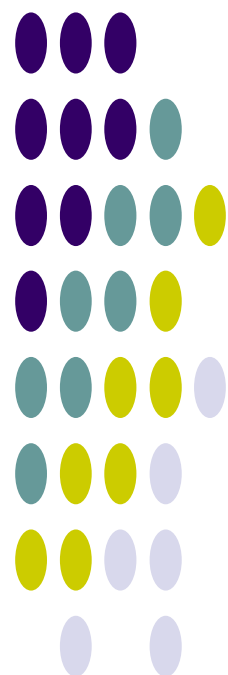


ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือ



ใบรับรองการสอบเทียบ “เครื่องชั่ง”

(Calibration Certificate of Electronic Balance)

Mettler-Toledo (Thailand) Ltd.

846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District

Bangna District, Bangkok 10260

+66 2723 0382

MT-TH.ServiceSupport@mt.com



NSC-TISI-TIS 17025
CALIBRATION 0062

Accuracy Calibration Certificate

Customer

Company: Emex Association Co., Ltd.
Address: 27,29 Soi Rama 2, Soi 30, Rama 2 Road, Bang Mot
City: Chom Thong Contact: Lamai Boonsri
Zip / Postal: 10150
State / Province: Bangkok
Order Number: 
* 0 3 3 2 6 2 3 5 6 3 *

Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: XP105DR Asset Number: N/A
Serial No.: B138280195 Terminal Model: PAT
Building: Office Terminal Serial No.: B138280195
Floor: 4 Terminal Asset No.: N/A
Room: Laboratory 7

Range	Max. Capacity	Readability (d)
1	31 g	0.00001 g
2	120 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)

METTLER TOLEDO Work Instruction: CP/W002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature		Humidity	
As Found	Start: 25.2 °C	End: 25.0 °C	Start: 51.6 %	End: 53.1 %

As Found Calibration Date: 04-Feb-2023
As Left Calibration Date: N/A
Issue Date: 06-Feb-2023

Calibrator: 
Suwicha Choykamchu

Approved Signatory: 
Technical Manager / Head of Calibration Center

Measurement Results

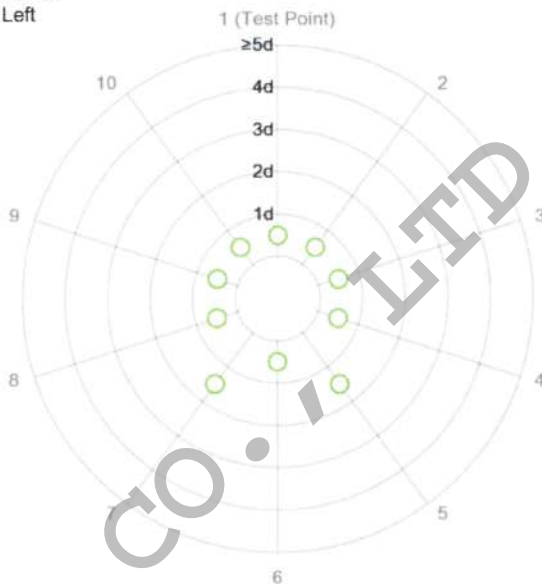
Repeatability

Test Load: 30 g

	As Found	As Left
1	30.00006 g	N/A
2	30.00007 g	N/A
3	30.00006 g	N/A
4	30.00007 g	N/A
5	30.00008 g	N/A
6	30.00006 g	N/A
7	30.00005 g	N/A
8	30.00007 g	N/A
9	30.00006 g	N/A
10	30.00007 g	N/A

Standard Deviation	0.000008 g	N/A
--------------------	------------	-----

○ As Found
◆ As Left



The "d" in the graph represents the readability of the range/interval in which the test was performed.

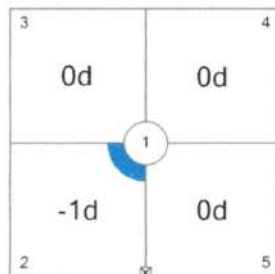
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 50 g

Position	As Found	As Left
1	50.0000 g	N/A
2	49.9999 g	N/A
3	50.0000 g	N/A
4	50.0000 g	N/A
5	50.0000 g	N/A

