

ภาคผนวก จ

สำเนาเอกสารรับรองเครื่องมือการตรวจวัด



Certificate of Calibration

Certificate No. : 67-420106-1

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisetukhakhon 25, Pracha-Utd Rd., Thungkru Bangkok 10140 Thailand

Equipment : pH Meter with electrode

pH meter

Manufacturer : Eutech

Model : pH 700

Range : N/A pH Resolution : 0.01 pH

Serial No. : 2884323

ID No. : N/A

Electrode

Model : ECF7252101B Serial No. : 01X099320

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (26.3 to 26.7) °C

Relative Humidity : (40 to 45) %

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

Calibrated by : Pernpon Chanpu

Calibration Method : In-house method CAL-M4201 direct measurement by using standard voltage calibrator

and using certified reference material (CRM)

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

1. Multiproduct Calibrator

| ID No. | Cert. No. | Due Date | Traceability |
|--------|---------------|-------------|---|
| 400005 | SG-E-00307/66 | 23 Aug 2025 | National Institute of Metrology Thailand (NIMT) |

2. Standard Buffer Solution

| pH | Cert. No. | Lot No. | Exp. Date | Traceability |
|--------|-----------|---------|-------------|---|
| 4.008 | 61293328 | 1027612 | 15 Sep 2026 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |
| 6.987 | 61297593 | 1027614 | 15 Sep 2025 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |
| 10.010 | 61306165 | 1027613 | 15 Sep 2025 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |

Approved by :

(Pernpon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-420106-1

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Electrical measurement

pH meter

Performing standard curve by Multiproduct Calibrator at pH (4,7,10)

| Adjustment Curve at nominal pH | Applied Voltage (mV) | Nominal Value (pH) | UUC Reading | | Correction (mV) | Uncertainty (± mV) |
|-----------------------------------|---------------------------|-------------------------|-------------|--------|----------------------|-------------------------|
| | | | (pH) | (mV) | | |
| 4, 7, 10 | 177.4800 | 4 | 4.00 | 177.5 | 0.0 | 0.12 |
| | 0.0000 | 7 | 7.00 | 0.0 | 0.0 | 0.086 |
| | -177.4800 | 10 | 10.00 | -177.4 | -0.1 | 0.12 |

Function : pH meter with electrode

Performing a three - buffer standard curve using buffer nominal pH (4,7,10)

| Adjustment Curve at nominal pH | Standard Buffer (pH) | UUC Reading (pH) | Correction (pH) | Uncertainty (± pH) |
|-----------------------------------|---------------------------|-----------------------|----------------------|-------------------------|
| | | | | |
| 4, 7, 10 | 4.008 | 4.01 | 0.00 | 0.0097 |
| | 6.987 | 7.00 | -0.01 | 0.011 |
| | 10.010 | 10.01 | 0.00 | 0.014 |

Remark

UUC : Unit Under Calibration

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

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

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Certificate of Calibration

Certificate No. : 67-410112-1

Page : 1 of 2

Submitted by :

M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment :

Digital Thermo-Hygrometer

Manufacturer : Digicon

Model : TH-02A

Range Temperature : 0 °C to 50 °C Resolution : 0.1 °C

Range Humidity : 20 %R.H. to 99 %R.H. Resolution : 1 %R.H.

Serial No. : 1819A071796 ID No. : N/A

Environment :

Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Date of Received : 20 September 2024

Date of Calibration : 23 September to 24 September 2024

Date of Issue : 24 September 2024

Calibrated by : Chortip Samehusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4013 by compared with standard probe sensor humidity/temperature into humidity/temperature chamber.

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

Digital Indicator with Standard Probe Temp&Hum

ID.No. Cert.No. Due Date Traceability

400034 & 400035 SG-H-00611/67 04 Jan 2025 Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

Approved by :

(Permpoon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-410112-1

Page : 2 of 2

UUC Condition As-Received : Good

Result of Calibration : Without Adjustment

Function : Temperature measurement

Reference Humidity @ 50 %R.H.

| Standard Temperature (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|------------------------------|---------------------|--------------------|-----------------------|
| 19.99 | 19.7 | 0.3 | 0.46 |
| 25.00 | 24.7 | 0.3 | 0.46 |
| 30.01 | 29.7 | 0.3 | 0.46 |

Result of Calibration :

Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 °C

| Standard Humidity (%R.H.) | UUC Reading (%R.H.) | Correction (%R.H.) | Uncertainty (± %R.H.) |
|------------------------------|------------------------|-----------------------|--------------------------|
| 40.01 | 38 | 2 | 2.2 |
| 60.00 | 56 | 4 | 2.3 |

Remark

UUC : Unit Under Calibration

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

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

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Certificate of Calibration

Certificate No. : 67-200334-1 Page : 1 of 2

Submitted by : M Green Group Co., Ltd.
188/46 Wisutesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 ThailandEquipment : Electronic Balance
Manufacturer : SHIMADZU Model : AP225WD
Serial No. : D316300690
Capacity : 220 g Resolution : 0.00001g/102g, 0.0001g/220g

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (24.9 to 26.3) °C

Relative Humidity : (40.8 to 55.4) %

Air Pressure : 1003.0 mbar

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

Calibrated by : Akaradath Thirpichai

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

Edition 7 - November 2022

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

| Standard Weights | Cert.No. | Due Date | Traceability |
|------------------|-----------|-------------|--|
| E261-E2624 | C02232088 | 08 Nov 2024 | National Institute of Metrology (Thailand), (NIMT) |

Approved by :

(Sajja Sangkhum)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-200334-1 Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

| Nominal Value (g) | Correction (g) | Uncertainty ± (g) |
|----------------------|-------------------|----------------------|
| 0.001 | 0.00000 | 0.000015 |
| 0.01 | 0.00000 | 0.000016 |
| 0.1 | 0.00000 | 0.000018 |
| 1 | 0.00000 | 0.000026 |
| 10 | 0.00000 | 0.000053 |
| 20 | -0.00003 | 0.000071 |
| 50 | 0.00006 | 0.00011 |
| 100 | 0.00004 | 0.00020 |
| 150 | 0.0001 | 0.00038 |
| 200 | 0.0000 | 0.00038 |

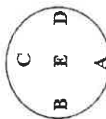
This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.13$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

| A | B | C | D | E |
|----------|---------|---------|---------|---------|
| -0.00005 | 0.00001 | 0.00002 | 0.00000 | 0.00000 |



Repeatability

Load test : 200 g

Sidev. : 0.000000 g

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Certificate of Calibration

Certificate No. : 67-400560-1

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment :

Liquid in Glass Thermometer

Manufacturer : N/A

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : 94-49747

Environment :

Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Chortip Samchusri

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

The temperature scale used was based on ITS-90


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

1. Platinum Resistance Thermometer (PRT)

| ID No. | Cert.No. | Due Date | Traceability |
|--------|------------|-------------|---|
| 400001 | TT-0023-24 | 16 Feb 2026 | National Institute of Metrology Thailand (NIMT) |

2. Standard Digital Thermometer

| ID No. | Cert.No. | Due Date | Traceability |
|--------|----------|-------------|---|
| 400003 | 23E1866 | 01 Jun 2025 | National Institute of Metrology Thailand (NIMT) |
| 400004 | 23E1866 | 01 Jun 2025 | National Institute of Metrology Thailand (NIMT) |

Approved by : 
(Pempon Charnpu)
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-400560-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC* reading 0 °C Standard reading -0.0321 °C

| Standard Reading (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|----------------------------|-----------------------|----------------------|-------------------------|
| 39.8223 | 40 | -0.2 | 0.31 |

Remark

UUC : Unit Under Calibration

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

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

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Certificate of Calibration

Certificate No. : 67-300569-1

Page : 1 of 2

Submitted by

: M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Uttd Rd., Thungkru, Bangkok 10140 Thailand

Equipment

: Burette

Manufacturer : GLASSCO

Class : A

Capacity : 10 ml

Graduation : 0.05 ml

ID No. : 2212-0344-1

Environment

: Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1008.0 mbar.

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Areerat Sombun

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

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

Electronic Balance

ID No.

Cert.No.

Due Date

Traceability

241005

67-200210-4

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300569-1

Page : 2 of 2

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

UUC Condition As-Received : Good

Delivery Time : 19.92 sec.

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 2 | 2.0044 |
| 5 | 5.0024 |
| 10 | 9.9915 |

Uncertainty of measurement with in ± 0.0039 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2.00 , providing a level of confidence of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300569-2

Page : 1 of 2

Submitted by

: M Green Group Co., Ltd.

188/46 Wisatusuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment

: Burette

Manufacturer : GLASSCO

Class : A

Capacity : 25 ml

Graduation : 0.1 ml

ID No. : 2212-0344-2

Environment

: Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1008.0 mbar.

Date of Received

: 20 September 2024

Date of Calibration

: 23 September 2024

Date of Issue

: 23 September 2024

Calibrated by

: Areerat Sombun

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

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

Electronic Balance

ID No.

Cert. No.

Due Date

Traceability

241005

67-200210-4

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

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Certificate of Calibration

Certificate No. : 67-300569-2

Page : 2 of 2

Result of Calibration :

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

UUC Condition As-Received : Good

Delivery Time : 46.13 sec.

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 5 | 5.0039 |
| 15 | 14.9824 |
| 25 | 24.9757 |

Uncertainty of measurement with in ± 0.0066 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2.00 ,
providing a level of confidence of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300569-3

Page : 1 of 2

Submitted by

: M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkrn, Bangkok 10140 Thailand

Equipment

: Measuring Pipette

Manufacturer : GLASSCO

Class : A

Capacity : 10 ml

Graduation : 0.1 ml

ID No. : MP10/01/19

Environment

: Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1000.8 mbar.

Date of Received

: 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by

: Arceat Sombun

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

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

Electronic Balance

ID No.

Cert. No.

Due Date

Traceability

241005

67-200210-4

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300569-3

Page : 2 of 2

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

UUC Condition As-Received : Good

Delivery Time : 12.20 sec.

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 2 | 1.9998 |
| 5 | 4.9871 |
| 10 | 9.9742 |

Uncertainty of measurement with in ± 0.0039 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300569-4

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisutesuknakhon 25, Pracha-Uttid Rd., Thungkru, Bangkok 10140 Thailand

Equipment

: Measuring Pipette

Manufacturer : GLASSCO

Class : A

Capacity : 25 ml

Graduation : 0.1 ml

ID No. : MP25/01/19

Environment

: Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1000.8 mbar.

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Arcerat Sombun

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

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

Electronic Balance

ID No.

Cert. No.

Due Date

Traceability

241005

67-200210-4

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

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Certificate of Calibration

Certificate No. : 67-300569-4

Page : 2 of 2

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

UUC Condition As-Received : Good

Delivery Time : 15.20 sec.

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 5 | 5.0302 |
| 15 | 15.0832 |
| 25 | 25.0398 |

Uncertainty of measurement with in ± 0.0067 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2.00 , providing a level of confidence of approximately 95%

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NSC-TIS-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-300571-1

Page : 1 of 2

Submitted by

: M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Uttd Rd., Thungkru, Bangkok-10140 Thailand

Equipment

: Cylinder

Manufacturer : GLASSCO

Class : A

Capacity : 100 ml

Graduation : 1 ml

ID No. : CY100/01/24

Environment

: Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1003.9 mbar.

Date of Received : 20 September 2024

Date of Calibration : 24 September 2024

Date of Issue : 24 September 2024

Calibrated by : Areerat Sombun

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

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

Electronic Balance

ID No.

Cert. No.

