

**ภาคผนวก จ**

เอกสารสอบเทียบ



## Certificate of Calibration

**Certificate No. :** 65-400665-1

**Page : 1 of 2**

**Submitted by :** TNP Environment Co., Ltd.

332/173 Moo 3 Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11110

**Equipment :** Air Chamber (Oven)

Manufacturer : Memmert

Model : UF75

Range : N/A °C

Resolution : 0.1 °C

Serial No. : B320.0251

ID No. : N/A

**Environment :** On site calibration was carried out at the Laboratory, TNP Environment Co., Ltd.

Ambient Temperature : (27.0 to 28.0 °C

Relative Humidity : (40 to 45) %

Line Voltage : (228.0 to 230.0) V

**Date of Received :** 26 December 2022

**Date of Calibration :** 26 December 2022

**Date of Issue :** 28 December 2022

**Calibrated by :** Permpon 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 Thermocouple probe

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
400029 & 400030	65-400548-1	26 Apr 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



( Bunjerd Masri )

Supervisor

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. : 65-400665-1**

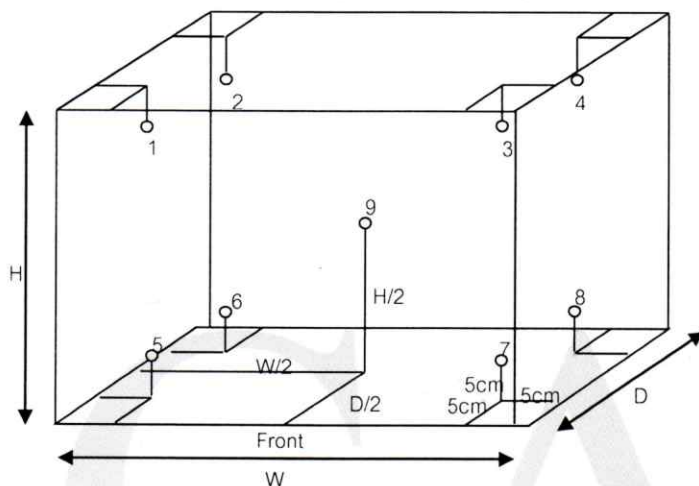
**Page : 2 of 2**

**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 = 0.40 m

D = 0.33 m

H = 0.56 m

Capacity = 0.07 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	
104.0	104.0	104.0	104.2	104.1	104.2	104.0	103.8	103.9	103.9	103.9	104.0	0.69
180.0	180.0	180.0	179.6	179.6	179.7	179.8	180.2	179.5	179.0	179.8	180.5	1.0

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
104.0	104.0	104.0	0.4	0.1	0.7
180.0	180.0	180.0	1.7	0.3	2.0

**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 -

*B*







**MCL**  
Microtech Calibration laboratory



NSC-TISI-TIS 17025  
CALIBRATION 0228

53/154 Moo 2, Semafahkarm Road, Tumbon Khukhot, Amphur Lamlukka, Pathumthani 12130

53/154 หมู่ 2 ถนนเสมาฟ้าคราม ตำบลลูกคต อำเภอลำลูกกา จังหวัดปทุมธานี 12130

Tel. 02-9877200 Fax. 02-9877205

Certificate No. : M22 - 1588A

Page : 1 of 4

# Certificate of Calibration

**Customer** : TNP ENVIRONMENT CO.,LTD.  
**Address** : 332/173 Moo 3 Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11111

**Description of Equipment** : Electronic Balance  
**Manufacturer** : Shimadzu  
**Model** : AP225WD  
**Serial Number** : D316301848  
**ID. / Control Number** : TNP.LAB.30  
**Made In** : Philippines  
**Location** : On - Site  
**Environmental Conditions** : Temperature ( 25 +/- 10 ) °C  
Humidity ( 50 +/- 25 ) % RH  
Atmospheric Pressure ( 1010 +/- 10 ) mbar

**Calibration Date** : APR 18, 2022  
**Issue Date** : APR 20, 2022

## Uncertainty of Measurement

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of  $k = 2$ . It has been evaluated according to the "Expression of the Uncertainty of Measurement in Calibration (M3003)" which provides a level of confidence approximately 95%.

Calibrated by : Sarawut Khrueapan

Approved by : 

( Precha Pavachot )

Laboratory Manager



**Certificate of Calibration**

<b>Description</b> : Electronic Balance	<b>Serial Number</b> : D316301848	<b>Resolution</b> : 0.0001,0.00001 g
<b>Manufacturer</b> : Shimadzu	<b>ID. /Control Number</b> : TNP.LAB.30	<b>Order No.</b> : 1398 - 22
<b>Model</b> : AP225WD	<b>Made In</b> : Philippines	<b>Received Date</b> : APR 18, 2022
<b>Unit</b> : g	<b>Capacity</b> : 220 g	<b>Calibration Date</b> : APR 18, 2022

**Result of Calibration** : Without Adjustment      **Resolution** : 0.0001,0.00001 g  
**Range** : 200 g

**2. Departure From Nominal Value**

Nominal Value g	UUC* Reading g	UUC* Error g	Uncertainty of Measurement +/- g
0	0.00000	0.00000	0.00013
0.1	0.10003	0.00003	0.00013
0.2	0.20002	0.00002	0.00022
0.5	0.50002	0.00002	0.00043
1	1.00002	0.00002	0.00043
2	2.00005	0.00005	0.00043
5	5.00007	0.00007	0.00068
10	10.00006	0.00006	0.00068
20	20.00003	0.00003	0.00068
50	49.99997	-0.00003	0.00068
100	99.99999	-0.00001	0.00068
200	199.9999	-0.0001	0.00068

UUC\* = Unit Under Calibration

**Certificate of Calibration**

<b>Description</b> : Electronic Balance	<b>Serial Number</b> : D316301848	<b>Resolution</b> :
<b>Manufacturer</b> : Shimadzu	<b>ID. /Control Number</b> : TNP.LAB.30	<b>Order No.</b> : 1398 - 22
<b>Model</b> : AP225WD	<b>Made In</b> : Philippines	<b>Received Date</b> : APR 18, 2022
<b>Unit</b> : g	<b>Capacity</b> : 220 g	<b>Calibration Date</b> : APR 18, 2022

**Result of Calibration** : Without Adjustment **Resolution** : 0.0001, 0.00001 g

**Range** : 200 g

**3. Effect of Center Loading**


Nominal Load g	UUC* Reading					Maximum Difference g
	A g	B g	C g	D g	E g	
50	49.99997	49.99997	49.99995	49.99996	49.99996	0.00002

A Mass of 50 g Was Placed to Various Position on The Pan.

The Weighing Machine Reading Error Obtained Is Given In Table

**4. Effect Tare Function**

Nominal Tare Weight g	Standard Weight g		UUC* Reading g	UUC* Error g
	Tare		0.00000	0.00000
	100	at 20 % 20.0000	20.0001	0.0001
	at 100 %	100.0000	100.0002	0.0002

UUC\* = Unit Under Calibration

..... END.....

### Certificate of Calibration

<b>Description</b> : Electronic Balance	<b>Serial Number</b> : D316301848	<b>Resolution</b> : 0.0001,0.00001 g
<b>Manufacturer</b> : Shimadzu	<b>ID. /Control Number</b> : TNP.LAB.30	<b>Order No.</b> : 1398 - 22
<b>Model</b> : AP225WD	<b>Made In</b> : Philippines	<b>Received Date</b> : APR 18, 2022
<b>Unit</b> : g	<b>Capacity</b> : 220 g	<b>Calibration Date</b> : APR 18, 2022

### Calibration Method

The Electronic balance was measured using standard weight following to in house calibration method MCL-CP14 and based on UKAS LAB 14: Edition 5 July 2015

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

### Reference Standard

Description	Model	Serial No.	Certificate No.	Due Date
Standard Weight Set	50 mg - 2 kg	N/A	B0-0805057/20	MAY 09, 2021

### Traceability of Measurement

The measurements are traceable to international system of units (SI)

The certificate is traceable to through Thai Heart Calibration Co.,Ltd.

**Range** : 200 g

**Resolution** : 0.0001,0.00001 g

### 1. Repeatability of Balance

Nominal Value g	Standard Deviation of Reading g
0	0.00000
200	0.0000





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23T238

Page : 1 of 2

Equipment : Liquid-in Glass Thermometer

Manufacturer: SK

Model : -

Serial No.: -

ID No.: TNP.LAB.12

Condition As-Received: Used Item

Received Date: 27 January 2023

Calibration Date: 07 February 2023  
to 10 February 2023

Reference: 2301-0937WN

Submitted by: TNP ENVIRONMENT CO.,LTD

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.

332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong,  
Nonthaburi 11110

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-T02 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) 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	A7A609	22I1274	17 Oct 2023
2) Industrial Platinum Resistance Thermometer	5627-12	571975	22I1274	17 Oct 2023

2. The UUC\* was immersed into liquid bath temperature controller and the top about 12 mm of the liquid column above the bath medium in every calibration points.

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Thammanoon Phuwardkien  
Issue Date : 14 February 2023

Approved Signatory :

[ ] Phalinee Prabpaipal  
[ ] Chatchawan Khunpiluek  
[✓] Wanlop Larpkurn

B 0307331



Cert. No.: 23T238

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:** Temperature measurement.