Maximum Deviation	0.0001 g	N/A
-------------------	----------	-----



As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

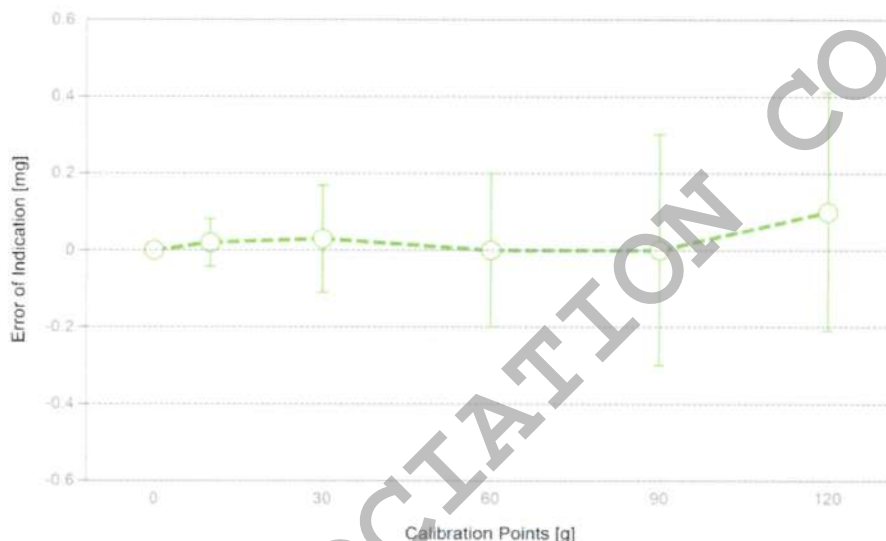
[Handwritten signature]
20.6.6

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.00000 g	0.00000 g	0.00000 g	0.018 mg	2
2	0.01000 g	0.01000 g	0.00000 g	0.020 mg	2
3	0.10001 g	0.10002 g	0.00001 g	0.024 mg	2
4	0.50000 g	0.50001 g	0.00001 g	0.029 mg	2
5	1.00000 g	1.00000 g	0.00000 g	0.033 mg	2
6	5.00000 g	5.00000 g	0.00000 g	0.049 mg	2
7	10.00002 g	10.00004 g	0.00002 g	0.062 mg	2
8	30.00003 g	30.00006 g	0.00003 g	0.14 mg	2
9 ¹	60.0000 g	60.0000 g	0.0000 g	0.20 mg	2
10	90.0000 g	90.0000 g	0.0000 g	0.30 mg	2
11 ¹	119.9999 g	120.0000 g	0.0001 g	0.31 mg	2

¹The calculated uncertainty was replaced by the CMC (Calibration and Measurement Capabilities) value because the calculated uncertainty was smaller than the CMC value.



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95 %.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.:	WS54	Date of Issue:	15-Jun-2022
Certificate Number:	179958	Calibration Due Date:	14-Dec-2023

Thermo Hygrometer

Equipment No.:	IN296	Date of Issue:	28-Oct-2022
Certificate Number:	22H2193	Calibration Due Date:	19-Oct-2023

Remarks

FACT adjustment functionality activated

Equipment condition: Good

Next calibration according to customer's procedure

Calibration data not decide by calibration laboratory

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

EMEX ASSOCIATION CO., LTD.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with $k=2$ in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: $1.0 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: $3 K$

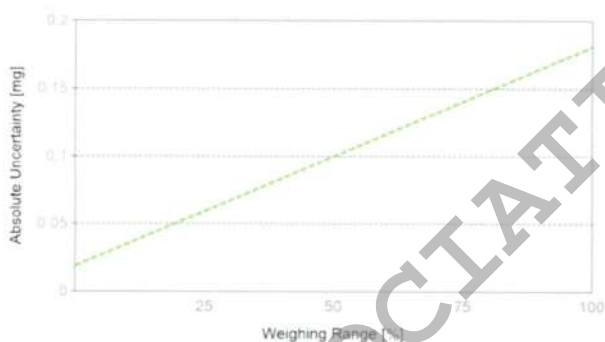
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.00001 g	31 g	$U_1 = 0.019 \text{ mg} + 0.00523 \text{ mg/g} \cdot R$	N/A
2	0.0001 g	120 g	$U_2 = 0.19 \text{ mg} + 0.00572 \text{ mg/g} \cdot (R - 31 \text{ g})$	N/A

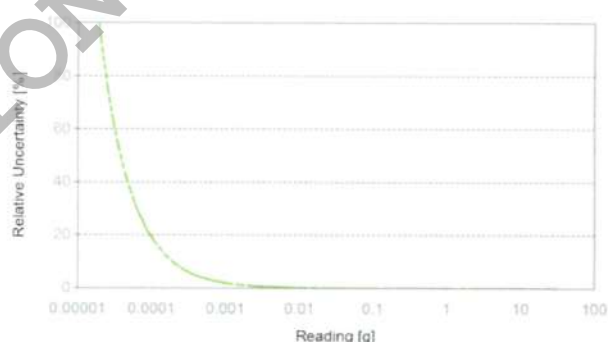
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.00120 g	0.019 mg	1.6%	N/A	N/A
0.01200 g	0.019 mg	0.16%	N/A	N/A
0.12000 g	0.020 mg	0.016%	N/A	N/A
1.20000 g	0.025 mg	0.0021%	N/A	N/A
120.0000 g	0.70 mg	0.00058%	N/A	N/A



As Found



As Left

The weighing range shown in the absolute uncertainty graph refers to the first interval/range of the device.