Due Date

Traceability

241002

67-200210-1

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300571-1

Page : 2 of 2

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

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 50 | 50.45 |
| 100 | 100.52 |

Uncertainty of measurement with in ± 0.063 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300571-2

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Uttd Rd., Thungkru, Bangkok 10140 Thailand

Equipment : Cylinder

Manufacturer : GLASSCO

Class : A

Capacity : 250 ml

Graduation : 2 ml

ID No. : CY250/01/19

Environment : Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1004.1 mbar.

Date of Received : 20 September 2024

Date of Calibration : 24 September 2024

Date of Issue : 24 September 2024

Calibrated by : Arccrat Sombun

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

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

Electronic Balance

ID No. : 241002

Cert. No. : 67-200210-1

Due Date : 02 Dec 2024

Traceability

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300571-2

Page : 2 of 2

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

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 150 | 151.02 |
| 250 | 251.16 |

Uncertainty of measurement with in ± 0.087 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2.00 , providing a level of confidence of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300571-3

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Uttd Rd., Thungkru, Bangkok 10140 Thailand

Equipment : Cylinder
Manufacturer : GLASSCO
Capacity : 1000 ml
Graduation : 10 ml
ID No. : CY1000/01/24
Class : A

Environment : Ambient Temperature : (20 ± 3) °C
Relative Humidity : (50 ± 10) %
Air Pressure : 1001.7 mbar.

Date of Received : 20 September 2024
Date of Calibration : 24 September 2024
Date of Issue : 24 September 2024
Calibrated by : Areerat Sombun

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

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

Electronic Balance

| ID No. | Cert. No. | Due Date | Traceability |
|--------|-------------|-------------|---|
| 241002 | 67-200210-1 | 02 Dec 2024 | National Institute of Metrology (Thailand) (NIMT) |

Approved by :

(Wipa Tovadee)
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300571-3

Page : 2 of 2

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

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 500 | 500.74 |
| 1000 | 1003.10 |

Uncertainty of measurement with in \pm 0.17 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

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Wipa Tovadee



Certificate of Calibration

Certificate No. : 67-300572-1 **Page** : 1 of 2

Submitted by : M Green Group Co., Ltd.
188/46 Wisatsuknakhon 25, Pracha-Uttd Rd., Thungkru, Bangkok 10140 Thailand

Equipment : Imhoff Cone
Manufacturer : VITLAB
Capacity : 1000 ml **Graduation** : 0.1, 50 ml
ID No. : CY1000/01/22

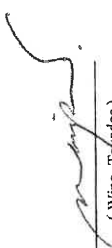
Environment : Ambient Temperature : $(20 \pm 3) ^\circ \text{C}$
Relative Humidity : $(50 \pm 10) \%$
Air Pressure : 1001.5 mbar.

Date of Received : 20 September 2024
Date of Calibration : 23 September 2024
Date of Issue : 23 September 2024
Calibrated by : Areerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-01

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

Electronic Balance
ID No. : 241002
Cert. No. : 67-200210-1
Due Date : 02 Dec 2024
Traceability : National Institute of Metrology (Thailand) (NIMT)

Approved by : 
(Wipa Teeradee)
Supervisor

The Uncertainties are for a confidence probability of approximately 95%
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Certificate of Calibration

Certificate No. : 67-300572-1 **Page** : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at $20 ^\circ \text{C}$
UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 500 | 500.74 |
| 1000 | 1009.16 |

Uncertainty of measurement with in $\pm 0.17 \text{ ml}$

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

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NSC-TISI-TISI 7025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-400547-1 Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatsukhakhon 25, Pracha-Utd Rd., Thungkru Bangkok 10140 Thailand

Equipment : Temperature Indicator with Thermistor Probe

Temperature Indicator

Manufacturer : Eutech Model : pH 700

Range : N/A °C Resolution : 0.1 °C

Serial No. : 2884323 ID No. : N/A

Thermistor probe

Model : N/A Sheath Material : Stainless

Diameter : 3 mm. Length : 115 mm.

Serial No. : PH5TEMB01P 279 ID No. : N/A

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (26.3 to 26.7) °C

Relative Humidity : (40 to 45) %

Line Voltage : (220.0 to 223.0) VAC

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

Calibrated by : Permpon Chanpu

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003

by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

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

1. Platinum Resistance Thermometer (PRT)

ID No. Cert.No. Due Date Traceability

400002 TT-0095-24 01 Jul 2026 National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No. Cert.No. Due Date Traceability

400033 24E633 21 Feb 2026 National Institute of Metrology Thailand (NIMT)

Approved by :

(Permpon Chanpu)

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. : 67-400547-1 Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

| Immersion Depth (mm.) | Standard Reading (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|----------------------------|----------------------------|-----------------------|----------------------|-------------------------|
| 130 | 25.004 | 24.9 | 0.1 | 0.19 |

Remark

UUC : Unit Under Calibration

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

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

-o0o





Certificate of Calibration

Certificate No. : 67-400548-1

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisutesukhakhon 25, Pracha-Utit Rd., Thungkru Bangkok 10140 Thailand

Equipment : Temperature controlled enclosure (Refrigerator)

Manufacturer : Biobase

Model : BXC-Y250M (II)

Range : N/A °C

Resolution : 0.1 °C

Serial No. : YC025025190108

ID No. : N/A

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (26.3 to 27.4) °C

Relative Humidity : (39 to 47) %

Line Voltage : (226.0 to 230.0) V

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

Calibrated by : Pempon Chaupha

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with RTD Probe

ID No. Cert.No.

400046 & 400042 67-400442-1

Traceability

Due Date

26 Jan 2025 National Institute of Metrology Thailand (NIMT)

Approved by :

(Pempon Chaupha)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-400548-1

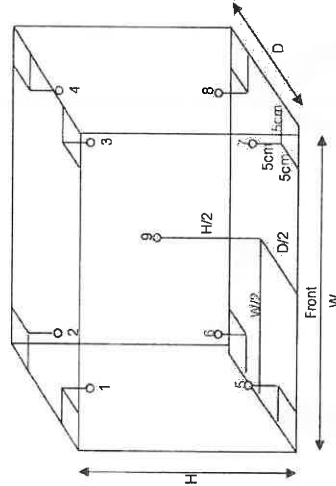
Page : 2 of 2

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 = 0.50 m

D = 0.40 m

H = 1.20 m

Capacity = 0.24 m³

| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Temperature (°C) @ Sensor No. | | | | | | | | | Uncertainty (± °C) |
|--------------------|-----------------------------|--------------------------------|--|------|------|------|------|------|------|------|------|-----------------------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 4.0 | 2.0 | 2.0 | 4.70 | 4.42 | 5.04 | 4.99 | 4.52 | 4.22 | 4.74 | 4.67 | 3.89 | 0.45 |

| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Uniformity (°C) | Measured Stability (°C) | Overall Variation (°C) |
|--------------------|-----------------------------|--------------------------------|-----------------------------|----------------------------|---------------------------|
| 4.0 | 2.0 | 2.00 | 1.23 | 0.13 | 1.40 |

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-





Certificate of Calibration

Certificate No. : 67-400548-2

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatesukhakhon 25, Pracha-Uttd Rd., Thungkru Bangkok 10140 Thailand

Equipment : Temperature controlled enclosure (Oven)

Manufacturer : Memmert

Model : UF110

Range : N/A °C Resolution : 0.1 °C

Serial No. : B419.1092 ID No. : N/A

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (26.3 to 27.4) °C

Relative Humidity : (39 to 47) %

Line Voltage : (226.0 to 230.0) V

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

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

ID No. Cert. No. Due Date Traceability

400046 & 400023 67-400198-1 01 Oct 2024 National Institute of Metrology Thailand (NIMT)

Approved by :

(Permpon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-400548-2

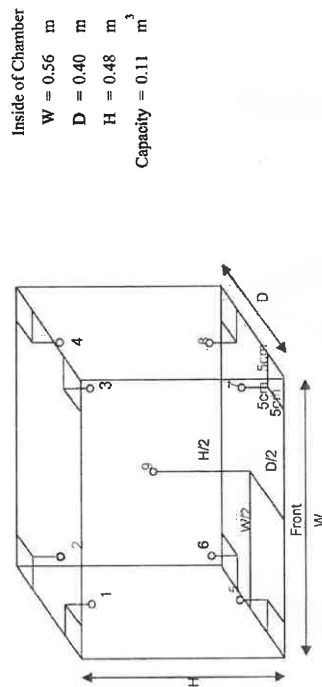
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



| 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 | |
| 103.0 | 103.0 | 103.0 | 102.3 | 102.9 | 103.7 | 103.7 | 102.3 | 102.3 | 103.8 | 102.2 | 102.7 | 0.82 |
| 104.0 | 104.0 | 104.0 | 103.3 | 103.9 | 104.8 | 104.5 | 103.2 | 103.3 | 104.8 | 103.2 | 103.7 | 0.84 |
| 105.0 | 105.0 | 105.0 | 104.3 | 104.9 | 105.8 | 105.7 | 104.3 | 104.3 | 105.8 | 104.3 | 104.7 | 0.83 |
| 150.0 | 150.0 | 150.0 | 149.3 | 149.9 | 151.3 | 151.2 | 149.1 | 149.2 | 151.2 | 149.3 | 149.5 | 1.1 |
| 180.0 | 180.0 | 180.0 | 179.0 | 179.8 | 181.4 | 181.1 | 178.8 | 179.0 | 181.1 | 178.8 | 179.3 | 1.1 |

| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Uniformity (°C) | Measured Stability (°C) | Overall Variation (°C) |
|--------------------|-----------------------------|--------------------------------|-----------------------------|----------------------------|---------------------------|
| 103.0 | 103.0 | 103.0 | 1.3 | 0.3 | 2.0 |
| 104.0 | 104.0 | 104.0 | 1.5 | 0.3 | 2.1 |
| 105.0 | 105.0 | 105.0 | 1.4 | 0.3 | 2.0 |
| 150.0 | 150.0 | 150.0 | 2.3 | 0.5 | 2.7 |
| 180.0 | 180.0 | 180.0 | 2.5 | 0.5 | 3.3 |

Remark The uncertainty is not combine uniformity of the air chamber

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

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

-o0o-





Certificate of Calibration

Certificate No. : 67-400548-3

Page : 1 of 2

Submitted by :

M Green Group Co., Ltd.

188/46 Wisatsukhakhon 25, Pracha-Utd Rd., Thungkru Bangkok 10140 Thailand

Equipment :

Water Bath

Manufacturer : Memmert

Model : WNB29

Range : N/A °C

Resolution :0.1 °C

Serial No. : L619.0037

ID No. : N/A

Environment :

On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (26.3 to 27.4) °C

Relative Humidity : (39 to 47) %

Line Voltage : (226.0 to 230.0) V

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

Calibrated by : Pempon Chanpu

Calibration Method :

This instrument was calibrated by In-house method CAL-M4006 based on ASTM E715-80

The temperature scale used was based on ITS-90

Reference Standard Instruments :

This certification is traceable to the International System of Units

Standard Digital Thermometer with RTD probe

ID No.

Cert. No.