**Type:** Total Immersion

**Scale Division:** 1 °C

Reference point ( 0 °C ) Error = -0.9681 °C, with Uncertainty of Measurement of  $\pm 0.16$  °C

<b>UUC*</b>	<b>Standard</b>		<b>Uncertainty</b>
<b>Reading</b>	<b>Temperature</b>	<b>Error</b>	<b>of Measurement</b>
( °C )	( °C )	( °C )	( $\pm$ °C )
20	21.4342	-1.4342	0.16
30	31.5544	-1.5544	0.16
40	41.1382	-1.1382	0.16

**Note:** UUC\* : Unit Under Calibration

The UUC\* readings were made under magnification and resolved to one tenth of one scale division.

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%.

-o0o-

**Certificate No. T/O 660071**

**Date of issue : 14-Mar-2023**

**Equipment Description** : Incubator  
**Equipment Model** : SMART i250-DS  
**Equipment Serial No.** : 0410-0121-0003  
**I.D. No. or Control No.** : -  
**Manufacturer** : Entech Industrial Solution Co.,Ltd.  
**Customer Name** : TNP ENVIRONMENT CO.,LTD.  
**Customer Address** : 332/173 Moo 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong,  
Nonthaburi 11110  
**Total pages of certificate** : 2 pages  
**Instrument Receiving Date** : 3-Mar-2023  
**Receiving No.** : O-230081  
**Environmental Conditions** : All of the measurement were carried out in the working area  
Temperature : ( 25 ± 15 ) °C  
Humidity : ( 55 ± 30 ) % RH  
Voltage : ( 220 ± 22 ) VAC  
**Calibration Place** : 332/173 Moo 3 Tambon Bang Rak Phatthana, Amphoe Bang Bua Thong,  
Nonthaburi 11110

**Calibration Procedure No.** : This instrument was calibrated by comparison of reference radiation source standard according to calibration work instration no WI-CL-18-C

*The calibration certificate expended uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k$ , which for a normal distribution corresponds to a coverage probability of approximately 95%*

*The standard uncertainty of measurement has been determined in accordance with M 3003*

*The expression uncertainty and confidence in measurement.*

*This certificate is applied only to item under test environmental condition.*

*This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal are not valid and The results relate only to the items tested/calibrated.*

*This calibration certificate documents are traceability to national standards, which realize the unit of measurement according to the International system of units (SI).*

**Date of Calibration** : 3-Mar-2023



Mr. Kittipong Kaewsai  
Calibration Engineer



Ms. Nongluck Wongsettee  
Technical Manager



**Certificate No. : T/O 660071**

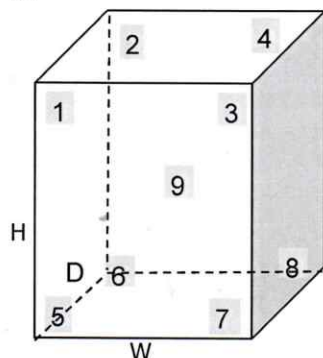
**The Reference Standard Instrument :-**

Instrument	Model	Serial No.	Cert No.	Due date
1) Data logger with RTD Probe	Agilent 34972A	MY49017365	PSL-T 0524-2/65	4-Apr-2023

**Measured room conditions**

<b>Temperature :</b>	Minimum: 21.3 °C	Maximum: 22.8 °C
<b>Humidity :</b>	Minimum: 49.3 %RH	Maximum: 54.7 %RH
<b>Voltage :</b>	Minimum: 220.1 VAC	Maximum: 223.4 VAC
<b>Fresh Air Setting:</b>	off	

**Sensor Position :**



**Working Space of chamber :**

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

**Sensor Installation Details :**

- Sensor Number 1 to 8 installed approximately 50 mm From each wall.
- Sensor Number 9 installed approximately geometric of the chamber.

**Results :** The measurement results of the calibration were reported in the table below.

( \* ) Without adjustment

( ) After adjustment

UUC* Setting	UUC* Reading	Temperature Reading of Standard Sensor								
( °C )	( °C )	Sensor Position								
		1	2	3	4	5	6	7	8	9
20.0	20.0	20.34	20.30	20.14	20.18	20.15	20.02	19.93	19.94	20.02

UUC* Setting	UUC* Reading	Temperature Uniformity	Temperature Stability	Overall Variation	Uncertainty of Measurement	Coverage Factor
( °C )	( °C )	( °C )	( ± °C )	( °C )	( ± °C )	K
20.0	20.0	0.50	0.40	1.00	0.61	2

**UUC\* = Unit Under Calibration**

**Remark :-**

- Temperature reading of Standard Sensors shown in the table were taken from the average of Standard reading at each position.
- Temperature Uniformity was calculated from the difference between the maximum and minimum of actual temperature reading from all reference sensors at the same time.
- Temperature Stability was calculated from the maximum stability of nine positions, and formula of Stability is  $[( \text{Maximum Temperature Value} - \text{Minimum Temperature Value} ) / 2 ]$
- Overall Variation was calculated from the difference between the maximum and minimum measured temperature throughout observation time.

**End of Report**



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23CH126

Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Adwa  
Model : AD 12  
Serial No. : 1328  
ID No. : TNP.LAB.13  
Condition As-Received: Used Item  
Received Date : 27 January 2023  
Calibration Date : 30 January 2023  
Reference : 2301-0937WN-2  
Submitted by : TNP ENVIRONMENT CO.,LTD  
332/173 Moo 3, Bang Rak Phatthana,  
Bang Bua Thong, Nonthaburi 11110  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In - house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement  
with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

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

Issue Date : 31 January 2023

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.

A 0050390



Cert.No.: 23CH126

Page.: 2 of 2

**Condition of this calibration result**

1. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.008	CPA chem	826590	09 July 2023

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

**Calibration Results**

**Function : pH Measurement**

**Performing two buffers standard curve by using buffer nominal pH (4,7)**

<b>Unit Under Calibration</b>	<b>Standard pH Buffer Solution</b>	<b>Actual pH Reading</b>	<b>Actual mV Reading (mV)</b>	<b>Uncertainty of pH Measurement (<math>\pm</math>)</b>	<b>Coverage factor <math>k</math></b>
pH Electrode S/N.: 1328	4.008	4.01	N/A	0.0085	2.05
	6.987	6.99	N/A	0.011	2.00
	10.008	10.02	N/A	0.0095	2.00

- Remark**
- pH meter does not have voltage mode.
  - Can not connect the BNC because the plug does not match with the socket.
  - N/A = Not Available

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-

Malu.





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23M455

Page : 1 of 2

Equipment : Standard Weight Set

Manufacturer: -

Model : Class:F1

Serial No.: 15022021-01

ID No.: TNP.LAB.25

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 04 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1015.25 mbar

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.

332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong,  
Nonthaburi 11110

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23.4 °C material density of weight is 8000 kg/m<sup>3</sup>.

### 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) Standard Weight Set (E2)	73336	20026	MM-0018-22	28 Feb 2024
2) Standard Weight Set (E2)	73338	20028	MM-0019-22	28 Feb 2024

2.This certificate is not certified for any commercial transaction.

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Thapakorn Thammachai

Issue Date : 07 March 2023

Approved Signatory : \_\_\_\_\_

☐ Phalinee Prabpaipal

☒ Sura Suwannasri

☐ Chaowalit Rittirak

B 0309848



Cert No.: 23M455

Page: 2 of 2

**Result of calibration**

Nominal Value	Conventional mass		Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
	Before Adjustment	After Adjustment		
200 g	199.99986 g	-	0.30 mg	1.0 mg
100 g	100.00015 g	-	0.16 mg	0.50 mg
50 g	50.00015 g	-	0.10 mg	0.30 mg
20 g	20.000116 g	-	0.080 mg	0.25 mg
10 g	10.000041 g	-	0.060 mg	0.20 mg
5 g	5.000010 g	-	0.050 mg	0.16 mg
2 g	1.999936 g	-	0.040 mg	0.12 mg
1 g	0.999973 g	-	0.030 mg	0.10 mg
200 mg	200.059 mg	200.007 mg	0.020 mg	0.060 mg
100 mg	100.037 mg	99.981 mg	0.016 mg	0.050 mg

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

-o0o-

a 1151188

# Calibration Certificate

Cert. No. : CT-23-01-23295

Page : 1 of 4

Issued date : 24 January 2023

Equipment : Water Bath , Manufacturer : MLAB , Model : WBN30  
S/N = 0347 , Customer ID = -

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

Received Date : 20 January 2023

Ref. Job No. : SO6601-00020

Calibrated by : Mr.Apiwat Mungsamak

Cert. prepare by : Ms.Nattanicha Panumram

Calibrated Date : 20 January 2023

Approved by : Mr.Montree Ruschasetkul

Calibration Place : ห้องปฏิบัติการ2

Environment Condition : Temperature  $28.5 \pm 2.7$  (°c) , Humidity  $57.5 \pm 14.5$  (%RH)

Calibration Method : In-house method based on ASTM E715-80 (Reapproved 2006) , (MTEC WI No. # WICAL-02-003-R01 )

**Reference Standard Instrument :**

No	Instrument	code	Model	Due date
1	Temperature Data Logger	MTEC-CE-0175	MLAB	10/2023
2	Thermo Hygrometer	MTEC-CE-0183	TP-50	06/2023

**Condition of certificate :**

(1) This certificate is traceable to International System of units (SI Units). , (2) This certificate was certified only for the instrument we calibrated. , (3) This result of calibration was found accurate as show on date and place of calibration only. , (4) The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k =$  (see result table ) , providing a level of confidence of approximately 95%. , (5) This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration Division, Metrology Technical Co.,Ltd.



