : 2008-0964WN-1
Submitted by : Special Lab Envi And Consultant Co.,Ltd
47/91 Moo 3, Thambon Tha-it,
Pakkret, Nonthaburi 11120
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 : based on direct measurement by
using standard voltage calibrator and
certified reference material (CRM)
Calibrated by : Walalak Sirithean
Approved by : 
Approved Signatory
() Pornthippa Tameyakul
(☒) Malee Butkruea
() Saithip Meangmai
Issue Date : 28 August 2020

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.: 20CH1254

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	753	46530031	130RC098	19E3994	10 Oct 2020

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

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through Merck Ltd.,
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15185-01-00

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.007	Merck	HC99078000	31 May 2022
pH 6.866	Merck	HC99138402	31 May 2022
pH 9.183	Merck	HC99627703	31 May 2021

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

Calibration Results**Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4,7,9)

<u>Unit Under Calibration</u>	<u>Standard pH Buffer Solution</u>	<u>Actual pH Reading</u>	<u>Actual mV Reading (mV)</u>	<u>Uncertainty of pH measurement (±)</u>	<u>Coverage factor k</u>
pH Electrode S/N.: 2863304	4.007	4.01	173.3	0.011	2.00
	6.866	6.86	5.1	0.010	2.00
	9.183	9.18	-129.8	0.045	2.00

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Cert.No.: 20CH1254

Page.: 3 of 3

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: 2858459	0.00	414.12	414	0.02	0.58	2.00
	1.00	354.96	355	1.02	0.58	2.00
	2.00	295.80	296	2.02	0.58	2.00
	3.00	236.64	237	3.01	0.58	2.00
	4.00	177.48	177.4	4.01	0.058	2.00
	5.00	118.32	118.2	5.01	0.11	2.52
	6.00	59.16	59.1	6.00	0.058	2.00
	6.86	8.28	8.2	6.86	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	8.00	-59.16	-59.2	8.00	0.058	2.00
	9.00	-118.32	-118.3	9.01	0.058	2.00
	9.18	-128.97	-129.0	9.19	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00
	11.00	-236.64	-237	11.01	0.58	2.00
	12.00	-295.80	-296	12.02	0.58	2.00
	13.00	-354.96	-355	13.02	0.58	2.00
	14.00	-414.12	-414	14.02	0.58	2.00

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

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Certificate of Calibration

Certificate No. : 63-400218-4

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 (Refrigerator)
Manufacturer : Frozen Model : CC-280C
Range : N/A °C Resolution : 0.1 °C
Serial No. : 2081307016 ID No. : N/A

Environment : On site calibration was carried out at the Laboratory,
Special Lab Envi and Consultant Co., Ltd.
Ambient Temperature : (30.0 to 31.3) °C
Relative Humidity : (50 to 55) %
Line Voltage : (226.0 to 226.5) V

Date of Received : 04 May 2020

Date of Calibration : 04 May 2020

Date of Issue : 04 May 2020

Calibrated by : Bunjerd Masri

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400022 & 400023	63-400104-1	29 Aug 2020	National Institute of Metrology Thailand (NIMT)

Approved by :



(Bunjerd Masri)

Supervisor

Certificate of Calibration

Certificate No. : 63-400218-4

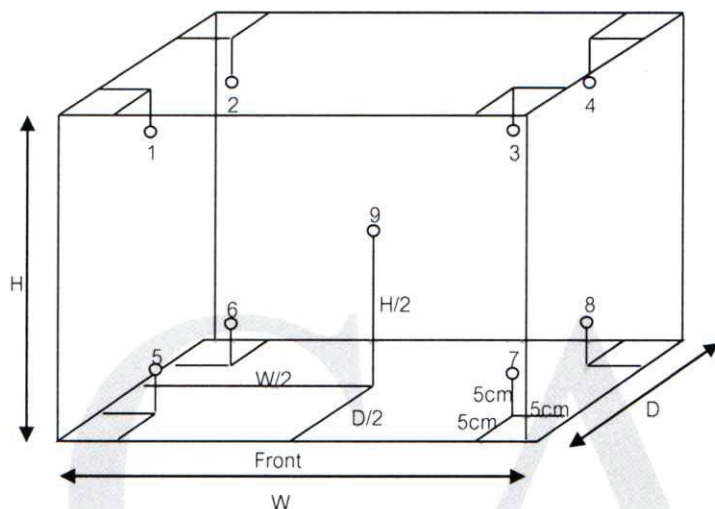
Page : 2 of 2

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 = 1.02 m

D = 0.47 m

H = 1.48 m

Capacity = 0.71 m³

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Temperature (° C) @ Sensor No.									Uncertainty (± ° C)
			1	2	3	4	5	6	7	8	9	
4.0	4.0	4.0	3.9	4.3	3.7	3.6	4.2	4.6	3.6	3.5	3.9	0.63