Due Date

Traceability

400046 & 400024

67-400198-2

30 Sep 2024

National Institute of Metrology Thailand (NIMT)

Approved by :

(Pempon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

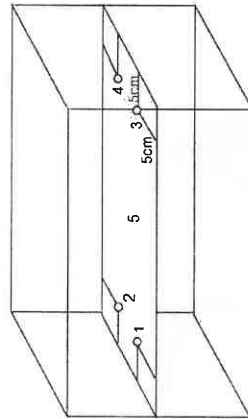
Certificate No. : 67-400548-3

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement



| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Temperature (°C) @ Sensor | | | | | Uncertainty (± °C) | Measured Uniformity (°C) | Measured Stability (°C) |
|--------------------|-----------------------------|--------------------------------|------------------------------------|-------|-------|-------|-------|-----------------------|-----------------------------|----------------------------|
| | | | No. | | | | | | | |
| 85.0 | 85.0 | 85.0 | 1 | 2 | 3 | 4 | 5 | 0.20 | 0.25 | 0.06 |
| | | | 84.55 | 84.44 | 84.49 | 84.46 | 84.62 | | | |

Remark The uncertainty is not combine uniformity of the water bath

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

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

- oDo -

P



NSC-TIS-TIS 7025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-400548-4 Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatsukhakhoon 25, Pracha-Uttd Rd., Thungkru Bangkok 10140 Thailand

Equipment : Temperature controlled enclosure (Incubator)

Manufacturer : Biobase

Model : Biochemistry Incubator

Range : 0 °C to 65 °C Resolution : 0.1 °C

Serial No. : KYP1502202003 ID No. : N/A

Environment : On site calibration was carried out at the Laboratory, M Green Group Co., Ltd.

Ambient Temperature : (31.0 to 32.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (226.0 to 230.0) V

Date of Received : 20 September 2024

Date of Calibration : 20 September 2024

Date of Issue : 21 September 2024

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 RTD Probe

ID No. Cert.No. Due Date Traceability

400029 & 400048 67-400444-1 02 Feb 2025 National Institute of Metrology Thailand (NIMT)

Approved by :

(Permpon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-400548-4

Result of Calibration : Without Adjustment

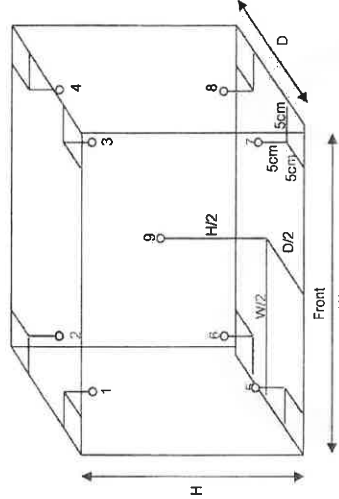
UUC Condition As-Received : Good

Function : Temperature measurement

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

Inside of Chamber

W = 0.45 m
D = 0.41 m
H = 0.85 m
Capacity = 0.16 m³



| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Temperature (°C) @ Sensor No. | | | | | | | | | Uncertainty (± °C) |
|--------------------|-----------------------------|--------------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-----------------------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 20.0 | 20.4 | 20.4 | 20.23 | 20.18 | 20.08 | 20.15 | 19.90 | 19.92 | 19.96 | 19.90 | 19.96 | 0.82 |

| Test Point (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Uniformity (°C) | | Measured Stability (°C) | | Overall Variation (°C) |
|--------------------|-----------------------------|--------------------------------|-----------------------------|------|----------------------------|------|---------------------------|
| | | | 0.38 | 0.43 | 0.43 | 0.43 | |
| 20.0 | 20.4 | 20.4 | 0.38 | 0.43 | 0.43 | 0.43 | 0.96 |

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-

P





Certificate of Calibration

Certificate No. : 67-300570-1

Page : 1 of 2

Submitted by

: M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Uthid Rd., Thungkru, Bangkok 10140 Thailand

Equipment

: Volumetric Flask

Manufacturer : GLASSCO

Class : A

Capacity : 100 ml

ID No. : VF100/01/19

Environment

: Ambient Temperature : (20 ± 3) °C

: Relative Humidity : (50 ± 10) %

: Air Pressure : 1003.9 mbar.

Date of Received

: 20 September 2024

Date of Calibration

: 24 September 2024

Date of Issue

: 24 September 2024

Calibrated by

: Areerat Sombun

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

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

Electronic Balance

ID No.

Cert.No.

Due Date

Traceability

241005

67-200210-4

02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Signature)
(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300570-1

Page : 2 of 2

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

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 100 | 100.063 |

Uncertainty of measurement with in \pm 0.018 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

-o0o-

(Signature)





Certificate of Calibration

Certificate No. : 67-300570-2

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment : Volumetric Flask
 Manufacturer : GLASSCO Class : A
 Capacity : 250 ml
 ID No. : VF250/01/19

Environment : Ambient Temperature : (20 ± 3) °C
 Relative Humidity : (50 ± 10) %
 Air Pressure : 1003.8 mbar.

Date of Received : 20 September 2024
 Date of Calibration : 24 September 2024
 Date of Issue : 24 September 2024
 Calibrated by : Areerat Sombun

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

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

Electronic Balance

| ID No. | Cert. No. | Due Date | Traceability |
|--------|-------------|-------------|---|
| 241002 | 67-200210-1 | 02 Dec 2024 | National Institute of Metrology (Thailand) (NIMT) |

Approved by :

(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300570-2

Page : 2 of 2

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

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 250 | 250.04 |

Uncertainty of measurement with in ± 0.051 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

-o0o-





NSC-TISI-TSI 7025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-300570-3

Page : 1 of 2

Submitted by : M Green Group Co., Ltd.

188/46 Wisatsuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment : Volumetric Flask

Manufacturer : GLASSCO **Class :** A

Capacity : 1000 ml

ID No. : VF1000/01/19

Environment : Ambient Temperature : $(20 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 10) \%$

Air Pressure : 1003.3 mbar.

Date of Received : 20 September 2024

Date of Calibration : 24 September 2024

Date of Issue : 24 September 2024

Calibrated by : Areerat Sombun

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

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

Electronic Balance

ID No. **Cert.No.** **Due Date** **Traceability**

241002 67-200210-1 02 Dec 2024

National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Signature)
(Wipa Tovadee)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-300570-3

Page : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at $20 ^\circ\text{C}$

UUC Condition As-Received : Good

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 1000 | 1000.25 |

Uncertainty of measurement with in ± 0.14 ml

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

-o0o-

(Signature)





NSC-TISI-TIS17023
CALIBRATION 0036

Certificate of Calibration

Certificate No. : 67-210362-1

Page : 1 of 2

Submitted by :

M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment :

Weight

Manufacturer : N/A

Material : Stainless Steel

Weight size : 1 g

ID No. : 63-210391-1

Assumed density of weight : 7950 kg / m³

Assumed Air density : 1.2 kg / m³

Environment : Ambient Temperature : (20 ± 2) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1005.7 mbar

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Wutichai Swatphong

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

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

Standard Weights

ID No. Cert. No.

E221-E2210 MM-0042-22

Due Date

21 Mar 2025

Traceability

National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Satja Sangkhum)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-210362-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

| No. | Nominal Value | Id.Mark | Conventional mass Value | Measuring Uncertainty |
|-----|---------------|---------|-------------------------|-----------------------|
| 1 | 1 g | none | 1 g +0.003 mg | ± 0.023 mg |

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

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

-o0o-

(Signature)





Certificate of Calibration

Certificate No. : 67-210362-2

Page : 1 of 2

Submitted by :

M Green Group Co., Ltd.

188/46 Wisatesuknakhon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment :

Weight

Manufacturer : N/A

Material : Stainless Steel

Weight size : 100 g

ID No. : 63-210391-2

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

Environment : Ambient Temperature : (20 ± 2) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1005.7 mbar

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Wuttichai Swatphong

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

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

Standard Weights

ID No.

E221-E2210

Cert. No.

MM-0042-22

Due Date

21 Mar 2025

Traceability

National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Satja Sangkhum)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-210362-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

| No. | Nominal Value | Id.Mark | Conventional mass Value | Measuring Uncertainty |
|-----|---------------|---------|-------------------------|-----------------------|
| 1 | 100 g | none | 100 g +0.06 mg | ± 0.11 mg |

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

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

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NSC-TIS-TIS 7025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-210362-3

Page : 1 of 2

Submitted by :

M Green Group Co., Ltd.

188/46 Wisateunkhachon 25, Pracha-Utd Rd., Thungkru, Bangkok 10140 Thailand

Equipment :

Weight

Manufacturer : N/A

Material : Stainless Steel

Weight size : 200 g

ID No. : 63-210391-3

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

Environment : Ambient Temperature : (20 ± 2) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1005.7 mbar

Date of Received : 20 September 2024

Date of Calibration : 23 September 2024

Date of Issue : 23 September 2024

Calibrated by : Wuttichai Swatphong

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

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

Standard Weights

ID.No.

E221-E2210

Cert.No.

MM-0042-22

Due Date

21 Mar 2025

Traceability

National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Sutja Sangkhum)

Supervisor

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Certificate of Calibration

Certificate No. : 67-210362-3

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

| No. | Nominal Value | Id.Mark | Conventional mass Value | Measuring Uncertainty |
|-----|---------------|---------|-------------------------|-----------------------|
| 1 | 200 g | none | 200 g +0.06 mg | ± 0.17 mg |

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

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

-o-o-





บริษัท ซีจี ไซแอนติฟิค จำกัด
CG SCIENTIFIC CO., LTD.



บริษัท ซีจี ไซแอนติฟิค จำกัด
CG SCIENTIFIC CO., LTD.

การดูแลบำรุงรักษาเชิงป้องกัน Preventive Maintenance

Customer Name: บริษัท เทสท์ เพค จำกัด
Product : Distillation Unit
Brand : GERHARDT
Model : Vapodest 30
Serial number : GER003718



- Part 1: สัญญาการให้บริการ (Service Contact)
Part 2: ข้อมูลพื้นฐานของเครื่องมือ (Details of Instrument)
Part 3: ตรวจสอบเช็คสภาพเครื่อง
Part 4: รายละเอียดและรายงานผลการให้บริการ Preventive Maintenance
4.1 ขั้นตอนการบริการ
4.2 รายงานผลการให้บริการ
Part 5: ข้อมูลสนับสนุนด้านเทคนิค (General Technical Support)
5.1 Care and Maintenance
5.1.1 การบำรุงรักษาทั่วไป (Basic maintenance)
5.1.2 General error message



1. ข้อมูลการให้บริการ (Service Contact)

หน่วยงานลูกค้า : บริษัท เทสต์ เทคโนโลยี
ที่อยู่ : 30/32 ซอยพหลโยธิน 2 ซอย 63 แขวงสามยุค เขตบางเขน กรุงเทพมหานคร 10150
โทรศัพท์ :
อีเมล :
บุคคลติดต่อ : คุณ กรกนก ขุนพิทักษ์
ตำแหน่ง :
โทรศัพท์ : 02-893-4211-17
อีเมล : lab_center@testtech.co.th

สัญญาการบริการจำนวน 1 ครั้ง ต่อ ปี

ครั้งที่ 1 วันที่ : 19 มีนาคม 2568
ครั้งที่ 2 วันที่ :
ครั้งที่ 3 วันที่ :

2. ข้อมูลพื้นฐานของเครื่องมือ (Details of Instrument)

2.1 รายละเอียดเครื่องมือ (Instrument Description)

ประเภทเครื่องมือ : Distillation Unit
ผลิตภัณฑ์ : GERHARDT
รุ่น : Vapodest 30
หมายเลขเครื่อง : GER003718
หมายเลขครุภัณฑ์ : EOL-062

2.2 ผู้ดำเนินการ

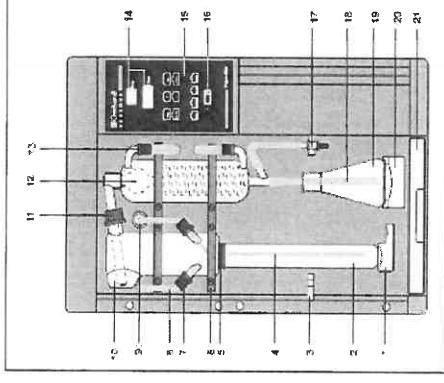
ดำเนินการทำ PM โดย

ชื่อ-นามสกุล : คุณณณฤทธิ์ ดอนวรรัตน์
ตำแหน่ง : วิศวกร
แผนก : บริการหลังการขาย
ฝ่าย : บริการหลังการขาย