ใบรับรองการสอบเทียบ “เครื่อง pH Meter”

(Calibration Certificate of pH Meter)



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.: 22CHO509

Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact
Serial No. : B535358167
ID No. : 0403-0102-16
Condition As-Received: Used Item
Received Date : 30 August 2022
Calibration Date : 30 August 2022
Reference : 2208-0862ON-9
Submitted by : Emex Association Co.,Ltd.
27,29 Soirama II, Soi 30,
Bangmod, Jomthong, Bangkok 10150
Calibration Place : ห้องปฏิบัติการ 7
Ambient Temperature : (24.4 - 24.6) °C
Relative Humidity: (50.9 - 51.2) %
Calibration Procedure : In - house method :
- CP-OCH2 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)

Calibrated by : Krisda Malee

Approved by :


Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 9 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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


19 Nov 2022

A 0044963



Cert. No.: 22CHO509

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	21E3245	07 Oct 2022
2) Digital Thermometer	-	130RC113	21T1689	23 Sep 2022

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 2.01	Merck	HC03981033	30 Sep 2023
pH 4.008	CPA chem	823320	20 Jun 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.015	CPA chem	794124	14 Feb 2023

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

Calibration Results**Function : pH Measurement**

Performing four buffers standard curve by using buffer nominal pH (2,4,7,10)

<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.: 2087140	*2.01	2.001	289.7	0.21	2.00
	4.008	4.008	173.3	0.0045	2.00
	6.985	6.986	-1.3	0.0092	2.00
	10.015	10.016	-178.4	0.011	2.00

Remark : * = Not NSC-ONSC Accredited

19 Nov 2022
Maha.



Cert.No.: 22CHO509

Page.: 3 of 3

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (2,4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter S/N.: B535358167	0.000	414.12	413.9	-0.001	0.058	2.00
	1.000	354.96	354.7	0.999	0.058	2.00
	2.000	295.80	295.6	2.000	0.058	2.00
	3.000	236.64	236.5	3.000	0.058	2.00
	4.000	177.48	177.4	4.000	0.058	2.00
	5.000	118.32	118.2	5.000	0.058	2.00
	6.000	59.16	59.1	6.000	0.058	2.00
	7.000	0.00	0.0	7.000	0.058	2.00
	8.000	-59.16	-59.2	8.001	0.058	2.00
	9.000	-118.32	-118.3	9.001	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00
	11.000	-236.64	-236.6	11.001	0.058	2.00
	12.000	-295.80	-295.8	12.001	0.058	2.00
	13.000	-354.96	-354.9	13.000	0.058	2.00
	14.000	-414.12	-414.1	14.000	0.058	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 %.

-o0o-

19.11.2022

Malu.

ใบรับรองการสอบเทียบ “เครื่อง Hot Air Oven”

(Calibration Certificate of Hot Air Oven)



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.: 22TM1279

Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UFB 500

Serial No. : G509.0594

ID No. : 0407-0101-09

Submitted by : Emex Association Co.,Ltd.
27,29 Soi Rama II, Soi 30,
Bangmod, Jomthong,
Bangkok 10150

Location : ห้องปฏิบัติการ 8

Received Order : 30 August 2022

Calibration Date : 30 August 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Khit Ruttanaprapachai

Approved by :

Approved Signatory

- () Pornthippa Tameyakul
(☒) Malee Butkruea
() Suwit Imjai

Issue Date :

6 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0044756



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2208-0862ON-3
Procedure Used :-

Cert. No.: 22TM1279
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

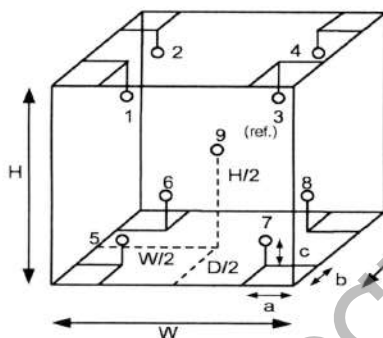
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	29
REL. Humid. (%)	64	67
AC Supply (Volt)	220	221

**Ref. Std. ID No.: @
Calibration Point**

Position :	(104) °C	(150, 180) °C
1	20-16RTD-01	21-16TC-01
2	20-16RTD-02	21-16TC-02
3	20-16RTD-03	21-16TC-03
4	20-16RTD-04	21-16TC-04
5	22-16RTD-05	21-16TC-05
6	20-16RTD-06	21-16TC-06
7	20-16RTD-07	21-16TC-07
8	22-16RTD-08	21-16TC-08
9 (ref.)	22-16RTD-09	21-16TC-09