Approved Signatory

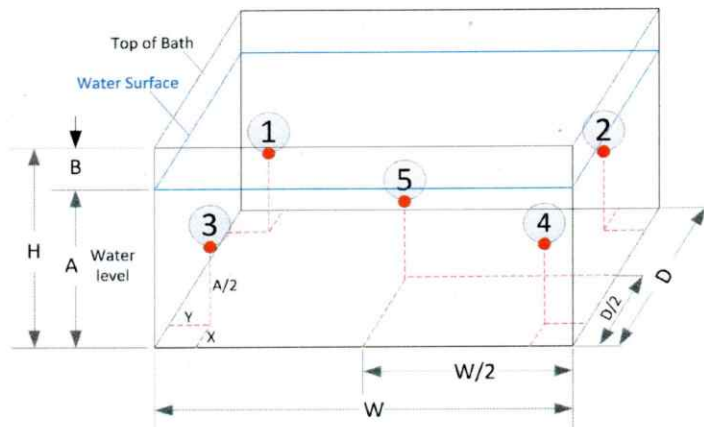


**Calibration Result :**

Page : 2 of 4

Condition of UUC :

- 1) Adjust Condition : Without Adjustment
- 2) Lid Cover : Flat Sheet (Plastic , from
- 3) Circulation : without circulation
- 4) X , Y = 5 cm. , B ~ 3 cm.



Pic 1 : Position of each sensor No.

(1) The quoted uncertainty include with " Stability".

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

(3) Uniformity = The maximum difference of measured temperatures at two any sensor which are observed at the same time.

(4) Overall variation = The difference of the maximum and the minimum measured temperature throughout observation time.

**Section 1 : Report of Temperature distribution**

Unit : ( °C )

Calibration Point	UUC Setting (*)	UUC Reading (*)	Measured Temperature @ Sensor No.					Uncertainty ( ± )	k (**)
			#1	#2	#3	#4	#5		
85	85	85.0	85.30	85.30	84.83	84.76	85.51	0.627	2

(\*) = The average of 30 values in each point , (\*\*) = Coverage factor (k) value

**Section 2 : Report of Chamber Performance**

Unit : ( °C )

Calibration Point	UUC Setting (*)	UUC Reading (*)	Temperature Uniformity	Temperature Stability ( ± °C )	Temperature Overall Variation
85	85	85.0	1.34	0.45	1.64

(\*) = The average of 30 values in each point

Approved Signatory : 

Certificate No. : CT-23-01-23295

Page : 3 of 4

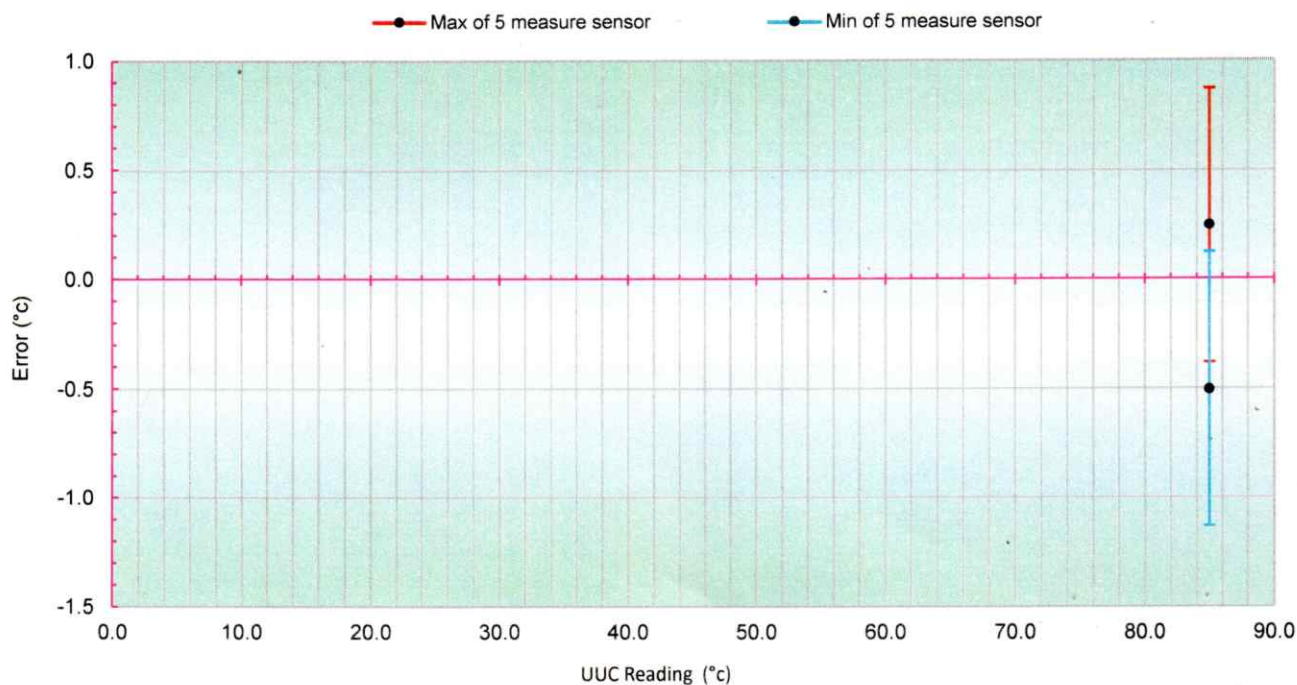
**Section 3 :** Possible of temperature in chamber. Show minimum and maximum of the average values and include with uncertainty of measurement. , The average values is average of each position standard sensor throughout observation time.

Unit : ( °C )

Calibration Point	UUC Setting (*)	UUC Reading (*)	Possible of Minimum temperature in chamber	Possible Maximum temperature in chamber
85	85	85.0	84.13	86.13

(\*) = The average of 30 values in each point

**Section 4 :** Trend of accuracy



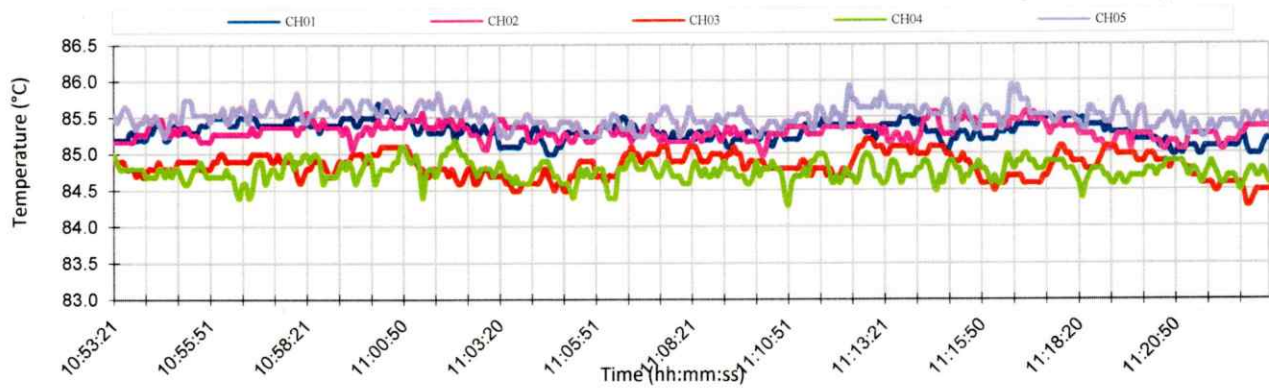
Approved Signatory : 

Certificate No. : CT-23-01-23295

Page : 4 of 4

Section 5 : Graph report for Temperature distribution , not include uncertainty of measurement

(5.1) Temperature Distribution at UUC Reading 85.0 °C



Approved Signatory : .....



## Certificate of Calibration

### Customer

Name : Innovative Instrument Co.,Ltd.  
Address : 7/139 Moo 13, Soi Suntinakorn 11 Tambon Bang Kaeo, Amphoe Bang  
Phli Samut Prakan Province 10540 Thailand

Certificate No : 22-DPM-236

Request No : Req-2022-1811

### Unit Under Calibration Details

Measurement Item : Bioaerosol Sampler Resolution : 0.001 inch H<sub>2</sub>O  
Manufacturer : Aquaria  
Model : Microflow  $\alpha$   
Serial Number : M3290  
ID : -

### Calibration Environment and Details

Temperature : 23 °C  $\pm$  3 °C  
Humidity : 55 %RH  $\pm$  15 %RH  
Received Date : 26 September 2022  
Calibrated Date : 6 October 2022  
Calibration By : Mr. Noppadon Luangart  
Location of Calibration : LAB 4 Air Velocity  
Calibration Procedure : In-house method CP-DPM-02 by Comparison With Standard Differential Pressure Transducer

Reference Standard	Model	Serial Number	Due Calibration
Digital Pressure Calibrator	ADT672-05-DP20-MBAR	273160C0023	4 July 2023
Thermo Hygrometer	SD700	Q597552	21 October 2022

**Traceability** : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI). National Institute of Metrology (Thailand),(NIMT)

**Note** : The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor  $k=2$ , providing a level of confidence approximately 95 %.