Part 3: Operational Qualification (OQ)

3.1 ตรวจสอบสภาพเครื่อง

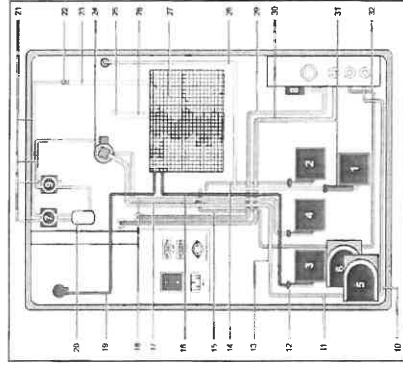
FRONT



| No | Description | PASS | FAIL | N/A |
|-----|--|-------------------------------------|--------------------------|--------------------------|
| 1. | Quick clamping device with wedge | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | Kjeldatherm digestion tube | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. | Holder for steam inlet tubing | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. | PTFP-Inlet tubing, steam | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. | Viton-cone | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. | Clamping for glassware | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. | Screw cap GL18 with silicone seal | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. | PTFP-Inlet tubing, NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. | PP-Distributor with PP-threaded joint | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. | Distribution head, PP | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. | Screw cap GL32 with silicone seal | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. | Distillation condenser | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. | Screw cap GL14 with plastic screw connection | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. | Display | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. | Keyboard, chemical-resistant | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. | Main switch, green | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. | Ventilation valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. | Distillate outlet tubing | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. | Erlenmeyer flask | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. | Platform | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. | Drip tray | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



REAR



| No | Description | PASS | FAIL | N/A |
|-----|---|-------------------------------------|--------------------------|--|
| 1. | Diaphragm pump NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | Diaphragm pump H_2CO_3 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap40 |
| 3. | Diaphragm pump H_2O for steam generator | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. | Diaphragm pump H_2O for sample | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30,40 |
| 5. | Peristaltic pump for suction sample | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30, 40 |
| 6. | Peristaltic pump for suction receiver | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> Option |
| 7. | Pinch-solenoid valve, steam | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. | Magnetic valve with pressure control | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. | Pinch-solenoid valve, shut-off | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. | Verprene-tubing 4x8 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. | Verprene-tubing 4x8 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30,40 |
| 12. | Non-return valve for diaphragm pumps | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. | Tubing reduction PP 51x10x5 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30,40 |
| 14. | Silicone tubing 4x7 mm. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap40 |
| 15. | Silicone tubing 4x7 mm. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> Option |
| 16. | Silicone-tubing 4x7 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. | Verprene-tubing 8x12 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30,40 |
| 18. | Verprene tubing 4x7 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> *Vap30,40 |
| 19. | Silicone tubing 4x7 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. | Ventilation glass | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. | Novoprene-tubing 4.8x8 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. | Tubing reduction | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. | Silicone tubing 6x10 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. | PP-distributor with PP-thread | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. | SKT-valve (built in with brass fitting) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. | Silicone tubing 8x16x80 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 27. | Steam generator | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 28. | PTFE-inlet tubing NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 29. | Silicone tubing 8x16 for cooling water inlet | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 30. | Silicone tubing 8x16 for cooling water outlet | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 31. | Viton-tubing 6x12*50 mm. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 32. | Silicone tubing 4x7 mm. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> Option |



Part 4:

รายละเอียดการตรวจสอบ

4.1 ขั้นตอนการบริการ

ตรวจสอบระบบไฟฟ้า (Electrical Test)

- ความต้านทานทางไฟฟ้าของเครื่องกับกราวด์
- กระแสไฟฟ้าที่ใช้งาน

PASS

FAIL

Remark

☒

☐

☐

ตรวจสอบสภาพเครื่อง (Optical Test)

- Main cable
- Electric wiring
- Pumps
- Distribution Head
- Condensor
- Steam generator
- Tubing
- Viton cone

PASS

FAIL

Remark

☒

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ตรวจสอบ Function การทำงาน (The Function Test)

- ระบบสร้างและควบคุมความดันของ Steam
- ระบบการเติมน้ำเข้า Sample Tube
- ระบบการเติม NaOH
- ระบบการ Suction ตั้ง Sample Tube และ Receiver

PASS

FAIL

Remark

☒

☐

☐

☐

4.2 รายงานผลการให้บริการ

1. TECHNICAL DATA

- Main Supply 220 volt + 10% 50 Hz
- Normal current

PASS

FAIL

Remark

☒

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☐

1.1 COOLING WATER BATH

- Temperature 15-20 °C
- Cooling Water Outlet
- Control Temperature

PASS

FAIL

Remark

☒

☐

☐

1.2 OPTICAL TEST VAP

30

- Screw cap GL14
- Screw cap GL18
- Screw cap GL32
- Distillation Head
- Condensor
- Viton Cone
- Ventilation Valve
- Micro Switch Sample

PASS

FAIL

Remark

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2. SYSTEM COOLING WATER INLET

- Cooling Water Inlet
- Cooling Water Outlet
- Flow control valve

PASS

FAIL

Remark

☒

☐

☐

3. SYSTEM CONTROL

| | PASS | FAIL | Remark |
|---------------------------------------|-------------------------------------|--------------------------|-----------|
| Key Board | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Display | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Program | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Adding H ₂ O | <input checked="" type="checkbox"/> | <input type="checkbox"/> | *Vap30/40 |
| Adding NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Adding H ₃ BO ₃ | <input checked="" type="checkbox"/> | <input type="checkbox"/> | *Vap-40 |
| Suction Sample | <input checked="" type="checkbox"/> | <input type="checkbox"/> | *Vap30/40 |

4. SYSTEM DISTILLATION

| | PASS | FAIL | Remark |
|--------------------------|-------------------------------------|--------------------------|--------|
| Boiler | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Level Sensor | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Neoprene-Tubing | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Solenoid Valve Shut-Off | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Solenoid Valve Steam | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Excess Pressure Detector | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Ventilation Valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Heater | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |

5. PUMP

| | PASS | FAIL | Remark |
|-------------------------------------|-------------------------------------|--------------------------|--------|
| Pump H ₂ O Steam | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| - Non-Return Valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Pump H ₂ O Sample | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| - Non-Return Valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Pump NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| - Non-Return Valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Pump H ₃ BO ₃ | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| - Non-Return Valve | <input checked="" type="checkbox"/> | <input type="checkbox"/> | N/A |
| Pump suction | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |

6. THE FOLLOWING PROGRAM RUN

| | PASS | FAIL | Remark |
|---|-------------------------------------|--------------------------|-----------|
| Addition H ₂ O | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 sec. |
| Addition NaOH | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 sec. |
| Addition H ₃ BO ₃ | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 sec. |
| Reaction Time | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 min |
| Distillation Time | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 min |
| Steam Capacity | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 30%-100% |
| Suction Time | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 0-99 sec. |

The Instrument is in perfect technical shape

Remark :

4.2 Error Code

The micro-processor continually surveys all the functions of the distillation system. As soon as an error arises it is shown on the display and accompanied by an acoustic signal.

| Error message | Measures |
|----------------------------|---|
| No tap water | Check cooling water inlet for blockages Ensure the tap is turned on Enter |
| No sample tube | Insert tube Enter |
| Check chemicals | Check set of tanks Enter |
| Low water Press Enter | Check the water inlet distilled H ₂ O Enter |
| Filling Steam generator | This message disappears as soon as steam generator is filled |

After the above mentioned errors are corrected, the following message is displayed.

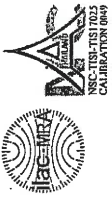
| Error message | Measures |
|------------------------------------|---|
| Stop Prog. No. x Continue=Enter | Enter = continue of interrupted program Reset = Standby-mode |

Other error messages

| Error message | Measures |
|-----------------------------------|--|
| Wait for steam | Message disappears as soon as stand-by is reached |
| Add sol. > 1min Continue=Enter | Check programming Enter=continue of interrupted program Reset=Standby-mode |
| Program undefined | Check programming Reset |
| Excess steam pressure | Switch the system off and call service |
| Sensor error | Switch the system off and call service |



QUALITY CALIBRATION CO.,LTD.
235 Petekkasem 63/2 Road, Lakson, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com



CERTIFICATE No : 24T6582
REFERENCE No : 73767-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : WATER BATH
MANUFACTURER : MEMMERT
MODEL : WPE 45
SERIAL No : L711.0024
ID No : EQL-147
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II SOI 63, RAMA II RD., SAMAEADAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 01-Jul-24

APPROVED BY :
ISSUED DATE : 02-Jul-24
RECEIVED DATE : 01-Jul-24

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.

F-G010 REV : 03



QUALITY CALIBRATION CO.,LTD.
235 Petekkasem 63/2 Road, Lakson, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com

CERTIFICATE No : 24T6582

PAGE : 2 OF 2

Calibration Report

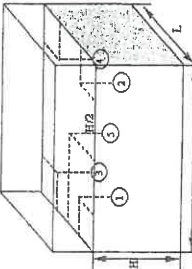
EQUIPMENT : WATER BATH
MANUFACTURER : MEMMERT
ID NUMBER : EQL-147
RECEIVED DATE : 01-Jul-24
AMBIENT TEMPERATURE : 24 °C ± 1 °C
MODEL : WPE 45
SERIAL NUMBER : L711.0024
CALIBRATION DATE : 01-Jul-24
RELATIVE HUMIDITY : 51 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001)BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.
2. REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER WITH RTD
INSTRUMENT MODEL 2625A
SERIAL No 6603614
CERTIFICATE No 23T6642
DUE DATE 19-Jul-24
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath (°C) : 1.1
Overall Variation of Line Voltage (V) : 4
Instrument Condition : Normal
Bath Inner Size (W*L*H) : 59*35*22 cm

BATH PERFORMANCE

| Calibrate Point (°C) | Average All Position Temp. (±°C) | Temperature Stability (±°C) | Radius Uniformity (°C) | Axial Uniformity (°C) | Overall Variation (°C) |
|----------------------|----------------------------------|-----------------------------|------------------------|-----------------------|------------------------|
| 41.5 | 41.50 | 0.05 | 0.04 | 0.02 | 0.12 |
| 44.5 | 44.48 | 0.03 | 0.03 | 0.03 | 0.08 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|-------|-------|-------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | Ref. 5 | |
| 41.5 | 41.5 | 41.51 | 41.47 | 41.51 | 41.48 | 41.50 | 0.14 |
| 44.5 | 44.5 | 44.47 | 44.47 | 44.49 | 44.47 | 44.49 | 0.14 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE BATH.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

F-G010 REV : 03



CERTIFICATE No : 25T0970
REFERENCE No : 76012-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : INCUBATOR
MANUFACTURER : MEMMERT
MODEL : IF 160
SERIAL No : D518.0082
ID No : EQL-205
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO.,LTD.
30,32 RAMA II RD., SAMAEDAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 04-Feb-25

APPROVED BY :
PONGSAK J.
ISSUED DATE : 12-Feb-25
RECEIVED DATE : 04-Feb-25



CERTIFICATE No : 25T0970

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : INCUBATOR
MANUFACTURER : MEMMERT
MODEL : IF 160
ID No : EQL-205
RECEIVED DATE : 04-Feb-25
AMBIENT TEMPERATURE : 25 °C ± 1 °C
S/N : D518.0082
CALIBRATION DATE : 04-Feb-25
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