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Uniformity (° C)	Measured Stability (° C)	Overall Variation (° C)
4.0	4.0	4.0	0.8	0.3	1.5

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 No. : CAL-20-293

Page : 1 of 3

CERTIFICATE OF CALIBRATION

Equipment	:	Spectrophotometer
Manufacturer	:	Thermo Scientific
Model	:	Genesys 20
Serial No.	:	3SGT041007
ID No.	:	SL-34
Customer	:	Special Lab Envi And Consultant Co.,Ltd.
	:	47/91 Moo 3, Tambol Tait , Amphur Pakrad,
	:	Nonthaburi, 11120.
Location	:	Becthai Laboratory
Date of Receipt	:	15 May 2020
Date of Calibration	:	15 May 2020
Date of Issue	:	15 May 2020
Ambient Temperature	:	(25±10) °C
Relative Humidity	:	(60±20) %
Condition As-Received	:	Used Item

Calibrated by

(Ms. Alisa Lamor)

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 $k=2.00$, 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.



Certificate No. : CAL-20-293

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	81255	16 Jan 22
Neutral Density Filter	RM-1N2N3N	8323	81257	16 Jan 22

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 the Guide to CPM-CAL-02 based on ASTM E275-08 (2013) 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



Certificate No. : CAL-20-293

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	639	1.00	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
	0.5717	0.575	0.0033	0.0033
	0.7341	0.736	0.0019	0.0036
	1.0726	1.077	0.0044	0.0032
440.0	Zero	0.000	0.0000	0.0028
	0.5611	0.562	0.0009	0.0032
	0.7168	0.716	-0.0008	0.0036
	1.0473	1.046	-0.0013	0.0032
465.0	Zero	0.000	0.0000	0.0028
	0.5114	0.515	0.0036	0.0032
	0.6610	0.664	0.0030	0.0035
	0.9651	0.968	0.0029	0.0032
546.1 (546.0)	Zero	0.000	0.0000	0.0028
	0.5233	0.522	-0.0013	0.0034
	0.6693	0.667	-0.0023	0.0032
	0.9796	0.977	-0.0026	0.0031
590.0	Zero	0.000	0.0000	0.0028
	0.5553	0.557	0.0017	0.0033
	0.6987	0.699	0.0003	0.0032
	1.0236	1.023	-0.0006	0.0030
635.0	Zero	0.000	0.0000	0.0028
	0.5411	0.541	-0.0001	0.0033
	0.6673	0.666	-0.0013	0.0032
	0.9771	0.976	-0.0011	0.0031

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. : 63-210407-1

Page : 1 of 2

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

Equipment : Weight
Manufacturer : LS Material : Stainless Steel
Weight size : 1 g
ID No. : 60-210017-1
Assumed density of weight : 7950 kg / m³
Assumed Air density : 1.2 kg / m³

Environment : Ambient Temperature : (20 ± 2) ° C
Relative Humidity : (50 ± 10) %
Air Pressure : 1004.5 mbar

Date of Received : 22 August 2020

Date of Calibration : 27 August 2020

Date of Issue : 27 August 2020

Calibrated by : Chanakan Pongsuwan

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
E2413-E2425	MM-0060-19	27 Mar 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Surachai Promthong)

Laboratory Manager



Certificate of Calibration

Certificate No. : 63-210407-1

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	1 g	none	1 g -0.027 mg	\pm 0.023 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. : 63-210407-2

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. : 60-210017-2

Assumed density of weight : 7950 kg / m³Assumed Air density : 1.2 kg / m³

Environment : Ambient Temperature : (20 ± 2) °C
Relative Humidity : (50 ± 10) %
Air Pressure : 1004.2 mbar

Date of Received : 22 August 2020

Date of Calibration : 27 August 2020

Date of Issue : 27 August 2020

Calibrated by : Chanakan Pongsuwan

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
E2413-E2425	MM-0060-19	27 Mar 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by :



(Surachai Promthong)

Laboratory Manager



Certificate of Calibration

Certificate No. : 63-210407-2

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 -0.20 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. : 63-210407-3

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. : 61-210565-1
Assumed density of weight : 7950 kg / m³
Assumed Air density : 1.2 kg / m³

Environment : Ambient Temperature : (20 ± 2) °C
Relative Humidity : (50 ± 10) %
Air Pressure : 1003.6 mbar

Date of Received : 22 August 2020

Date of Calibration : 27 August 2020

Date of Issue : 27 August 2020

Calibrated by : Chanakan Pongsuwan

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
E2413-E2425	MM-0060-19	27 Mar 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Surachai Promthong)

Laboratory Manager



Certificate of Calibration

Certificate No. : 63-210407-3

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	-0.05 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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