Calibration By :                     *me*                      
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :                     *pacit*                      
Mr. Pacit Mathavom  
Calibration Engineer Supervisor

Issue Date : 6 October 2022

Certificate No : 22-DPM-236

Request No : Req-2022-1811

Calibration Results : Without Adjustment

**Flow Rate Accuracy**

Flow Rate (L/min)	$\Delta P$ SETRA (inch H <sub>2</sub> O)	Mean STD Reading (inch H <sub>2</sub> O)	Error (inch H <sub>2</sub> O)		Uncertainty ( $\pm$ ) (inch H <sub>2</sub> O)
30	0.014	0.014	0.0%	0.0000	0.0012
60	0.050	0.050	0.0%	0.0000	0.0012
90	0.118	0.118	0.0%	0.0000	0.0012
100	0.138	0.138	0.0%	0.0000	0.0012
120	0.206	0.206	0.0%	0.0000	0.0012

**Note :**

Mean : The average standard of 4 values on each Point

inch H<sub>2</sub>O = 249.0889 Pascal

$\Delta P$  = Differential Pressure

End of Certificate



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23H487

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer

Manufacturer: EXTECH

Model : 448515

Serial No.: PONPE5899555

ID No.: TNP.LAB.22

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 07 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

Ambient Temperature: ( 25  $\pm$  3 ) °C

Relative Humidity: ( 50  $\pm$  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.

332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong,  
Nonthaburi 11110

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-H03 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### 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) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Standard Humidity/Temperature Meter	400	10203027	TH-0082-22	22 Aug 2023

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 Standards and Technology (NIST) , The United States of America

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Viporn Tantiyawutti

Issue Date : 10 March 2023

Approved Signatory :

☒ Chakrit Waewanjua

☐ Pornthippa Tameyakul

☐ Viporn Tantiyawutti

B 0310048





Cert. No.: 23H487

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity Measurement

<u>Reference</u> <u>Temperature</u> (°C)	<u>Standard</u> <u>Humidity</u> (%R.H.)	<u>UUC*</u> <u>Reading</u> (%R.H.)	<u>Error</u> (%R.H.)	<u>Uncertainty</u> <u>of Measurement</u> (±%R.H.)
25.0	50.1	29	-21.1	1.6

**Result of Calibration:-**

Without Adjustment

Function:

Temperature Measurement

<u>Standard</u> <u>Temperature</u> (°C)	<u>UUC*</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> <u>of Measurement</u> (±°C)
20.06	19.9	-0.16	0.46
24.99	25.1	0.11	0.46

**UUC\*** : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

-o0o-

a 1152575



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23H486

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer

Manufacturer: EXTECH

Model : 448515

Serial No.: PONPE5899554

ID No.: TNP.LAB.21

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 07 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

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.

332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong,  
Nonthaburi 11110

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-H03 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### 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) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Standard Humidity/Temperature Meter	400	10203027	TH-0082-22	22 Aug 2023

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 Standards and Technology (NIST) , The United States of America

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Viporn Tantiyawutti

Issue Date : 10 March 2023

Approved Signatory :

  
☒ Chakrit Waewanjua

☐ Pornthippa Tameyakul

☐ Viporn Tantiyawutti

B 0310047



Cert. No.: 23H486

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity Measurement

<u>Reference</u> <u>Temperature</u> (°C)	<u>Standard</u> <u>Humidity</u> (%R.H.)	<u>UUC*</u> <u>Reading</u> (%R.H.)	<u>Error</u> (%R.H.)	<u>Uncertainty</u> <u>of Measurement</u> (±%R.H.)
25.0	50.1	48	-2.1	1.6

**Result of Calibration:-**

Without Adjustment

Function:

Temperature Measurement

<u>Standard</u> <u>Temperature</u> (°C)	<u>UUC*</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> <u>of Measurement</u> (±°C)
20.06	19.7	-0.36	0.46
24.99	24.9	-0.09	0.46

**UUC\*** : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

-o0o-



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:** United Analyst and Engineering Consultant Co., Ltd.  
**Address:** 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
**City:** Phra Khanong **Contact:** Suwit Chotnok  
**Zip / Postal:** 10260  
**State / Province:** Bangkok  
**Order Number:**   
\* 0 3 3 2 4 0 1 4 9 4 \*

### Weighing Device

**Manufacturer:** Mettler Toledo **Instrument Type:** Weighing Instrument  
**Model:** MS603S/01 **Asset Number:** UAE.MIC.008/2553  
**Serial No.:** B007010311 **Terminal Model:** N/A  
**Building:** N/A **Terminal Serial No.:** N/A  
**Floor:** 2 **Terminal Asset No.:** N/A  
**Room:** Balance Room (206)

Range	Max. Capacity	Readability (d)
1	620 g	0.001 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: 22.8 °C	End: 23.0 °C	Start: 49.9 %	End: 58.3 %

**As Found Calibration Date:** 07-Apr-2022 **Calibrator:**   
**As Left Calibration Date:** N/A  
**Issue Date:** 08-Apr-2022  
**Approved Signatory:**   
☒ Kassakorn Tassanachaisakul  
☐ Santi Jitniyom  
☐ Surachet Sukkate

## Measurement Results

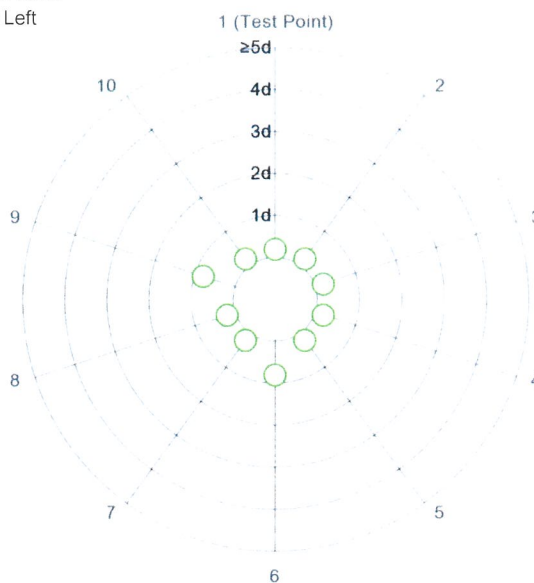
### Repeatability

Test Load: 200 g

	As Found	As Left
1	200.001 g	N/A
2	200.001 g	N/A
3	200.001 g	N/A
4	200.001 g	N/A
5	200.001 g	N/A
6	200.000 g	N/A
7	200.001 g	N/A
8	200.001 g	N/A
9	200.000 g	N/A
10	200.001 g	N/A

Standard Deviation	0.0004 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.

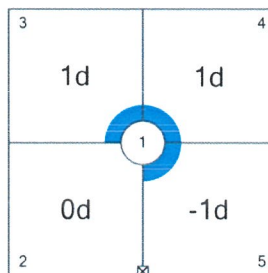
The results of this graph are based upon the absolute values of the differences from the mean value.

### Eccentricity

Test Load: 200 g

Position	As Found	As Left
1	200.001 g	N/A
2	200.001 g	N/A
3	200.002 g	N/A
4	200.002 g	N/A
5	200.000 g	N/A

Maximum Deviation	0.001 g	N/A
-------------------	---------	-----



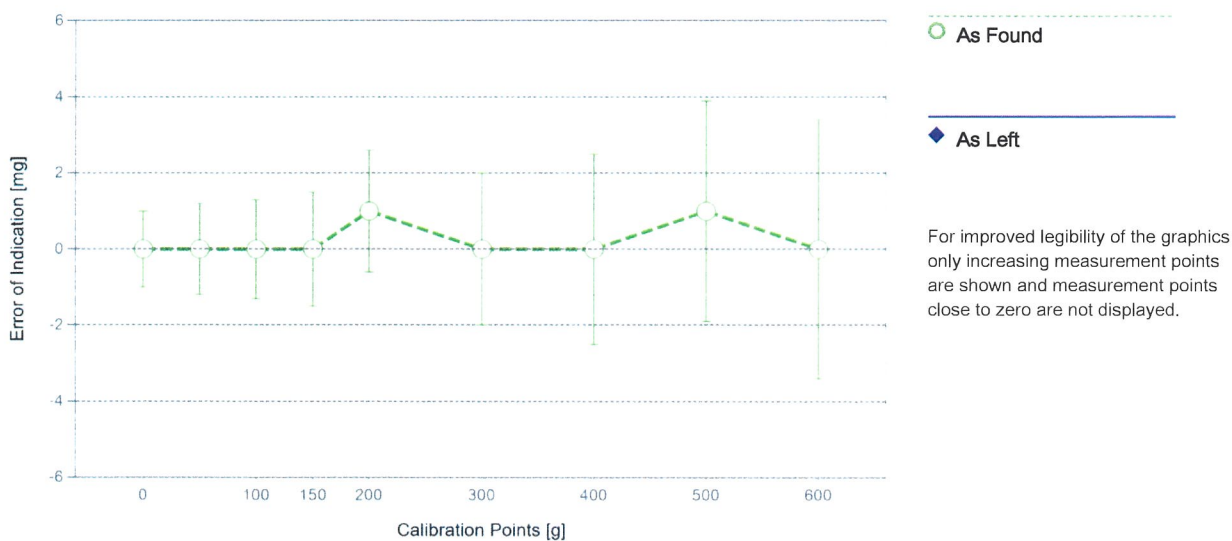
As Found

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

## Error of Indication

### As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.000 g	0.000 g	0.000 g	1.0 mg	2
2	0.500 g	0.500 g	0.000 g	1.2 mg	2
3	1.000 g	1.000 g	0.000 g	1.2 mg	2
4	50.000 g	50.000 g	0.000 g	1.2 mg	2
5	100.000 g	100.000 g	0.000 g	1.3 mg	2
6	150.000 g	150.000 g	0.000 g	1.5 mg	2
7	200.000 g	200.001 g	0.001 g	1.6 mg	2
8	300.001 g	300.001 g	0.000 g	2.0 mg	2
9	400.001 g	400.001 g	0.000 g	2.5 mg	2
10	500.001 g	500.002 g	0.001 g	2.9 mg	2
11	600.001 g	600.001 g	0.000 g	3.4 mg	2