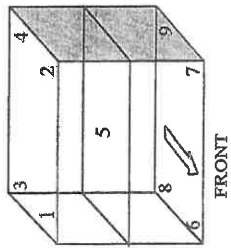
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 3 cm to 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER WITH RTD HYDRA 2635A 7301307
2) THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
3. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
4. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.
RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 11
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*72 cm



CHAMBER PERFORMANCE

| Calibration Point (°C) | Controller Temperature (°C) | Average All Position (°C) | Temperature Stability (±°C) | Temperature Uniformity (°C) | Overall Variation (°C) |
|------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|------------------------|
| 35.0 | 35.0 | 34.98 | 0.03 | 0.08 | 0.12 |
| 36.0 | 36.0 | 35.99 | 0.02 | 0.16 | 0.16 |
| 41.5 | 41.6 | 41.51 | 0.03 | 0.19 | 0.23 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|--------------------|
| | | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | |
| 35.0 | 35.0 | 34.96 | 35.01 | 34.94 | 35.00 | 35.01 | 34.99 | 34.98 | 34.97 | 35.01 | 0.25 |
| 36.0 | 36.0 | 35.98 | 36.03 | 35.95 | 36.01 | 36.04 | 36.01 | 35.91 | 35.99 | 36.04 | 0.25 |
| 41.6 | 41.6 | 41.49 | 41.53 | 41.43 | 41.52 | 41.59 | 41.53 | 41.42 | 41.53 | 41.58 | 0.36 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 3 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.
END OF CALIBRATION REPORT

F-G010 REV : 03



CERTIFICATE No : 25T0975
REFERENCE No : 76012-7

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : AUTOCLAVE
MANUFACTURER : HIRAYAMA
MODEL : HVE-50
SERIAL No : 30612085166
No : EQL-155

CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II RD., SAMAEDAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 04-Feb-25

APPROVED BY :
PONGSAK J.
ISSUED DATE : 12-Feb-25
RECEIVED DATE : 04-Feb-25

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



F-G010 REV : 03



CERTIFICATE No : 25T0975

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : AUTOCLAVE
MANUFACTURER : HIRAYAMA
ID NUMBER : EQL-155
RECEIVED DATE : 04-Feb-25
AMBIENT TEMPERATURE : 29°C ± 1°C
MODEL : HVE-50
SERIAL NUMBER : 30612085166
CALIBRATION DATE : 04-Feb-25
RELATIVE HUMIDITY : 53 %RH ± 10 % RH

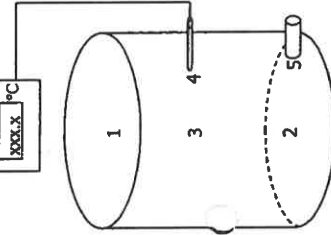
CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BASED ON BS 2646-1:2021 BY COMPARISON WITH CALIBRATED RTD DATA LOGGERS ON LOCATION 1 AND 2 WERE PLACED IN THE UPPER HALF AND LOWER HALF OF CHAMBER FREE SPACE RESPECTIVELY. THE THIRD SENSOR WAS PLACED WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE INSTRUMENT CHAMBER. SENSOR NUMBER 4 WAS ATTACHED TO THE LOAD TEMPERATURE PROBE, IF FITTED, WITHIN 15 mm OF ITS TIP. SENSOR NUMBER 5 WAS PLACED IN THE CHAMBER DRAIN OR VENT WITHIN 100 mm OF ITS CONNECTION TO THE CHAMBER.

REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER
MODEL : VALPROBE
SERIAL No : S350.S367.DV35.DN94
CERTIFICATE No : 25T0777
DUE DATE : 24-Jan-26
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Ambient Temperature around the Chamber variation : 1.2 °C
Autoclave Condition : Normal
Chamber Size (Diameter*H): 30 * 71 cm

CHAMBER PERFORMANCE

| Controller Temperature (°C) | Average Position (°C) | Stability (±°C) | Temperature Uniformity (°C) | Overall Variation (°C) | Pressure (MPa) | Holding time (min) | Operating Cycle time (min) |
|-----------------------------|-----------------------|-----------------|-----------------------------|------------------------|----------------|--------------------|----------------------------|
| 115 | 115.71 | 0.10 | 0.20 | 0.20 | 0.090 | 15 | 60 |
| 121 | 121.65 | 0.10 | 0.20 | 0.20 | 0.125 | 15 | 60 |

FRONT

TEMPERATURE MEASUREMENT ACCURACY TEST(°C)

| Calibration Point | Controller Temp. | Indicating Temp. | #1 | #2 | #3 | #4 | #5 | Uncertainty (± °C) |
|-------------------|------------------|------------------|--------|--------|--------|--------|--------|--------------------|
| 115 | 115 | 115 | 115.66 | 115.65 | 115.76 | 115.76 | 115.70 | 0.63 |
| 121 | 121 | 121 | 121.59 | 121.60 | 121.71 | 121.71 | 121.66 | 0.64 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT OF TEMPERATURE MEASUREMENT ACCURACY TEST EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : THE STABILITY TERM IN THE UNCERTAINTY BUDGET WAS REPLACED BY THE STANDARD REPEATABILITY.

NOTE 3 : LOCATION 3 WAS REFERENCE LOCATION.

NOTE 4 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA. THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



F-G010 REV : 03



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.
80-82 ถนนประชาภิไทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipatai Rd., Bangkokhuprom, Pranakorn, Bangkok 10200
Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thavati@thaiunique.com, Website : www.thaiunique.com

ATOMIC ABSORPTION SPECTROMETER TEST CERTIFICATE

Certificate No : SV2410/22223
Instrument Type : Atomic Absorption Spectrophotometers
Model : AA240FS
Serial Number : EL08043418
Organization : Test Tech Co., Ltd.
Address : 30,32 Soi 63 Rama II Rd. Samaedam Bangkokhution, Bangkok 10150
Date : 17 Oct 2024

Hollow cathode lamps used

| Element | Lamp number | Comments |
|-----------|--------------|----------|
| Arsenic | 56-101003-00 | |
| Copper | 56-101014-00 | |
| Potassium | 56-101042-00 | |
| Iron | 56-101027-00 | |
| Manganese | 56-101337-00 | |

| Test description | Specification | Result | Comments |
|-----------------------------------|-----------------|--------|----------|
| Light throughput (%Gain) or (EHT) | | | |
| Cu at 324.8 nm | ≤ 64 % or 380 V | 32 % | Pass |
| As at 193.7 nm | ≤ 80 % or 540 V | 54 % | Pass |
| K at 766.5 nm* | ≤ 84 % or 540 V | 64 % | Pass |
| Fe at 248.3 nm | ≤ 80 % or 540 V | 63 % | Pass |
| Mn at 279.5 nm | ≤ 64 % or 380 V | 53 % | Pass |
| Photometric noise Cu BGC off | | | |
| STDV @ 0 Abs | ≤ 0.0005 | 0.0001 | Pass |



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.
80-82 ถนนประชาภิไทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipatai Rd., Bangkokhuprom, Pranakorn, Bangkok 10200
Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thavati@thaiunique.com, Website : www.thaiunique.com

Wavelength accuracy

| | | | |
|----------------|---------------------|----------|------|
| Cu at 324.8 nm | 323.0 nm - 326.0 nm | 324.7 nm | Pass |
| As 193.7 nm | 192.0 nm - 195.0 nm | 193.7 nm | Pass |
| K at 766.5 nm* | 765.0 nm - 768.0 nm | 766.4 nm | Pass |
| Fe at 248.3 nm | 246.8 nm - 249.8 nm | 248.3 nm | Pass |
| Mn at 279.5 nm | 278.0 nm - 281.0 nm | 279.5 nm | Pass |

High solids nebulizer setting**

| | | | |
|-----------------|---------------------|------------|------|
| Uptake rate | 7.2 - 10.6 ml / min | 7.8 ml/min | Pass |
| Max Abs | ≥ 0.75 Abs | 0.79 Abs | Pass |
| Precision(%RSD) | ≤ 0.5 % | 0.4 % | Pass |

Zeeman Background Correction Accuracy (%)***

| | | | |
|-------------------|---------|-----|-----|
| BCA @ Au 242.8 nm | < 3.7 % | *** | *** |
|-------------------|---------|-----|-----|

Zeeman Magnetic Sensitivity Ratio (%)***

| | | | |
|-------------------|--------|-----|-----|
| MSR @ Cu 324.7 nm | > 70 % | *** | *** |
|-------------------|--------|-----|-----|

Characteristic mass and sensitivity ****

| | | | |
|------------------|------------|------|------|
| Sensitivity | ≥ 0.21 Abs | **** | **** |
| Precision (%RSD) | ≤ 4.0 % | **** | **** |

* for Wideband PMT (Wavelength 190nm - 900nm)

** for Flame system

*** for Zeeman system


**** for Graphite furnace system



CALIBRATED BY :

Signature : 
Engineer : Sutiya Nacharoen
Date : 17 / Oct / 2024

APPROVED BY :

Signature : 
Service Manager : Suchai Sangnankiatichai
Date : 17 / Oct / 2024



CERTIFICATE No : 24M8919
REFERENCE No : 74484-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : AND
MODEL : GR-200
SERIAL No : 14243876
ID No : EQL-130
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II SOI 63, RAMA II RD.,
SAMAEDAM, BANGKHUNTHIAN, BANGKOK
10150

CALIBRATED BY : PRASERT P.
CALIBRATION DATE : 05-Sep-24
APPROVED BY :
PONGSAK J.
ISSUED DATE : 09-Sep-24
RECEIVED DATE : 05-Sep-24

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



F-G010 REV 03



CERTIFICATE No : 24M8919

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : AND
MODEL : GR-200
ID No : EQL-130
AIR PRESSURE : 1011mbar \pm 1mbar
AMBIENT TEMPERATURE : 25°C \pm 1°C
RECEIVED DATE : 05-Sep-24
CALIBRATION DATE : 05-Sep-24
RELATIVE HUMIDITY : 50 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

1. STANDARD WEIGHT SET
INSTRUMENT : MODEL : SERIAL No : CERTIFICATE No : DUE DATE
E2 : QK-1-151 : M2302013S : 02-Feb-25
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

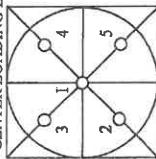
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.0 | 0.0000 | 0.0000 | 0.000082 |
| 0.1 | 0.1000 | 0.0000 | 0.000083 |
| 0.2 | 0.2000 | 0.0000 | 0.000083 |
| 0.5 | 0.5000 | 0.0000 | 0.000083 |
| 1.0 | 1.0000 | 0.0000 | 0.000084 |
| 2.0 | 2.0000 | 0.0000 | 0.000086 |
| 5.0 | 5.0000 | 0.0000 | 0.000089 |
| 10.0 | 10.0000 | 0.0000 | 0.000094 |
| 20.0 | 20.0000 | 0.0000 | 0.00012 |
| 50.0 | 50.0000 | 0.0000 | 0.00019 |
| 100.0 | 100.0000 | 0.0000 | 0.00019 |
| 200.0 | 200.0000 | 0.0000 | 0.00019 |

5. OFF CENTER LOADING ERROR



| POINT | READING (g) |
|--------------------|-------------|
| 1 | 99.9999 |
| 2 | 99.9999 |
| 3 | 100.0000 |
| 4 | 99.9999 |
| 5 | 99.9999 |
| OFF-CENTER LOADING | 0.0001 |

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A
COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



F-G010 REV 03



CERTIFICATE No.: 24M6589
REFERENCE No.: 73767-8

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
MODEL : BCA224i-1S
SERIAL No : 43402017
ID No : EQL-268
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : ATSAWIN Y.
CALIBRATION DATE : 01-Jul-24