Probe Installation Details : **Dimension of Chamber :**

a = 5.0 cm	D = 0.40 m
b = 5.0 cm	W = 0.56 m
c = 5.0 cm	H = 0.48 m
	Capacity = 0.11 m ³

Handwritten signature and date: 19.7.23
Malu.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2208-0862ON-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1279

Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
104.0	104.5	104.5	0.059	0.30	0.63	0.42	2
150.0	150.0	150.0	0.11	0.66	1.0	1.1	2
180.0	180.0	180.0	0.12	1.0	1.6	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	104.395	104.210	104.124	104.066	104.286	104.121	104.523	104.000	104.252
150.0	150.005	149.892	149.621	149.609	150.357	149.773	150.470	149.801	149.902
180.0	179.780	179.694	179.351	179.371	180.540	179.815	180.783	179.899	179.878

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

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation

UUC* : Unit Under Calibration

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

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

-o0o-

Handwritten signature and date
19 Nov 2022
Malu

ใบรับรองการสอบเทียบ “เครื่อง Water Bath”

(Calibration Certificate of Water Bath)



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.: 22TM1109

Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath

Manufacturer : M-LAB

Model : WBN 30

Serial No. : 0318

ID No. : 0408-0101-09

Submitted by : Emex Association Co.,Ltd.
27,29 Soirama II, Soi 30,
Bangmod, Jomthong,
Bangkok 10150

Location : ห้องวิเคราะห์เคมี 8

Received Order : 30 August 2022

Calibration Date : 31 August 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :

malu.

Approved Signatory

- () Pornthippa Tameyakul
(☒) Malee Butkruea
() Suwit Imjai

Issue Date :

7 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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

Handwritten signature and date: 19 Nov. 25

A 0043424



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2208-0862ON-1
Procedure Used :-

Cert. No.: 22TM1109
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Data Acquisition	34972A	MY57013823	22LM24	26 Feb 2023

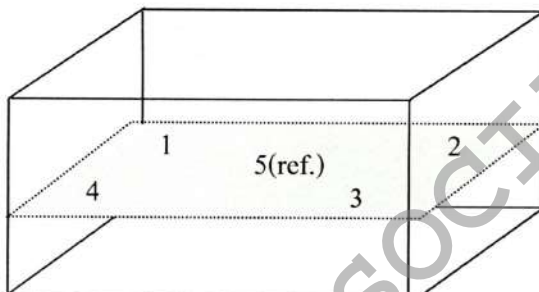
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	27	49	221
Finished of Calibration	26	52	220



Front

Position :	Ref. Std. S/N.:
1	4804539-006
2	4804539-007
3	4804539-008
4	4804539-009
5(ref.)	4804539-010

Handwritten signature and date:
19 Nov. 22
Mahu.



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2208-0862ON-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 22TM1109

Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.994	85.066	85.002	84.966	85.146

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
85.0	0.36	0.12	0.19	2

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

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

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

UUC* : Unit Under Calibration

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

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

-o0o-


19 Nov. 2022
Mahu.

ใบรับรองการสอบเทียบ “เครื่อง Incubator”
(Calibration Certificate of Incubator)



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.: 22TM1282

Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Accuplus
Model : i250
Serial No. : i250402-0609-0265
ID No. : 0410-0101-09
Submitted by : Emex Association Co.,Ltd.
27,29 Soi Rama II, Soi 30,
Bangmod, Jomthong,
Bangkok 10150
Location : ห้องปฏิบัติการ 9
Received Order : 30 August 2022
Calibration Date : 31 August 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Khit Ruttanaprapachai

Approved by :

Approved Signatory

- () Pornthippa Tameyakul
(☒) Malee Butkruea
() Suwit Imjai

Issue Date :

6 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0044758



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2208-0862ON-5

Cert. No.: 22TM1282

Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

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

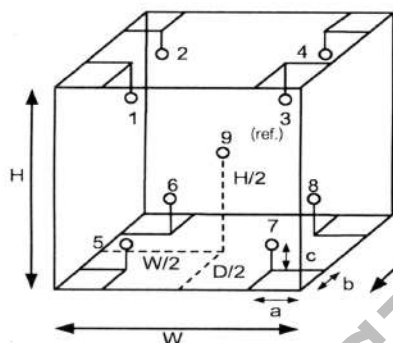
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	24
REL.Humid. (%)	59	62
AC Supply (Volt)	222	222



Position :	Ref. Std. ID No.:
1	20-16RTD-01
2	20-16RTD-02
3	20-16RTD-03
4	20-16RTD-04
5	22-16RTD-05
6	20-16RTD-06
7	20-16RTD-07
8	22-16RTD-08
9 (ref.)	22-16RTD-09

Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.49 m
W = 0.48 m
H = 1.2 m
Capacity = 0.28 m³

Signature
19.7.23
Malu