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 F1

Weight Set No.:	WS55	Date of Issue:	09-Jul-2021
Certificate Number:	CCM-0137-21-C	Calibration Due Date:	07-Jul-2022

### Weight Set 2: OIML E2

Weight Set No.:	WS80	Date of Issue:	23-Feb-2022
Certificate Number:	C208581631	Calibration Due Date:	14-Aug-2023

### Thermo Hygrometer

Equipment No.:	IN161	Date of Issue:	14-Jun-2021
Certificate Number:	21H1220	Calibration Due Date:	01-Jun-2022

## 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.

## 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:  $3.0 \cdot 10^{-6} / K$

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

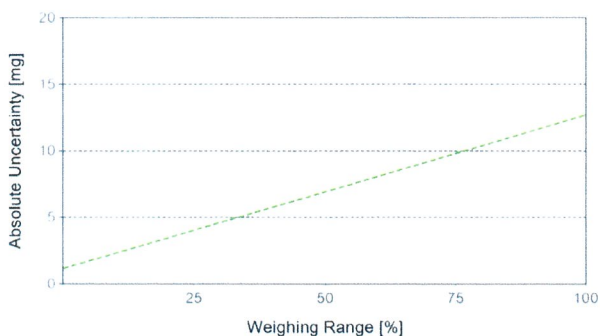
### Linearization of Uncertainty Equation

Range			As Found	As Left
	d	Max		
1	0.001 g	620 g	$U_1 = 1.2 \text{ mg} + 0.0186 \text{ mg/g} \cdot R$	N/A

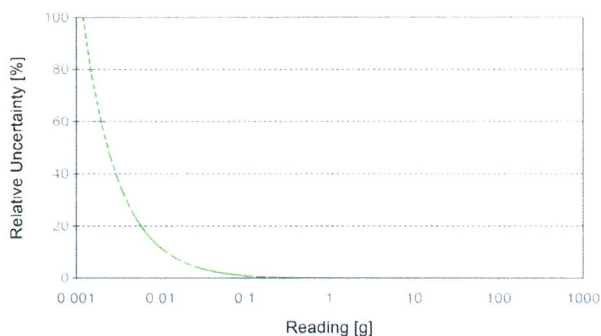
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

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

Net Indication	As Found		As Left	
0.062 g	1.2 mg	1.9%	N/A	N/A
0.620 g	1.2 mg	0.20%	N/A	N/A
6.200 g	1.3 mg	0.021%	N/A	N/A
62.000 g	2.4 mg	0.0038%	N/A	N/A
620.000 g	13 mg	0.0021%	N/A	N/A



As Found



As Left

## Calibration Certificate

**Certificate No.:** 2203120-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakanong, Bangkok 10260

Page 1 of 3

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** AB204-S/FACT  
**Serial No.:** 1129361010  
**ID No.:** UAE.WAS.002/2552  
**Order No.:** 2203120  
**Operation No.:** 2203120-001  
**Date of Receipt:** 1 June 2022  
**Date of Calibration:** 1 June 2022

**Calibrated by** Mr.Taveesak Seilee  
Scientist

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

**Date of Issue:** 7 June 2022

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

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





# Calibration Report

**Certificate No.:** 2203120-001-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** AB204-S/FACT

**Resolution:** 0.0001 g

**Serial No.:** 1129361010

**ID No.:** UAE.WAS.002/2552

**Capacity:** 220 g

**Date of Calibration:** 1 June 2022

Page 2 of 3

**Environment Condition:** Ambient Temperature: 19.9 ± 0.3 °C Relative Humidity: 45 ± 1.5 %

**Place of Calibration:** 108, Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

**Condition of Equipment:** Good Condition

## Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1-500mg	B308068554	TCS	M2201020S	6 January 2023
Standard Weight Class E2	1-500g	B308068128	TCS	M2201021S	6 January 2023

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	PONPE 490	NFI.BTH 010/18	Quality Reborn	QR22-0350	18 February 2023

3. This certification is traceable to SI UNIT

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

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

## Calibration Results:

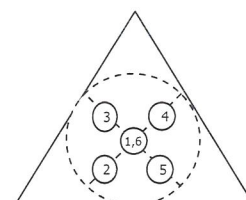
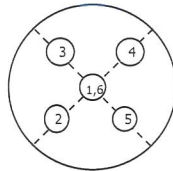
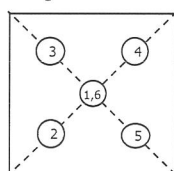
### 1. Repeatability of Reading:

Nominal Value ( g )	Standard Deviation of Reading ( g )
100	0.000048
200	0.000052

### 2. Off-Center Error:

A mass of 50 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
( g )	( g )	( g )	( g )	( g )	( g )	( g )
49.9999	49.9998	49.9998	49.9999	49.9998	49.9998	0.0001



# Calibration Report

**Certificate No.:** 2203120-001-01

**Equipment:**

Electronic Balance

**Model:** AB204-S/FACT

**Serial No.:** 1129361010

**Capacity:** 220 g

**Manufacturer:** METTLER TOLEDO

**Resolution:** 0.0001 g

**ID No.:** UAE.WAS.002/2552

**Date of Calibration:** 1 June 2022

Page 3 of 3

**Calibration Results:** (Continued)

**Calibration Range:** 0 - 200 g

**Calibration Adjustment:** Internal Calibration

## 3. Departure from Nominal Value:

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor <i>k</i>
Unload	0.00000	0.0000	0.0000	0.000088	2.00
0.01	0.01000	0.0100	0.0000	0.000088	2.00
0.05	0.05000	0.0499	0.0001	0.000088	2.00
0.1	0.10000	0.1000	0.0000	0.000088	2.00
0.2	0.20000	0.2000	0.0000	0.000088	2.00
0.5	0.50000	0.5000	0.0000	0.000088	2.00
1	1.00000	0.9999	0.0001	0.000088	2.00
2	2.00000	1.9999	0.0001	0.000089	2.00
5	5.00000	5.0000	0.0000	0.000089	2.00
10	9.99998	9.9999	0.0001	0.000092	2.00
20	19.99999	19.9999	0.0001	0.000094	2.00
50	49.99990	49.9999	0.0000	0.00012	2.00
70	69.99989	69.9998	0.0001	0.00014	2.00
100	100.00001	99.9999	0.0001	0.00017	2.00
150	149.99991	149.9997	0.0002	0.00022	2.00
200	200.00007	199.9998	0.0003	0.00030	2.00

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

----- End -----



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

เอกสารไม่ควบคุม



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.: 22MM210  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance

**Manufacturer :** Mettler Toledo

**Model :** XSR205

**Serial No. :** C009071872


**ID No. :** UAE.WAO.012/2563

**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phakhanong,  
Bangkok 10260

**Location :** Balance Room

**Received order :** 26 April 2022  
**Calibration Date :** 26 April 2022  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Kunchit Promprat

**Approved by :**   
Approved Signatory

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

**Issue Date :** 29 April 2022

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.

เอกสารไม่ควบคุม  
0049716





Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2204-0542OC-1

Cert.No.: 22MM210  
Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

**Condition of this result of calibration**

**1. Reference standard instruments:-**

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
1) Standard Weight Set (E2)	15884	-	70RC138	MM-0009-21	3 Feb 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.
4. This certificate is not certified for any commercial transaction.
5. This certification is traceable to the International System of Unit.

**Result of calibration** ( ) Without Adjustment ( \* ) After Adjustment by Internal Calibration

<b>Range capacity :</b>	0 g to 81 g	<b>Resolution</b>	0.00001 g
	81 g to 220 g	<b>Resolution</b>	0.0001 g

**Before Adjustment :**

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
( g )	( g )	( g )	( $\pm$ mg )	( k )
80	80.00004	-0.00004	0.15	2.00
200	199.9999	+0.0001	0.35	2.00

**After Adjustment :**

**1. Determination of the standard deviation of weighing machine** ( n = 10 )

<u>Applied Weight</u>	<u>Standard Deviation of Reading ( g )</u>
( g )	
80	0.000008
200	0.00005

Malu .



Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2204-0542OC-1

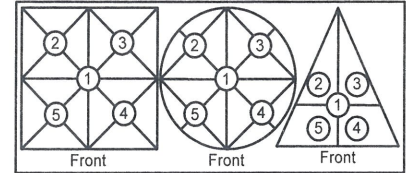
Cert.No.: 22MM210

Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

A mass of 100 g was placed to various position on the pan.  
The weighing machine reading error obtained is given in the table



Maximum difference between  
off-center and central loading  
( g )  
0.0002

Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )
-0.0002	-0.0001	0.0000	-0.0002	-0.0002

#### 3. Departure from nominal value

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( ± mg )	Coverage Factor ( k )
Unload	0.00000	0.00000	0.016	2.13
0.05	0.05001	-0.00001	0.016	2.13
0.1	0.10001	-0.00001	0.017	2.11
1	1.00002	-0.00002	0.019	2.05
5	5.00003	-0.00003	0.026	2.00
20	20.00008	-0.00008	0.049	2.00
50	50.00010	-0.00010	0.080	2.00
80	80.00014	-0.00014	0.15	2.00
100	100.0001	-0.0001	0.21	2.00
150	150.0001	-0.0001	0.29	2.00
200	200.0001	-0.0001	0.35	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-

Maku.



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.: 22TM1064

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Incubator

**Manufacturer :** Memmert

**Model :** BE 400

**Serial No. :** e402.1032

**ID No. :** UAE.MIC.001/2546

**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260

**Location :** Microbiology Laboratory

**Received Order :** 11 July 2022

**Calibration Date :** 11 July 2022

**Ambient Temperature :** (  $26 \pm 10$  ) °C

**Relative Humidity :** (  $50 \pm 30$  ) %

**Calibrated by :** Man Pattanapongpaiboon

**Approved by :**

Approved Signatory

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

**Issue Date :**

18 July 2022

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

เอกสารไม่ควบคุม





Equipment : Incubator  
 Condition As-Received : Used Item  
 Reference : 2207-0245OC-2

Cert. No.: 22TM1064

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	MY57013823	22LM24	26 Feb 2023

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

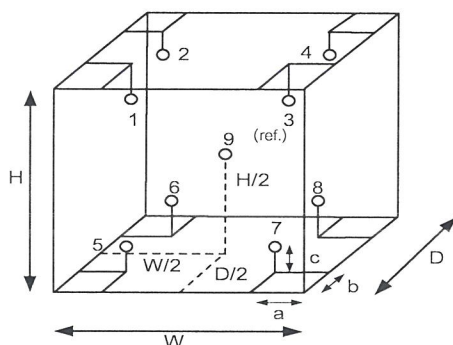
3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	62	63
AC Supply ( Volt )	222	223



Position :	Ref. Std. ID No.:
1	21-17RTD-01
2	21-17RTD-02
3	17RTD-03
4	17RTD-04
5	17RTD-05
6	17RTD-06
7	17RTD-07
8	17RTD-08
9 (ref.)	17RTD-09

#### Probe Installation Details :

a = 5.0 cm  
 b = 5.0 cm  
 c = 5.0 cm

#### Dimension of Chamber :

D = 0.40 m  
 W = 0.33 m  
 H = 0.40 m  
 Capacity = 0.053 m<sup>3</sup>

เอกสารไม่ควบคุม



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2207-0245OC-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM1064

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>
37.0	38.0	38.0	0.092	0.62	0.94	0.30	2
56.0	57.5	57.5	0.083	0.87	1.3	0.42	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
37.0	37.629	37.576	37.476	37.577	36.834	36.997	36.824	37.038	37.387
56.0	56.489	56.520	56.445	56.485	55.291	55.589	55.899	55.591	56.097

**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-

เอกสารไม่ควบคุม

# FOSS

## Customer Service Report

FOSS South East Asia

3388 Sirinrat Building, 25th – 26th Floor, Unit No. 3388/90,  
Rama IV Road, Klongton , Klongtoey, Bangkok, Thailand 10110

Report No:

6623

Date:

July 26, 2022

Customer:

United Analyst and Engineering

Address:

กรุงเทพฯ

Instrument:

KT8100

Serial:

31889052

Hours

Travel To Customer

Start

8.00

Finish

8.30

30 mins.

Labour

8.00-12.00

3+3

13.00-16.00 = 6 hrs.

Travel From Customer

16.30

17.30

1 hrs.

### Job Type

Application		Special		Standard			
Normal	<input checked="" type="checkbox"/>	Courtesy Visit	<input checked="" type="checkbox"/>	Installation	<input checked="" type="checkbox"/>	Training	<input checked="" type="checkbox"/>
Distributor	<input checked="" type="checkbox"/>	PMA Onboarding	<input checked="" type="checkbox"/>	Quote	<input checked="" type="checkbox"/>	In House	<input checked="" type="checkbox"/>
Internal	<input checked="" type="checkbox"/>	Warranty	<input checked="" type="checkbox"/>	Repair	<input checked="" type="checkbox"/>	PM	<input checked="" type="checkbox"/>
Digital Service	<input checked="" type="checkbox"/>	Sales Support	<input checked="" type="checkbox"/>	Remote	<input checked="" type="checkbox"/>	Other	<input checked="" type="checkbox"/>

PO/Quote Number:

If applicable

PMA Type

If applicable

Contract No.

If applicable

### Details of Work / Test

### Condition / Status

- Unpack ตรวจสอบเครื่อง ไม่พบความเสียหาย

OK

- ตรวจสอบ Accessory kit

OK

- ตรวจสอบ น้ำยาละลาย ที่ Alkali, ที่ น้ำยาล้าง แก้ว เครื่อง

OK

- ตรวจสอบ เครื่อง ตาม IQ, OQ, PQ

OK

Instrument Ready for Use

OK

Not OK

If not OK, Comment

Part No:

Batch

Description

Qty

I confirm this report is accurate and complete

Signed FOSS

Pannipa O.

Signed Customer

Karnphong

Name

Pannipa Onnom

Name

Karnphong Boonpiang

Would you be willing to participate in a brief survey in order to tell us how we performed?

Email

## เอกสารไม่ควบคุม





## Kjeltec™ 8100 Distillation Unit

**This IQ applies to Kjeltec™ 8100 Distillation Unit manufactured by FOSS Analytical. The installation is performed by FOSS trained service personnel.**

### 1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical AB's Application Notes.

### 2 Purpose

This installation Qualification is designed to assure that:

- The Kjeltec instrument is received complete, with all required parts in good condition.
- The location of the instrument is environmentally and ergonomically suitable
- The instrument is assembled and configured correctly
- Suitable electricity and water are supplied to the instrument, see table 2 for requirements.

### 3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit	918 89052

#### Dedicated Analytical Solutions

**FOSS Analytical A/S**  
69 Slangerupgade  
DK-3400 Hillerød  
Denmark

Tel +45 7010 3370  
Fax +45 7010 3371  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

**FOSS Analytical AB**  
Box 70  
SE-263 21 Höganäs  
Sweden

Tel +46 42 361500  
Fax +46 42 340349  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

## 4 Control of Received Equipment

### 4.1 Verify that the correct instrument type and accessory kit items are received and in proper condition

The packing list (shipped with the instrument) specifies all the items. The installer will verify that all items are received as shipped on the packing list. For each item listed, verify that the acceptance criteria are met. If so, write “Y” in the right column of the table immediately following.

Packing List Item	Acceptance Criteria	Pass/Y/N)
Kjeltec 8100 Distillation Unit	No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Accessory kit, according to packing list	Included. No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Handling device for digestion tube	Included. No visible damage.	Y
Tanks with level sensors for Waste, Alkali and Water	Included. No visible damage.	Y
Receiver flask	Included. No visible damage.	Y
One digestion tube 250ml One digestion tube 100 ml	Included. No visible damage.	Y
Tube adapter	Included. No visible damage.	Y
User manual	Kjeltec 8100 Distillation Unit	Y
Owners guide	Kjeltec 8100 Distillation Unit	Y
Quick guide	Kjeltec 8100 Distillation Unit	Y
Spare parts manual	Kjeltec 8100 Distillation Unit	Y
Application notes	AN 300 included AN 303 included	Y



## 5 Installation

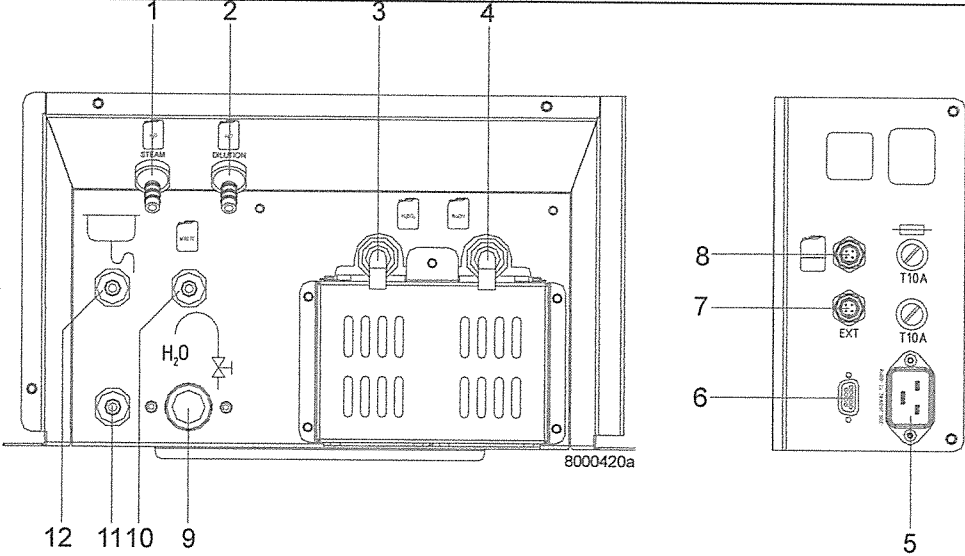
### 5.1 The equipment must be installed in a suitable location with power, water and draining available

Verify that the instrument installation site meets the acceptance criteria given in the table below. If so, write “Y” in the right column of the table immediately following.

Location Requirements	Acceptance Criteria	Pass (Y/N)
Adequate space for instrument	Dimensions 48x58x69 cm	Y
AC supply available for instrument	200-240 V 50/60Hz	Y
Current	10 A	Y
Cold water supply available	2 L/min at 30°C	Y
Drain	For cooling water and waste (depending on local waste disposal legislation)	Y
Ambient temperature	Max. 40°C	Y
Ambient humidity	Max. 80% relative	Y
Internal fuses	T10A AH	Y

## 5.2 The instrument must be assembled correctly

Verify that all tubes are correct connected. If so, write “Y” in the right column of the table immediately following.

Instrument Tubing Connections	Acceptance Criteria	Pass (Y/N)
 <p>1. Deionised water in (steam generator)</p> <p>2. Deionised water in (dilution water)</p> <p>3. *) Receiver solution in</p> <p>4. Alkali in</p> <p>5. Power</p> <p>6. Not used</p> <p>7. External titration module</p> <p>8. Level sensors</p> <p>9. Cooling water in (tap water)</p> <p>10. Waste water out (tube drain vessel)</p> <p>11. Drain</p> <p>12. Cooling water out (tap water)</p> <p>*) Only on Kjeltrec 8200</p>	Visual verification by installer	Y

### 5.3 The instrument should be assembled and powered up

Connect the distilling unit to the power supply. Perform the start up procedure and check that the expected response is obtained. If so, write “Y” in the right column of the table immediately following.

Action	Expected Response	Pass (Y/N)
Switch on the power	The instruments start up and the self test will run. The sample counter shows the number of analysed samples since first power and the Software Version shows the version of the instruments software.	Y
	After start-up, Program 1 is loaded and the Analyse menu is displayed.	Y
Turn on the cold water tap	No visible reaction	Y
Press the <b>“Manual”</b> view	The Manual menu is opened	Y
Open the door with the handle, place the test tube and receiver flask in position. Close the door.		Y
Select <b>Dilution</b> and press <b>Start</b>	Water is added to the tube	Y
Select <b>Alkali</b> and press <b>Start</b>	Alkali is added to the tube	Y
Select <b>Steam</b> and press start	After heating up, steam is entering the tube	Y
Select <b>Drain</b> and press <b>Start</b>	The tube is drained	Y



## 6 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

## 7 IQ Documentation

Upon successful completion and recording of all instructions above, sign and date this sheet below.  
If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Installed By: Pannipa Onnom

Company: Foss SEA

Customer Name: United Analyst and Engineering

Company: United Analyst and Engineering

Date completed: July 25, 2022

## Kjeltec™ 8100 Distillation Unit

**This OQ applies to Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The operation qualification is performed by FOSS trained service personnel.**

### 1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical Application Notes.

### 2 Purpose

This procedure is designed to test the function of the instrument according to factory test specifications:

- Alkali volume
- Distillation Accuracy
- Distillation Repeatability

### 3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit, 200-240 V 50/60 Hz	91889052

#### Dedicated Analytical Solutions

**FOSS Analytical A/S**  
69 Slangerupgade  
DK-3400 Hillerød  
Denmark

Tel +45 7010 3370  
Fax +45 7010 3371  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

**FOSS Analytical AB**  
Box 70  
SE-263 21 Höganäs  
Sweden

Tel +46 42 361500  
Fax +46 42 340349  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

## 4 Performance

### 4.1 Verify the dispensed volumes of reagents

**Note!** To verify the dispensed volumes of reagents a triple test should be done to be statistic correct. Then calculate a mean value.

1. Choose “Manual” in the menu. (When starting up the instrument Program 1 is loaded)
2. Open the safety door by pressing **Open** and place a tube in the instrument. Close the safety door.

#### Water

1. Press **Dilution** and then press **Start**. 80 ml of water will be filled into the tube.
2. Measure the collected water in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

**Note!** If the water volume needs to be calibrated, go to 4.8.5 Dilution Pump Calibration in the User Manual.

#### Alkali

1. Press **Alkali** and then press **Start**. 50 ml of alkali will be filled into the tube.
2. Measure the collected alkali in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Table 1 Volume control

Test	Result	Expected result	Passed (Y/N)
Water volume	<u>83</u> ml <u>83</u> ml <u>82</u> ml Mean <u>82.67</u> ml	76- 84 ml	Y
Alkali volume	<u>52</u> ml <u>52</u> ml <u>53</u> ml Mean <u>52.33</u> ml	47- 54 ml	Y



## 4.2 Verify the distillation procedure, accuracy and precision

The distillation principle is to convert ammonium ( $\text{NH}_4^+$ ) into ammonia ( $\text{NH}_3$ ) by using an alkali ( $\text{NaOH}$ ) and thereafter steam distil it into a receiver flask containing boric acid and titrate with standard acid solution using colorimetric end-point detection. Ammonium sulphate, a substance with known ammonia content, can be used to check the accuracy of the distillation. The recovery is calculated from obtained result.

The way to perform this test will be described in the following.

### Chemical Check

Use ammonium sulphate ( $(\text{NH}_4)_2\text{SO}_4$ , purity > 99.5 % \*)

Mol. weight = 132.14 g/mol, Nitrogen content in ammonium sulphate (99.5 %) = 21.09% \*)

### Analysis conditions according to AN 300

Water	80 ml
Alkali	50 ml NaOH (40%w/w)
Receiver solution	30 ml boric acid (4%)
Distillation time	5 minutes
SAfE	5 seconds
Titrant	0.2N HCl

### For reagent preparation see Appendix A

1. Start the instrument and run two blanks without chemicals according to above analysis conditions, distil into a receiver flask containing boric acid. Titrate with a standard acid solution using colorimetric end-point detection. If the blanks are less than 0,2 ml continue with the recovery tests:
2. Weigh 0.15 g ammonium sulphate into a tube. Prepare 6 samples (tubes).
3. Run the six samples according to above analysis conditions. Titrate with a standard acid solution using colorimetric end-point detection.
4. Calculate the recovery according to below equations. Expected results of recovery should be 100%±1%.

Recovery test	Result	Expected result	Passed (Y/N)
Blank value (water blank)	1. <u>0.08</u> ml 2. <u>0.14</u> ml	0.05-0.20 ml	Y
Recovery	1. <u>100.20</u> % 2. <u>100.30</u> % 3. <u>100.63</u> % 4. <u>99.01</u> % 5. <u>99.97</u> % 6. <u>100.09</u> %		
Accuracy	Mean Value: <u>100.03</u>	99-101%	Y
Precision	SD: <u>0.557</u>	SD <1%	Y

\*) **Note!** Please also note that the below calculations must be adjusted if other purity levels of ammonium salts are used. A certificate for the chemical supplier should be available

Purity	Nitrogen content
99,5%	21.09%
99,6%	21.12%
99,7%	21.14%
99,8%	21.16%
99,9%	21.18%

$$\% \text{ Nitrogen} = \frac{(ml_{\text{sample}} - ml_{\text{blank}}) \times N \times 14,007 \times 100}{mg_{\text{sample}}} \quad \begin{matrix} \nearrow 0.1005 \\ 21.72 \end{matrix}$$

$N$  = Normality of titrant to 4 places of decimal.

$$\% \text{ Recovery} = \frac{\% \text{ Nitrogen}}{21.09} \times 100$$

mg sample

- ① ~~0.1592~~ 23.56
- ②
- ③
- ④
- ⑤
- ⑥

## 5 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

## 6 OQ Documentation

Upon successful completion of tests above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Performed By: \_\_\_\_\_

Company: \_\_\_\_\_

Customer Name: \_\_\_\_\_

Company: \_\_\_\_\_

Date completed: \_\_\_\_\_



## 7 Appendix A

### 7.1 Preparation of Reagents

#### 7.1.1 Alkali

To convert ammonium into ammonia an excess of sodium hydroxide is necessary.

Use 400 g NaOH per litre of solution. Commercially available in concentrations up to 50 %. Do not use concentrations above 40 % as this will lead to crystal formation impairing the function of the pumps. If you can only buy concentrations > 40 %, dilute it before use.

#### 7.1.2 Titrant acid, determination of concentration

To be able to achieve accurate nitrogen / protein results, one must be quite sure that the HCl (hydrochloric acid) concentration is what it is supposed to be. A titration against a predetermined solution of sodium carbonate as described below is thus necessary. Incorrect HCl concentration can otherwise cause substantial errors.

- **Standard substance**

Weigh approx. 10 g of anhydrous sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). Use a mortar to make a fine powder. Dry it for 1 h at 265 °C or 2 h at 200 °C. After cooling in a desiccator, transfer the sodium carbonate to a beaker with a tight lid. Store it in a desiccator.

- **Indicator solutions**

Dissolve 0.1 g methyl red in 100 ml methanol. Dissolve 0.1g bromocresol green in 100 ml methanol.

- **Procedure**

Weigh approx. 0.4 g of the standard substance, using an analytical balance, note the weight ( $W_1$ ). Transfer the sodium carbonate to a receiver flask and add 40 ml of  $\text{H}_2\text{O}$  (distilled or deionized). Add 8 drops from each of the indicator solutions. Titrate to pink. Note the amount in ml used ( $A_1$ ). Boil this solution for a few minutes. The solution will turn green. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour change occurs. Note also this volume

( $A_2$ ). Boil the solution for a few minutes. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour occurs. Note also this volume ( $A_3$ )

**Note!** Temperature changes will influence the volume and the concentration of the titrant solution. The working temperature of the titrant should approximate that of its temperature during standardization. If temperature corrections are necessary, sufficient accuracy may be obtained by use of a correction table. (AOAC 942.25)

## 7.2 Calculation

$$\text{Molarity (M)} = \frac{18,870 \times W_1}{(A_1 + A_2 + A_3)}$$

**Note!** Concentration must be accurate to four digits, i.e. 0.2000 M.

**Note!** The colour change of this official procedure (AOAC 936.15) may be difficult to see, therefore a pH meter or a mixed indicator (e.g. 0.1 g Methyl red and 0.1 g Bromocresol green in 100 ml methanol) will make it much easier to perform.

## 7.3 Receiver Solution

Boric acid 4 % with bromocresol green / methyl red indicator solution

In order to obtain accurate results the receiver solution is adjusted so that a small (0.05-0.20 ml) positive blank is obtained when running a blank sample. The 4 % boric acid receiver solution is prepared by dissolving 400 g of boric acid in about 5-6 l very hot deionized water. Mix and add more hot deionized water to a volume of about 9 l. Cool the solution to room temperature and add 100 ml of bromocresol green solution (100 mg in 100 ml methanol) and 70 ml of methyl red solution (100 mg in 100 ml of methanol). Dilute to 10 l with deionized water and mix carefully.

**Note!** The addition of alkali is to achieve a positive blank value. This should, however, be kept between 0.05 - 0.20 ml titrant, to obtain good repeatability when testing blanks.

Adjustment of the boric acid is made by the following procedure:

1. Transfer 25 ml boric acid solution to a receiver flask and add 100 ml of distilled water. If the solution in the flask is still red, titrate with 0.1 M sodium hydroxide solution until a neutral grey colour is obtained. Calculate the amount of sodium hydroxide solution necessary to adjust the boric acid solution in the 10 l flask with the formula: ml 1.0 M alkali = ml titrant x 40
2. Add the calculated amount of 1.0 M alkali solution to the boric acid solution. Mix.
3. To check proceed as follows using 25 ml of the boric acid solution. Run a blank. If the value of this blank is high (0.5 ml of 0.2 M HCl) the boric acid is incorrectly adjusted. This might create irregular blanks. For correction add HCl directly into the boric acid tank, mix it carefully and repeat until a reading of 0.05 - 0.20 ml HCl is obtained. If a positive blank is not achieved, add further small quantities of 1 M NaOH and repeat the check until a satisfactory value is achieved.

## **Kjeltec™ 8100 Distillation Unit Tecator™ 2508/2520 Digester**

### **1 Scope**

This PQ applies to the Digestion system 2508/2520 (including exhaust and scrubber unit) and Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The user of the instrument performs the PQ.

### **2 Intended Use**

The Digestion system (including exhaust and scrubber) and Kjeltec 8100 Distillation Unit are intended for laboratory use analyzing parameters as specified in FOSS Application Notes.

### **3 Purpose**

The guidelines are intended to assist the user in successfully developing Performance Qualifications for the specific application(s) to which the instrument is applied.

The Performance Qualification (PQ) includes the process of demonstrating that the Digestion system 2508/2520 (including exhaust and scrubber unit) and the Kjeltec 8100 Distillation unit consistently perform according to a specification appropriate for its routine use. Main activities in the PQ phase are:

- Preventive maintenance
- On-going verification tests

This document suggests routines to fulfill the requirements for an acceptable PQ but the final procedure should be adapted to local routines for similar equipment.

### **4 Definition of Test Procedures**

#### **4.1 Preventive Maintenance**

Maintenance of the Kjeltec 8100 should be performed according to the instructions in manual, see User Manual Kjeltec 8100/8200 Distillation Unit, chapter 5. Maintenance. A yearly service is recommended (service agreement).

Maintenance of the Digestion block (including exhaust and scrubber) should be performed according to instruction in the user manual, see User Manual Tecator Digester, chapter 5. Maintenance.

#### **Dedicated Analytical Solutions**

**FOSS Analytical A/S**  
69 Slangerupgade  
DK-3400 Hillerød  
Denmark

Tel +45 7010 3370  
Fax +45 7010 3371  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

**FOSS Analytical AB**  
Box 70  
SE-263 21 Höganäs  
Sweden

Tel +46 42 361500  
Fax +46 42 340349  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)



## 4.2 Ongoing Qualification Tests

### Block Temperature

The temperature for the digestion is limited by the boiling point for the sulphuric acid, this can be increased by adding a salt ( $K_2SO_4$ ) to the digestion mixture. It's important that the optimal ratio between acid and salt is kept; please follow recommendation in AN 300 or suggested procedures for a specific kind of sample material.

The block temperature itself can be controlled external by inserting a temperature probe in the intended hole in the aluminium block (front row of holes).

Use the reagents and method procedure specified in AN 300. Use only reagents of recognized analytical grade, unless otherwise specified and distilled or demineralised water or water of equivalent purity.

*Suggested standard material for internal quality control:*

Ammonium sulphate  $[(NH_4)_2SO_4]$ , min. 99.5 % (mass fraction), with certified purity.

**Note: The above chemical is usually readily available with a certificate specifying the purity.**

Alternatively ammonium iron(II) sulphate,  $(NH_4)_2 Fe (SO_4)_2 \times 6 H_2O$ , with certified purity may be used.

Tryptophan ( $C_{11}H_{12}N_2O_2$ ), minimum assay 99 % (mass fraction). Nitrogen content 137.2 g/kg. Do not dry in an oven before use.

Acetanilide ( $C_8H_9NO$ ), minimum assay 99 % (mass fraction). Nitrogen content 103.6 g/kg. Do not dry in an oven before use.

Sucrose, ( $C_{12}H_{22}O_{11}$ ), with a nitrogen content of not more than 0.002 % (mass fraction). Do not dry in an oven before use.

### Blank Tests

Carry out a blank test following the currently used procedure for digestion, distillation and titration taking 2 ml of water and about 0.7 g of sucrose instead of the test portion. Keep a record of blank values. If blank values change, identify the cause.

**Note: The amount of titrant used in the blank test should always be greater than 0.0 ml. Blanks within the same laboratory should be consistent across time.**

## 4.3 Recovery Tests

Regularly run recovery studies to check the accuracy of procedure and equipment:

- *Nitrogen loss.* - Use 0.12 g ammonium sulphate and 0.67 g sucrose per flask weighted to the nearest 0.1 mg. Add all other reagents as stated in the method currently used ( $Kjeltabs$ ,  $H_2SO_4$ , etc). Digest and distil under same conditions as for sample. Recoveries shall be >99 %.
- *Digestion efficiency* - Use a test portion of minimum 0.15 g of tryptophan or acetanilide and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Determine the nitrogen content according to the current procedure in use. The recoveries of tryptophan shall be >98.5 %; the recoveries of acetanilide shall be >99.5 %.
- *Distillation and titration efficiency* – Distil 0.10 – 0.15 g  $\pm 0.0001$  g ammonium sulphate, omitting the digestion step. The recoveries should be >99.5 %.

**Note: Results less than 98.5 % or more than 101.0 % in either of the recovery tests indicate failures in the procedure and/or inaccurate concentration of the standard volumetric hydrochloric acid solution (should be adjusted to four decimals accuracy according to procedure in AN 300)**

## External Quality Control Program

It is recommended to participate in an external quality control program, such a proficiency program or ring test, with equivalent sample material as analysed within the laboratory.

## Calculation and Expression of Results

$$w_n = \frac{14.007(V_s - V_b)N \times 100\%}{m}$$

Where:

$w_n$  is the nitrogen content of the sample, expressed as a percentage by mass.

$V_s$  is the numerical value of the volume of the hydrochloric acid standard volumetric solution) used in the sample test, in milliliters, expressed to the nearest 0.05 ml.

$V_b$  is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the blank test, in milliliters, expressed to the nearest 0.05 ml.

$N$  is the numerical value of the exact normality of the hydrochloric acid standard volumetric solution, expressed to four decimal places.

$m$  is the numerical value of the mass of the test portion , in milligrams, expressed to the nearest 1 mg for sample weights >1 g or to the nearest 0.1 mg for sample weights <1 g.

## 5 Maintenance

### 5.1 Maintenance Kjeltex™ 8100

See instructions in User Manual - Kjeltex 8100/8200, chapter 5 Maintenance.

### 5.2 Maintenance Tecator™ Digestor

See instructions in User Manual - Tecator Digestor, chapter 5 Maintenance.

## 6 The Maintenance Record Charts

This record charts are provided to assist you in keeping your system in good working order. Please make copies and use them regularly as they can often help us to help you in the unlikely event a system malfunction.

## 6.1 FossCare™ Service Log

[illegible]

## เอกสารไม่ควบคุม

**D** Applicable for FOSS sales and service companies.



[illegible]

Applicable for FOSS sales and service companies.









6.2.4 Additional Maintenance

Date	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Cleaning of Steam Generator																				
Signature																				
Number of analyses																				

เอกสารไม่ควบคุม

6.2.5 Yearly Maintenance

Date	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
FOSS Service Visit																				
Signature																				
Number of analyses																				

เอกสารไม่ควบคุม