APPROVED BY :
ISSUED DATE : 02-Jul-24
RECEIVED DATE : 01-Jul-24

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No.: 24M6589

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
MODEL : BCA224i-1S
ID No : 43402017
AIR PRESSURE : 1006mbar \pm 1mbar
AMBIENT TEMPERATURE : 25°C \pm 1°C
RECEIVED DATE : 01-Jul-24
CALIBRATION DATE : 01-Jul-24
RELATIVE HUMIDITY : 59 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION
1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 62019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT MODEL SERIAL No CERTIFICATE No DUE DATE
1) STANDARD WEIGHT SET E2 QK-1151 M2302013S 02-Feb-25
2) STANDARD WEIGHT E2 15843 M2302014S 02-Feb-25
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

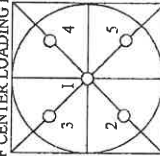
- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 200 g WAS 0.000042 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.0 | 0.0000 | 0.0000 | 0.000093 |
| 0.1 | 0.1000 | 0.0000 | 0.000093 |
| 0.5 | 0.5000 | 0.0000 | 0.000099 |
| 1.0 | 1.0000 | 0.0000 | 0.000099 |
| 2.0 | 2.0000 | 0.0000 | 0.00010 |
| 20.0 | 20.0001 | -0.0001 | 0.00011 |
| 45.0 | 45.0001 | -0.0001 | 0.00015 |
| 50.0 | 50.0000 | 0.0000 | 0.00012 |
| 80.0 | 80.0001 | -0.0001 | 0.00018 |
| 100.0 | 100.0000 | 0.0000 | 0.00019 |
| 120.0 | 120.0000 | 0.0000 | 0.00022 |
| 140.0 | 140.0001 | -0.0001 | 0.00025 |
| 160.0 | 160.0000 | 0.0000 | 0.00027 |
| 180.0 | 180.0000 | 0.0000 | 0.00030 |
| 200.0 | 200.0000 | 0.0000 | 0.00032 |

5. OFF CENTER LOADING ERROR



| POINT | READING (g) |
|--------------------|-------------|
| 1 | 100.0000 |
| 2 | 100.0000 |
| 3 | 100.0000 |
| 4 | 100.0000 |
| 5 | 100.0000 |
| OFF-CENTER LOADING | 0.0000 |

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A
COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



CERTIFICATE No : 24T8915
REFERENCE No : 74483-5

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UFE 500
SERIAL No : G508.0791
ID No : EQL-128
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II SOI 63, RAMA II RD., SAMAEADAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 05-Sep-24
APPROVED BY :
PONGSAK J.
ISSUED DATE : 09-Sep-24
RECEIVED DATE : 05-Sep-24



CERTIFICATE No : 24T8915

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UFE 500
ID No : EQL-128
RECEIVED DATE : 05-Sep-24
AMBIENT TEMPERATURE : 24 °C ± 1 °C
SN : G508.0791
CALIBRATION DATE : 05-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

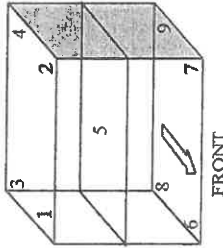
CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD P100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.
2. REFERENCE STANDARD INSTRUMENTS :-
 - 1) DATA LOGGER WITH RTD HYDRA 2635A
 3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
 4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
 5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

| |
|---|
| Overall Ambient Temperature around the Chamber (°C) variation : 4 |
| Overall Line Voltage (V) variation : 6 |
| Instrument Condition : Normal |
| Chamber Size (W*H*H): 56*40*48 cm |



CHAMBER PERFORMANCE

| Calibrate Point (°C) | Average All Position Temp. (°C) | Temperature Stability (±°C) | Temperature Uniformity (°C) | Overall Variation (°C) |
|----------------------|---------------------------------|-----------------------------|-----------------------------|------------------------|
| 104.0 | 104.09 | 0.24 | 0.72 | 1.03 |
| 180.0 | 179.88 | 0.20 | 1.00 | 1.24 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | Ref. 5 | #6 | #7 | #8 | #9 | |
| 104.0 | 104.0 | 104.13 | 103.69 | 104.30 | 103.76 | 103.78 | 104.35 | 104.38 | 104.13 | 104.31 | 0.38 |
| 180.0 | 180.0 | 180.05 | 179.34 | 180.20 | 179.29 | 179.51 | 180.23 | 180.27 | 179.92 | 180.11 | 1.1 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA. THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.
END OF CALIBRATION REPORT

F-G010 REV : 03



CERTIFICATE No : 24T8914
REFERENCE No : 74483-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UFE 500
SERIAL No : G512.2005
ID No : EQL-161
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30.32 RAMA II SOI 63, RAMA II RD., SAMAEADAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 05-Sep-24
APPROVED BY :
ISSUED DATE : 09-Sep-24
RECEIVED DATE : 05-Sep-24



CERTIFICATE No : 24T8914

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UFE 500
ID No : EQL-161
RECEIVED DATE : 05-Sep-24
AMBIENT TEMPERATURE : 24°C ± 1°C
S/N : G512.2005
CALIBRATION DATE : 05-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

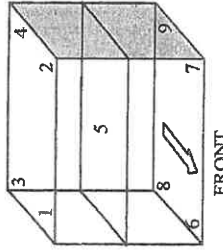
2. REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER WITH RTD
MODEL : HYDRA 2635A
SERIAL No : 6633300
CERTIFICATE No : 24T6468
DUE DATE : 26-Jun-25
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

| |
|---|
| Overall Ambient Temperature around the Chamber (°C) variation : 2 |
| Overall Line Voltage (V) variation : 4 |
| Instrument Condition : Normal |
| Chamber Size (W*L*H): 56*40*48 cm |



CHAMBER PERFORMANCE

| Calibrate Point (°C) | Average All Position Temp. (°C) | Temperature Stability (±°C) | Temperature Uniformity (°C) | Overall Variation (°C) |
|----------------------|---------------------------------|-----------------------------|-----------------------------|------------------------|
| 104.0 | 104.00 | 0.08 | 0.66 | 0.72 |
| 180.0 | 180.17 | 0.15 | 1.61 | 1.87 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | Ref. 5 | #6 | #7 | #8 | #9 | |
| 104.0 | 104.0 | 103.97 | 103.90 | 104.09 | 104.12 | 103.75 | 104.12 | 104.32 | 103.74 | 104.01 | 0.38 |
| 179.0 | 179.0 | 180.03 | 179.92 | 180.38 | 180.23 | 179.51 | 180.78 | 180.88 | 179.24 | 180.51 | 1.1 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.
END OF CALIBRATION REPORT



CERTIFICATE No : 24T8916
REFERENCE No : 74483-6

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 110
SERIAL No : B414.0764
ID No : EQL-169
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : TEST TECH CO., LTD.
30,32 RAMA II SOI 63, RAMA II RD., SAMAEADAM,
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 05-Sep-24

APPROVED BY :
PONGSAK J.
ISSUED DATE : 09-Sep-24
RECEIVED DATE : 05-Sep-24



CERTIFICATE No : 24T8916

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 110
ID No : EQL-169
RECEIVED DATE : 05-Sep-24
AMBIENT TEMPERATURE : 24 °C ± 1 °C
S/N : B414.0764
CALIBRATION DATE : 05-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm to 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

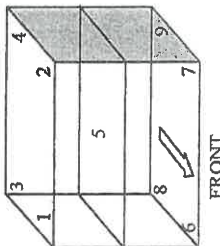
2. REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER WITH RTD
MODEL : HYDRA 2635A
SERIAL No : 7301307
CERTIFICATE No : 24T6467
DUE DATE : 26-Jun-25
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

| |
|---|
| Overall Ambient Temperature around the Chamber (°C) variation : 3 |
| Overall Line Voltage (V) variation : 8 |
| Instrument Condition : Normal |
| Chamber Size (W*L*H): 56*40*48 cm |



CHAMBER PERFORMANCE

| Calibrate Point (°C) | Average All Position Temp. (°C) | Temperature Stability (±°C) | Temperature Uniformity (°C) | Overall Variation |
|----------------------|---------------------------------|-----------------------------|-----------------------------|-------------------|
| 104.0 | 104.11 | 0.06 | 0.43 | 0.55 |
| 120.0 | 120.18 | 0.04 | 0.58 | 0.67 |
| 140.0 | 140.24 | 0.09 | 0.71 | 0.91 |
| 150.0 | 150.20 | 0.10 | 0.79 | 0.98 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | |
| 104.0 | 104.0 | 104.37 | 104.10 | 104.39 | 104.07 | 104.01 | 104.25 | 103.95 | 103.92 | 103.97 | 0.38 |
| 120.0 | 120.0 | 120.54 | 120.25 | 120.45 | 120.23 | 120.00 | 120.33 | 119.94 | 119.90 | 120.00 | 0.46 |
| 140.0 | 140.0 | 140.64 | 140.33 | 140.53 | 140.28 | 139.98 | 140.48 | 139.88 | 139.88 | 140.09 | 0.46 |
| 150.0 | 150.0 | 150.66 | 150.29 | 150.55 | 150.23 | 149.90 | 150.47 | 149.85 | 149.80 | 150.06 | 0.46 |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





SCIMET Co., Ltd.
1194 Soi Wachirathansathit 57, Bangchak,
Phrakhanong, Bangkok 10260 Thailand
Email: scimet2022@gmail.com, Tel: 02 460 9239
https://www.scimet.co.th

Calibration Certificate

Certificate No. C06240053

Equipment: TURBIDIMETER
Model: 2100N
Serial No.(or ID): 970400003415 (EQL-024)
Manufacturer: HACH
Condition: In Condition
Job No.: KSM72402432
Received Date: 12 September 2024
Issued Date: 12 September 2024
Page: 1 of 2

Customer
TEST TECH CO., LTD.
30,32 Rama II Soi 63, Rama II Rd., Samaedam, Bangkhuntien Bangkok 10150 Thailand


Calibration Place
TEST TECH CO., LTD.(503 ซอยทองหล่อ)
30,32 Rama II Soi 63, Rama II Rd., Samaedam, Bangkhuntien Bangkok 10150 Thailand


Calibration Date
12 September 2024

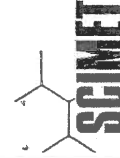
Environment Condition
Temperature: 24.4 °C ± 0.2 °C
Humidity: 58.4 %RH ± 1.1 %RH

The Method used
In-house method, W106, based on Hach Manufacturer Method 8195

Traceability
This certificate is traceable to Primary standard Fromazin and StabCal accepted by United States Environmental Protection Agency (EPA) through Hach Company Certificate No. A3304 , A3312 , A3305 , A3304 , A3305


(Mr. Dumrong Boonsopon)
Person in charge


(Mr. Thalengkeat Pongngam)
Authorized signatory



Certificate No.: C06240053
Page 2 of 2

Calibration Results:

| Before Adjustment | | | | |
|---------------------|-------------|------------|-----------|-------------|
| Std Turbidity (NTU) | UUC Reading | Correction | Deviation | Uncertainty |
| 0.040 | 0.121 | -0.081 | 0.002 | 0.070 |
| 20.40 | 20.0 | 0.40 | 0.0 | 1.0 |
| 205.0 | 198 | 7.0 | 0.3 | 10 |
| 1026.0 | 995 | 31.0 | 0.0 | 50 |
| 4114.0 | 4017 | 97.0 | 5.0 | 200 |

After Adjustment

| Std Turbidity (NTU) | UUC Reading | Correction | Deviation | Uncertainty |
|---------------------|-------------|------------|-----------|-------------|
| 0.040 | 0.122 | -0.082 | 0.003 | 0.070 |
| 20.40 | 20.5 | -0.10 | 0.0 | 1.0 |
| 205.0 | 205 | 0.0 | 0.3 | 10 |
| 1026.0 | 1027 | -1.0 | 0.3 | 50 |
| 4114.0 | 4113 | 1.0 | 1.1 | 200 |

The End of Certificate



Bara Scientific Co., Ltd.
988 U Chu Liang Building Floor 7 Rama4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-156/25
Equipment UV/Vis Spectrophotometer
Model UV-1900i
Manufacturer Shimadzu
Serial No. A12535780311 ML
ID No. EQL-233
Date of receipt 22 April 2025
Date of calibration 22 April 2025
Date of issue 25 April 2025
Customer name Test Tech Co., Ltd.
Address 30,32 Rama II Sol 63, Rama II Road, Samae Dam, Bang Khun Thian, Bangkok 10150.

Temperature (25.5 - 28.6) °C (On site)
Humidity (43.3 - 49.7) %RH (On site)

Equipment condition Good Operation

Calibration Location Water Room

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability
Wavelength Accuracy is traceable to certificate No. 126732 and 126733
Photometric Accuracy is traceable to certificate No. 126735 and 111398
Stray Light is traceable to certificate No. 126749
The above certificate are traceable to SI unit through Stama Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janloey

Approved by

Mr. Pannaphong Phannmekakul
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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Bara Scientific Co., Ltd.
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Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 2 of 3

Certificate No. BSCC-UV-156/25

Calibration Results:

1. Wavelength Accuracy

| Certified Wavelength (nm) | UUC (nm) | Error (nm) | Uncertainty (±nm) |
|---------------------------|----------|------------|-------------------|
| 279.44 | 279.20 | -0.24 | 0.18 |
| 418.53 | 418.51 | -0.02 | 0.18 |
| 536.52 | 536.54 | 0.02 | 0.18 |
| 684.50 | 684.64 | 0.14 | 0.18 |
| 879.41 | 879.45 | 0.04 | 0.18 |

2. Photometric Accuracy (UV)

| Wavelength (nm) | Certified Absorbance (A) | UUC (A) | Error (A) | Uncertainty (±A) |
|-----------------|--------------------------|---------|-----------|------------------|
| 235 | CNR | CNR | CNR | CNR |
| 257 | CNR | CNR | CNR | CNR |
| 257 | 0.0000 | 0.0000 | 0.0000 | 0.0075 |
| 257 | 0.8540 | 0.8505 | -0.0035 | 0.0075 |
| 313 | CNR | CNR | CNR | CNR |
| 313 | CNR | CNR | CNR | CNR |
| 350 | 0.0000 | -0.0001 | -0.0001 | 0.0075 |
| 350 | 0.6332 | 0.6320 | -0.0012 | 0.0075 |

*CNR = Customer not request

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www.barascientific.com



Certificate of Calibration

Certificate No. BSCC-UV-156/25 Number of Page(s) 3 of 3

Calibration Results:

3. Photometric Accuracy (Visible)

| Wavelength (nm) | Certified Absorbance (A) | UUC (A) | Error (A) | Uncertainty (±A) |
|-----------------|--------------------------|---------|-----------|------------------|
| 420.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5761 | 0.5788 | 0.0027 | 0.0042 |
| | 0.7119 | 0.7131 | 0.0012 | 0.0042 |
| 440.0 | 1.0189 | 1.0207 | 0.0018 | 0.0042 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5610 | 0.5634 | 0.0024 | 0.0042 |
| 465.0 | 0.7001 | 0.7010 | 0.0009 | 0.0042 |
| | 1.0026 | 1.0039 | 0.0013 | 0.0042 |
| | CNR | CNR | CNR | CNR |
| 546.1 | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 590.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5249 | 0.5258 | 0.0009 | 0.0042 |
| | 0.8975 | 0.8988 | -0.0007 | 0.0042 |
| 635.0 | 1.0009 | 1.0002 | -0.0007 | 0.0042 |
| | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 680.0 | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 700.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5666 | 0.5670 | 0.0004 | 0.0042 |
| | 0.7620 | 0.7609 | -0.0011 | 0.0042 |
| 750.0 | 1.0962 | 1.0966 | -0.0004 | 0.0042 |
| | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |

*CNR = Customer not request

4. Stray Light*

| Standard | Wavelength (nm) | Transmission (%T) | Absorbance (A) |
|-------------------------|-----------------|-------------------|----------------|
| cut-off wavelength (nm) | 201.13±0.11nm | 0.9706 | 2.0130 |

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

*Stray Light not NSC-ONSC Accredited.

The measurement uncertainty is based on a standard uncertainty multiplied by a coverage factor (k=2) providing a level of confidence of approximately 95%.

End of Certificate

The above results are valid exclusively for the calibrated item(s) as mentioned in this report / certificate. Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.

ภาคผนวก ฉ

กฎหมายที่เกี่ยวข้อง

ประกาศกระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม

เรื่อง กำหนดมาตรฐานควบคุมการระบายน้ำทิ้งจากอาคารบางประเภทและบางขนาด

พ.ศ. ๒๕๖๗

โดยที่เป็นการสมควรปรับปรุงการกำหนดมาตรฐานควบคุมการระบายน้ำทิ้งจากอาคาร ให้เหมาะสมตามความก้าวหน้าในทางวิทยาศาสตร์ เทคโนโลยี และความเปลี่ยนแปลงทางเศรษฐกิจ สังคม ของประเทศ และให้สอดคล้องกับสภาพการณ์ปัจจุบัน

อาศัยอำนาจตามความในมาตรา ๕๕ แห่งพระราชบัญญัติส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติ พ.ศ. ๒๕๓๕ รัฐมนตรีว่าการกระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม โดยคำแนะนำของคณะกรรมการควบคุมมลพิษ และโดยความเห็นชอบของคณะกรรมการสิ่งแวดล้อมแห่งชาติ จึงออกประกาศไว้ ดังต่อไปนี้

ข้อ ๑ ให้ยกเลิกประกาศกระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม เรื่อง กำหนดมาตรฐานควบคุมการระบายน้ำทิ้งจากอาคารบางประเภทและบางขนาด ฉบับวันที่ ๗ พฤศจิกายน พ.ศ. ๒๕๔๘ ข้อ ๒ ในประกาศนี้

“อาคาร” หมายความว่า อาคารที่ก่อสร้างขึ้น ไม่ว่าจะมึลักษณะเป็นอาคารหลังเดียวหรือเป็นกลุ่มของอาคารซึ่งตั้งอยู่ภายในพื้นที่ซึ่งเป็นบริเวณเดียวกัน และไม่ว่าจะมีท่อระบายน้ำท่อเดียวหรือมีหลายท่อที่เชื่อมติดต่อกันระหว่างอาคารหรือไม่ก็ตาม

“น้ำทิ้ง” หมายความว่า น้ำที่เกิดจากกิจกรรมของอาคารที่ระบายหรือระบายลงสู่แหล่งน้ำสาธารณะหรือออกสู่สิ่งแวดล้อม

ข้อ ๓ ให้แบ่งอาคาร ออกเป็น ๓ ชนิด คือ

ชนิดที่ ๑ อาคารอยู่อาศัย หมายถึง อาคารที่มีวัตถุประสงค์ให้เป็นที่พักอาศัยของบุคคลทั้งการอยู่อาศัยอย่างถาวรหรือชั่วคราว ได้แก่

- (๑) อาคารชุด ตามกฎหมายว่าด้วยอาคารชุด
- (๒) หอพัก ตามกฎหมายว่าด้วยหอพัก
- (๓) หอพัก ห้องเช่า ห้องแบ่งเช่า หรือกิจการอื่นในทำนองเดียวกันตามกฎหมายว่าด้วยการสาธารณสุข

- (๔) สถานรับเลี้ยงเด็ก ตามกฎหมายว่าด้วยคุ้มครองเด็ก
- (๕) สถานดูแลผู้สูงอายุหรือผู้ทุพพลภาพ ตามกฎหมายว่าด้วยการประกอบอาชีพสุขภาพ
- (๖) ที่พักอาศัยสำหรับลูกจ้างประเภทกิจการก่อสร้าง ตามกฎหมายว่าด้วยการคุ้มครองแรงงาน

ชนิดที่ ๒ อาคารพาณิชย์ หมายถึง อาคารที่ใช้ประโยชน์ในการพาณิชย์กรรม หรือบริการธุรกิจอย่างเดียวหรือหลายอย่าง ได้แก่

- (๑) โรงแรม ตามกฎหมายว่าด้วยโรงแรม

- (๒) ศูนย์การค้าหรือห้างสรรพสินค้า
 - (๓) ตลาด ตามกฎหมายว่าด้วยการสาธารณสุข
 - (๔) สถานบริการประเภทสถานอาบน้ำ นวดหรืออบตัว ตามกฎหมายว่าด้วยสถานบริการ
 - (๕) ภัตตาคารหรือร้านอาหาร
 - (๖) อาคารที่ทำการของทางราชการ รัฐวิสาหกิจ หรือองค์การระหว่างประเทศและของเอกชน
 - (๗) อาคารโรงเรียนเอกชน ตามกฎหมายว่าด้วยโรงเรียนเอกชน โรงเรียนของทางราชการ
- อาคารสถาบันอุดมศึกษาของเอกชน ตามกฎหมายว่าด้วยสถาบันอุดมศึกษาของเอกชนและสถาบันอุดมศึกษาของทางการ

ชนิดที่ ๓ อาคารสถานพยาบาล หมายถึง สถานพยาบาล ตามกฎหมายว่าด้วยสถานพยาบาลประเภทที่รับผู้ป่วยไว้ค้างคืน

ข้อ ๔ ให้แบ่งขนาดของอาคาร ออกเป็น ๔ ประเภท ดังต่อไปนี้

| ประเภทอาคาร | หน่วย | อาคารประเภท ก. | อาคารประเภท ข. | อาคารประเภท ค. | อาคารประเภท ง. |
|--|-----------|-----------------------|--------------------------------|-------------------------------|----------------|
| ๑. อาคารอยู่อาศัย | | | | | |
| อาคารชุด | ห้องชุด | ตั้งแต่ ๕๐๐ ขึ้นไป | ตั้งแต่ ๑๐๐ แต่ไม่ถึง ๕๐๐ | ไม่ถึง ๑๐๐ | - |
| หอพัก | ห้อง | - | ตั้งแต่ ๕๐๐ ขึ้นไป | ตั้งแต่ ๕๐ แต่ไม่ถึง ๒๕๐ | ไม่ถึง ๕๐ |
| หอพัก ห้องเช่า ห้องแบ่งเช่า หรือกิจการอื่นในทำนองเดียวกัน ตามกฎหมายว่าด้วยการสาธารณสุข | ห้อง | - | ตั้งแต่ ๕๐๐ ขึ้นไป | ตั้งแต่ ๕๐ แต่ไม่ถึง ๒๕๐ | ไม่ถึง ๕๐ |
| สถานรับเลี้ยงเด็ก | - | - | - | - | ทุกขนาด |
| สถานดูแลผู้สูงอายุหรือผู้ทุพพลภาพ | - | - | - | - | ทุกขนาด |
| ที่พักอาศัยสำหรับลูกจ้างประเภทกิจการก่อสร้าง | - | - | - | - | ทุกขนาด |
| ๒. อาคารพาณิชย์ | | | | | |
| โรงแรม | ห้อง | ตั้งแต่ ๒๐๐ ขึ้นไป | ตั้งแต่ ๖๐ แต่ไม่ถึง ๒๐๐ | ไม่ถึง ๖๐ | - |
| สถานบริการประเภทสถานอาบน้ำ นวดหรืออบตัว | ตารางเมตร | - | ตั้งแต่ ๕,๐๐๐ ขึ้นไป | ตั้งแต่ ๑,๐๐๐ แต่ไม่ถึง ๕,๐๐๐ | ไม่ถึง ๑,๐๐๐ |
| โรงเรียนเอกชน โรงเรียนของทางการ สถาบันอุดมศึกษาของเอกชนหรือสถาบันอุดมศึกษาของทางการ | | ตั้งแต่ ๒๕,๐๐๐ ขึ้นไป | ตั้งแต่ ๕,๐๐๐ แต่ไม่ถึง ๒๕,๐๐๐ | - | ไม่ถึง ๕,๐๐๐ |

| ประเภทอาหาร | หน่วย | อาหาร ประเภท ก. | อาหาร ประเภท ข. | อาหาร ประเภท ค. | อาหาร ประเภท ง. |
|---|-----------------------------------|--------------------------|---------------------------------------|--------------------------------------|--------------------|
| อาหารที่ทำจากของทาง ราชการ รัฐวิสาหกิจ หรือ องค์การระหว่างประเทศและ ของเอกชน | | ตั้งแต่ ๕๕,๐๐๐ ขึ้นไป | ตั้งแต่ ๑๐,๐๐๐ แต่ไม่ถึง ๕๕,๐๐๐ | ตั้งแต่ ๕,๐๐๐ แต่ไม่ถึง ๑๐,๐๐๐ | ไม่ถึง ๕,๐๐๐ |
| | ศูนย์การค้า หรือห้างสรรพสินค้า | ตั้งแต่ ๒๕,๐๐๐ ขึ้นไป | ตั้งแต่ ๕,๐๐๐ แต่ไม่ถึง ๒๕,๐๐๐ | - | ไม่ถึง ๕,๐๐๐ |
| ตลาด | | ตั้งแต่ ๒,๕๐๐ ขึ้นไป | ตั้งแต่ ๑,๕๐๐ แต่ไม่ถึง ๒,๕๐๐ | ตั้งแต่ ๑,๐๐๐ แต่ไม่ถึง ๑,๕๐๐ | ไม่ถึง ๑,๐๐๐ |
| | ภัตตาคารหรือร้านอาหาร | ตั้งแต่ ๒,๕๐๐ ขึ้นไป | ตั้งแต่ ๕๐๐ แต่ไม่ถึง ๒,๕๐๐ | ตั้งแต่ ๒๕๐ แต่ไม่ถึง ๕๐๐ | ไม่ถึง ๒๕๐ |
| ๓. อาคารสถานพยาบาล | เตียง | ตั้งแต่ ๓๐ ขึ้นไป | ตั้งแต่ ๑๐ แต่ไม่ถึง ๓๐ | - | ไม่ถึง ๑๐ |

ข้อ ๕ กำหนดมาตรฐานควบคุมการระบายน้ำทิ้งจากอาคารไว้ ดังต่อไปนี้

| พารามิเตอร์ | ค่ามาตรฐาน | | | | |
|---|-----------------------------------|-----------------------------------|-----------------------------------|--|--|
| | อาหาร ประเภท ก. | อาหาร ประเภท ข. | อาหาร ประเภท ค. | อาหาร ประเภท ง. | |
| ๑. ความเป็นกรดและด่าง (pH) | ๕.๕ - ๙.๐ | ๕.๕ - ๙.๐ | ๕.๕ - ๙.๐ | ๕.๕ - ๙.๐ | |
| ๒. บีโอดี (Biochemical Oxygen Demand) | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๓๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๔๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๕๐ มิลลิกรัมต่อลิตร | |
| | | | | สำหรับอาคารอยู่อาศัย และอาคารสถานพยาบาล | |
| ๓. ของแข็งแขวนลอยทั้งหมด (Total Suspended Solids) | ไม่เกิน ๓๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๔๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๕๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๖๐ มิลลิกรัมต่อลิตร | |
| ๔. ของแข็งละลายน้ำทั้งหมด (Total Dissolved Solids) | ไม่เกิน ๑,๐๐๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๑,๐๐๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๑,๓๐๐ มิลลิกรัมต่อลิตร | - | |

| พารามิเตอร์ | ค่ามาตรฐาน | | | | |
|---|--|--|---|---|--|
| | อาคาร ประเภท ก. | อาคาร ประเภท ข. | อาคาร ประเภท ค. | อาคาร ประเภท ง. | |
| | สำหรับอาคารอยู่ อาศัยและอาคาร พาณิชย์ | สำหรับอาคารอยู่ อาศัยและอาคาร พาณิชย์ | สำหรับอาคารอยู่ อาศัยและอาคาร พาณิชย์ | สำหรับอาคารอยู่ อาศัยและอาคาร พาณิชย์ | |
| | เพิ่มขึ้นจาก ปริมาณในน้ำใช้ ปกติไม่เกิน ๑,๐๐๐ | เพิ่มขึ้นจาก ปริมาณในน้ำใช้ ปกติไม่เกิน ๑,๐๐๐ | - | - | |
| ๕. ซัลไฟด์ (Sulfide) | ไม่เกิน ๑๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๑๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๑๐ มิลลิกรัมต่อลิตร | - | |
| ๖. ทึบเคอีน (Total Kjeldahl Nitrogen) | ไม่เกิน ๓๕ มิลลิกรัมต่อลิตร | ไม่เกิน ๓๕ มิลลิกรัมต่อลิตร | ไม่เกิน ๔๐ มิลลิกรัมต่อลิตร | - | |
| ๗. น้ำมันและไขมัน (Oil and Grease) | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๒๐ มิลลิกรัมต่อลิตร สำหรับอาคารอยู่อาศัย ไม่เกิน ๕๐ มิลลิกรัม ต่อลิตร สำหรับอาคาร พาณิชย์และอาคาร สถานพยาบาล |
| ๘. แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมด (Total Coliform Bacteria) (สำหรับอาคารสถานพยาบาล) | ไม่เกิน ๕,๐๐๐ (เอ็มพีเอ็มต่อ ๑๐๐ มิลลิลิตร) | ไม่เกิน ๕,๐๐๐ (เอ็มพีเอ็มต่อ ๑๐๐ มิลลิลิตร) | - | - | |
| ๙. แบคทีเรียกลุ่มฟีคัลโคลิฟอร์ม (Fecal Coliform Bacteria) (สำหรับอาคารสถานพยาบาล) | ไม่เกิน ๑,๐๐๐ (เอ็มพีเอ็มต่อ ๑๐๐ มิลลิลิตร) | ไม่เกิน ๑,๐๐๐ (เอ็มพีเอ็มต่อ ๑๐๐ มิลลิลิตร) | - | - | |
| ๑๐. คลอรีนอิสระ (Free Chlorine) (สำหรับอาคารสถานพยาบาล) | ไม่เกิน ๑๐ มิลลิกรัมต่อลิตร | ไม่เกิน ๑๐ มิลลิกรัมต่อลิตร | - | - | |

ข้อ ๖ การตรวจสอบมาตรฐานควบคุมการระบายน้ำทิ้งจากอาคารให้ใช้วิธีการ ดังต่อไปนี้

๖.๑ ความเป็นกรดและด่าง ให้ใช้เครื่องวัดความเป็นกรดและด่างของน้ำ (pH Meter) ที่มีความละเอียดไม่ต่ำกว่า ๐.๑ หน่วย

๖.๒ บีโอดี ให้ใช้วิธีบ่มตัวอย่างที่อุณหภูมิ ๒๐ องศาเซลเซียส เป็นเวลา ๕ วันติดต่อกัน และหาค่าออกซิเจนละลายด้วยวิธีแอสไซด์ฟิเคชัน (Azide Modification) หรือวิธีเมมเบรนอิเล็กโทรด (Membrane Electrode) หรือวิธีออปติคอลโพรบ (Optical Probe)

๖.๓ ของแข็งแขวนลอยทั้งหมด ให้ใช้วิธีการกรองผ่านกระดาษกรองใยแก้ว (Glass Fiber Filter) และอบแห้งที่อุณหภูมิ ตั้งแต่ ๑๐๓ ถึง ๑๐๕ องศาเซลเซียส เป็นเวลาอย่างน้อย ๑ ชั่วโมง

๖.๔ ของแข็งละลายน้ำทั้งหมด ให้ใช้วิธีระเหยด้วยตัวอย่างที่กรองผ่านกระดาษกรองใยแก้ว (Glass Fiber Filter) และอบแห้งที่อุณหภูมิ ๑๘๐ องศาเซลเซียส เป็นเวลาอย่างน้อย ๑ ชั่วโมง

๖.๕ ซัลไฟด์ ให้ใช้วิธีไอโอดิเมทริก (Iodometric Method) หรือวิธีเมทิลีนบลู (Methylene Blue Method)

๖.๖ ทิตเร็น ให้ใช้วิธีเจลดาล์ (Kjeldahl)

๖.๗ น้ำมันและไขมัน ให้ใช้วิธีสกัดด้วยตัวทำละลายแล้วแยกน้ำมันของน้ำมันและไขมัน

๖.๘ แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมดและแบคทีเรียกลุ่มฟิโคไลโคลิฟอร์ม ให้ใช้วิธีมัลติเพิล ทิวบ์ เฟอว์เมนเทชัน เทคนิก (Multiple Tube Fermentation Technique)

๖.๙ คลอรีนอิสระ ให้ใช้วิธีไทเทรต (Titrimetric method) หรือวิธีอิเล็กโทรด (Colorimetric method) หรือวิธีไอโอดิเมทริก อิเล็กโทรด (Iodometric Electrode Technique)

ข้อ ๗ การคิดคำนวณขนาดของอาคารตามข้อ ๔ ให้เป็นไปตามวิธีการที่คณะกรรมการควบคุมมลพิษกำหนด โดยประกาศในราชกิจจานุเบกษา

ข้อ ๘ การตรวจสอบค่ามาตรฐานน้ำทิ้งตามข้อ ๖ ต้องเป็นไปตามคู่มือวิเคราะห์น้ำและน้ำเสียของสมาคมวิศวกรรมสิ่งแวดล้อมแห่งประเทศไทย หรือ Standard Methods for the Examination of Water and Wastewater ซึ่ง American Public Health Association, American Water Works Association และ Water Environment Federation ของประเทศสหรัฐอเมริกากำหนดฉบับล่าสุด หรือตามที่คณะกรรมการควบคุมมลพิษประกาศในราชกิจจานุเบกษา

ข้อ ๙ การเก็บตัวอย่างน้ำทิ้งเพื่อการตรวจสอบมาตรฐานควบคุมการระบายน้ำทิ้งตามข้อ ๕ ให้เป็น ดังต่อไปนี้

๙.๑ ให้เก็บในจุดระบายทิ้งลงสู่แหล่งน้ำสาธารณะหรือออกสู่สิ่งแวดล้อมหรือจุดอื่นที่สามารถใช้เป็นตัวแทนของน้ำทิ้งที่ระบายออกจากอาคาร ในกรณีมีการระบายทิ้งหลายจุดให้เก็บทุกจุด

๙.๒ วิธีการเก็บตัวอย่างน้ำทิ้ง ณ จุดเก็บตัวอย่างตามข้อ ๙.๑ ให้เก็บแบบจ้วง (Grab Sampling)

ข้อ ๑๐ ประกาศนี้ให้ใช้บังคับตั้งแต่วันถัดจากวันประกาศในราชกิจจานุเบกษาเป็นต้นไป

ประกาศ ณ วันที่ ๒๘ มิถุนายน พ.ศ. ๒๕๖๗

พลตำรวจเอก พัชรวาท วงษ์สุวรรณ

รัฐมนตรีว่าการกระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม