

# ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือที่ใช้ในการตรวจวิเคราะห์  
(Calibration)

# REPORT

of the

Department of the Interior

Section



ตารางการสอบเทียบเครื่องมือที่ใช้ในการตรวจวัดและวิเคราะห์

| Item | Description | Parameter      | List of Equipment                 | Equipment No.       | Calibration Date | Next Calibration |
|------|-------------|----------------|-----------------------------------|---------------------|------------------|------------------|
| 1.   | Ambient Air | Orifice        | ORIFICE TRANSFER STANDARD/Tisch   | S/N 0068            | 21/09/2022       | September 2023   |
|      |             | TSP            | High Volume Air Sampler/TET       | S/N TSP-35          | 11/07/2023       | July 2024        |
|      |             |                | High Volume Air Sampler/TET       | S/N TSP-40          | 05/07/2023       | July 2024        |
|      |             |                | Electronic Balance/METTLER TOLEDO | S/N 1116392227      | 11/04/2023       | April 2024       |
|      |             | PM-10          | High Volume Air Sampler/TET       | S/N PM10-15         | 11/07/2023       | July 2024        |
| 2.   | Water       |                | High Volume Air Sampler/TET       | S/N PM10-29         | 05/07/2023       | July 2024        |
|      |             |                | Electronic Balance/METTLER TOLEDO | S/N 1116392227      | 11/04/2023       | April 2024       |
|      |             | pH             | pH Meter/Horiba                   | S/N B06D0012        | 01/11/2023       | November 2024    |
|      |             | TSS, SS        | Electronic Balance/METTLER TOLEDO | S/N 1116392227      | 11/04/2023       | April 2024       |
|      |             | DO             | DO Meter/HORIBA                   | S/N D75J0012        | 14/01/2023       | January 2024     |
|      |             | BOD            | BOD Incubator                     | ID/N TET.LAB.BOD 05 | 11/04/2023       | April 2024       |
|      |             | TDS            | Electronic Balance/METTLER TOLEDO | S/N 1116392227      | 11/04/2023       | April 2024       |
|      |             | Oil & Grease   | Electronic Balance/METTLER TOLEDO | S/N 1116392227      | 11/04/2023       | April 2024       |
|      |             | Total Coliform | Incubator Model INE 500           | S/N E.505.0595      | 10/04/2023       | April 2024       |
|      |             | Bacteria       |                                   |                     |                  |                  |



RECALIBRATION

DUE DATE:

September 21, 2023

# Certificate of Calibration

## Calibration Certification Information

Cal. Date: September 21, 2022      Rootsometer S/N: 438320      Ta: 296 °K  
Operator: Jim Tisch      Pa: 748.3 mm Hg  
Calibration Model #: TE-5025A      Calibrator S/N: 0068

| Run | Vol. Init (m3) | Vol. Final (m3) | ΔVol. (m3) | ΔTime (min) | ΔP (mm Hg) | ΔH (in H2O) |
|-----|----------------|-----------------|------------|-------------|------------|-------------|
| 1   | 1              | 2               | 1          | 1.3760      | 3.2        | 2.00        |
| 2   | 3              | 4               | 1          | 0.9710      | 6.4        | 4.00        |
| 3   | 5              | 6               | 1          | 0.8730      | 8.0        | 5.00        |
| 4   | 7              | 8               | 1          | 0.8300      | 8.8        | 5.50        |
| 5   | 9              | 10              | 1          | 0.6870      | 12.7       | 8.00        |

## Data Tabulation

| Vstd (m3) | Qstd (x-axis) | $\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis) | Va     | Qa (x-axis) | $\sqrt{\Delta H \left( Ta/Pa \right)}$ (y-axis) |
|-----------|---------------|------------------------------------------------------------------------------------------|--------|-------------|-------------------------------------------------|
| 0.9870    | 0.7173        | 1.4080                                                                                   | 0.9957 | 0.7236      | 0.8895                                          |
| 0.9828    | 1.0121        | 1.9912                                                                                   | 0.9914 | 1.0211      | 1.2579                                          |
| 0.9806    | 1.1233        | 2.2262                                                                                   | 0.9893 | 1.1332      | 1.4064                                          |
| 0.9796    | 1.1802        | 2.3349                                                                                   | 0.9882 | 1.1907      | 1.4750                                          |
| 0.9744    | 1.4184        | 2.8160                                                                                   | 0.9830 | 1.4309      | 1.7789                                          |
| QSTD      | m=            | 2.01042                                                                                  | QA     | m=          | 1.25889                                         |
|           | b=            | -0.03659                                                                                 |        | b=          | -0.02312                                        |
|           | r=            | 0.99996                                                                                  |        | r=          | 0.99996                                         |

## Calculations

Vstd =  $\Delta Vol((Pa - \Delta P)/Pstd)(Tstd/Ta)$       Va =  $\Delta Vol((Pa - \Delta P)/Pa)$   
Qstd = Vstd/ΔTime      Qa = Va/ΔTime

For subsequent flow rate calculations:

$$Qstd = 1/m \left( \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} \right) - b \right) \quad Qa = 1/m \left( \left( \sqrt{\Delta H \left( Ta/Pa \right)} \right) - b \right)$$

## Standard Conditions

|                                           |           |
|-------------------------------------------|-----------|
| Tstd:                                     | 298.15 °K |
| Pstd:                                     | 760 mm Hg |
| Key                                       |           |
| ΔH: calibrator manometer reading (in H2O) |           |
| ΔP: rootsmeter manometer reading (mm Hg)  |           |
| Ta: actual absolute temperature (°K)      |           |
| Pa: actual barometric pressure (mm Hg)    |           |
| b: intercept                              |           |
| m: slope                                  |           |

## RECALIBRATION

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30





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## High Volume TSP&PM-10 Calibration Report

Location : Thai Environmental Tech

Site ID : Bangkok

Date : 5-Jul-23

ITEM : TSP

Serial No : (No. 40 )

Calibrate By : Pipat

### Site Conditions

Barometric Pressure (mm Hg) : 760.00

Temperature (°C) : 25.0

Average Press. (mm Hg) : 750.6

Average Temp (°C) : 28.9

Corrected Pressure (mm Hg) : 760.0

Temperature (deg K) : 298.0

Corrected Average (mm Hg) : -

Average Temp: (Deg K) : -

### Calibration Orifice

Make : Tisch

Model : TE-5025A

Serial# : 0068

Qstd Slope : 2.01042

Qstd Intercept : -0.36590

Calibration Due Date : 21-Sep-23

### Calibration Information

| Plate or Test # | ORIFICE (in H <sub>2</sub> O) | Qstd (m <sup>3</sup> /min) | Indicate (CFM) | IC (corrected) | Linear Regression<br>Slope : 29.4911<br>Intercept : 1.2335<br>Corr. Coeff : 0.9818<br># of Observations: 5 |
|-----------------|-------------------------------|----------------------------|----------------|----------------|------------------------------------------------------------------------------------------------------------|
| 1               | 12.80                         | 1.962                      | 60.0           | 57.00          |                                                                                                            |
| 2               | 9.20                          | 1.691                      | 54.0           | 52.00          |                                                                                                            |
| 3               | 7.00                          | 1.498                      | 50.0           | 48.00          |                                                                                                            |
| 4               | 5.00                          | 1.294                      | 40.0           | 40.00          |                                                                                                            |
| 5               | 3.00                          | 1.044                      | 30.0           | 30.00          |                                                                                                            |

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H_2O(Pa/Pstd)(Tstd/Ta)) - b]$$

$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I[\text{Sqrt}(298/Tav)(Pav/760)]) - b)$$

m = sampler slope

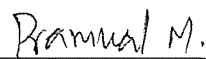
b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

Calibrate By : 

Approve By : 

**NOTE: Ensure calibration orifice has been certified within 12 months of use**





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## High Volume TSP&PM-10 Calibration Report

Location : Thai Environmental Tech

Site ID : Bangkok

Date : 11-Jul-23

ITEM : TSP

Serial No : (No.35 )

Calibrate By : Pipat

### Site Conditions

Barometric Pressure (mm Hg) : 760.00

Temperature (°C) : 25.0

Average Press. (mm Hg) : 750.8

Average Temp (°C) : 28.4

Corrected Pressure (mm Hg) : 760.0

Temperature (deg K) : 298.0

Corrected Average (mm Hg) : -

Average Temp: (Deg K) : -

### Calibration Orifice

Make : Tisch

Model : TE-5025A

Serial# : 0068

Qstd Slope : 2.01042

Qstd Intercept : -0.36590

Calibration Due Date : 21-Sep-23

### Calibration Information

| Plate or Test # | ORIFICE (in H <sub>2</sub> O) | Qstd (m <sup>3</sup> /min) | Indicate (CFM) | IC (corrected) | Linear Regression<br>Slope : 30.1571<br>Intercept : 0.3626<br>Corr. Coeff : 0.9846<br># of Observations: 5 |
|-----------------|-------------------------------|----------------------------|----------------|----------------|------------------------------------------------------------------------------------------------------------|
| 1               | 12.50                         | 1.941                      | 60.0           | 57.00          |                                                                                                            |
| 2               | 9.20                          | 1.691                      | 54.0           | 52.00          |                                                                                                            |
| 3               | 7.00                          | 1.498                      | 50.0           | 48.00          |                                                                                                            |
| 4               | 5.00                          | 1.294                      | 40.0           | 40.00          |                                                                                                            |
| 5               | 3.00                          | 1.044                      | 30.0           | 30.00          |                                                                                                            |

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H_2O(P_a/P_{std}))(T_{std}/T_a)] - b]$$

$$IC = I[\text{Sqrt}(P_a/P_{std}))(T_{std}/T_a)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I[\text{Sqrt}(298/T_a)](P_a/760)) - b)$$

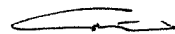
m = sampler slope

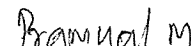
b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

Calibrate By : 

Approve By : 

**NOTE: Ensure calibration orifice has been certified within 12 months of use**





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## High Volume TSP&PM-10 Calibration Report

Location : Thai Environmental Tech

Site ID : Bangkok

Date : 5-Jul-23

ITEM : PM10

Serial No : (No. 29)

Calibrate By : Pipat

### Site Conditions

Barometric Pressure (mm Hg) : 760.00

Temperature (°C) : 25.0

Average Press. (mm Hg) : 750.6

Average Temp (°C) : 28.7

Corrected Pressure (mm Hg) : 760.0

Temperature (deg K) : 298.0

Corrected Average (mm Hg) : -

Average Temp: (Deg K) : -

### Calibration Orifice

Make : Tisch

Model : TE-5025A

Serial# : 0068

Qstd Slope : 2.01042

Qstd Intercept : -0.03659

Calibration Due Date : 21-Sep-23

### Calibration Information

| Plate or Test # | ORIFICE (in H <sub>2</sub> O) | Qstd (m <sup>3</sup> /min) | Indicate (CFM) | IC (corrected) | Linear Regression<br>Slope : 34.1794<br>Intercept : 1.0242<br>Corr. Coeff : 0.9939<br># of Observations: 5 |
|-----------------|-------------------------------|----------------------------|----------------|----------------|------------------------------------------------------------------------------------------------------------|
| 1               | 12.20                         | 1.756                      | 60.0           | 60.00          |                                                                                                            |
| 2               | 9.60                          | 1.559                      | 54.0           | 54.00          |                                                                                                            |
| 3               | 7.40                          | 1.371                      | 50.0           | 50.00          |                                                                                                            |
| 4               | 5.00                          | 1.130                      | 40.0           | 40.00          |                                                                                                            |
| 5               | 3.00                          | 0.880                      | 30.0           | 30.00          |                                                                                                            |

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H_2O(P_a/P_{std}))(T_{std}/T_a)] - b]$$

$$IC = I[\text{Sqrt}(P_a/P_{std})(T_{std}/T_a)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I[\text{Sqrt}(298/T_a)(P_a/760)] - b)$$

m = sampler slope

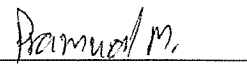
b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

Calibrate By : 

Approve By : 

**NOTE: Ensure calibration orifice has been certified within 12 months of use**





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## High Volume TSP&PM-10 Calibration Report

Location : Thai Environmental Tech

Site ID : Bangkok

Date : 11-Jul-23

ITEM : PM10

Serial No : (No. 15 )

Calibrate By : Pipat

### Site Conditions

Barometric Pressure (mm Hg) : 760.00

Temperature (°C) : 25.0

Average Press. (mm Hg) : 750.6

Average Temp (°C) : 29.5

Corrected Pressure (mm Hg) : 760.0

Temperature (deg K) : 298.0

Corrected Average (mm Hg) : -

Average Temp: (Deg K) : -

### Calibration Orifice

Make : Tisch

Model : TE-5025A

Serial# : 0068

Qstd Slope : 2.01042

Qstd Intercept : -0.03659

Calibration Due Date : 21-Sep-23

### Calibration Information

| Plate or Test # | ORIFICE (in H <sub>2</sub> O) | Qstd (m <sup>3</sup> /min) | Indicate (CFM) | IC (corrected) | Linear Regression<br>Slope : 35.3007<br>Intercept : 0.2307<br>Corr. Coeff : 0.9894<br># of Observations: 5 |
|-----------------|-------------------------------|----------------------------|----------------|----------------|------------------------------------------------------------------------------------------------------------|
| 1               | 12.00                         | 1.741                      | 60.0           | 60.00          |                                                                                                            |
| 2               | 9.00                          | 1.510                      | 54.0           | 54.00          |                                                                                                            |
| 3               | 7.00                          | 1.334                      | 50.0           | 50.00          |                                                                                                            |
| 4               | 5.00                          | 1.130                      | 40.0           | 40.00          |                                                                                                            |
| 5               | 3.00                          | 0.880                      | 30.0           | 30.00          |                                                                                                            |

### Calculations

$Q_{std} = 1/m[\sqrt{(H_2O(P_a/P_{std}))(T_{std}/T_a))}-b]$

$IC = I[\sqrt{(P_a/P_{std}))(T_{std}/T_a)]$

$Q_{std}$  = standard flow rate

$IC$  = corrected chart response

$I$  = actual chart response

$m$  = calibrator  $Q_{std}$  slope

$b$  = calibrator  $Q_{std}$  intercept

$T_a$  = actual temperature during calibration (deg K)

$P_a$  = actual pressure during calibration (mm Hg)

$T_{std}$  = 298 deg K

$P_{std}$  = 760 mm Hg

For subsequent calculation of sampler flow:

$1/m((I[\sqrt{(298/T_a)}](P_a/760)))-b]$

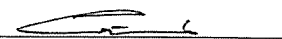
$m$  = sampler slope

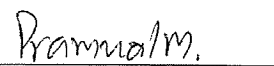
$b$  = sampler intercept

$I$  = chart response

$T_a$  = daily average temperature

$P_a$  = daily average pressure

Calibrate By : 

Approve By : 

**NOTE: Ensure calibration orifice has been certified within 12 months of use**





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



Cert.No.: 23MM160

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance

**Manufacturer :** Mettler Toledo

**Model :** AB204

**Serial No. :** 1116392227

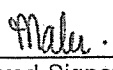
**ID No. :** TET.LAB.BAL01

**Submitted by :** Thai Environmental Technic Limited  
1/6 Soi Ramkhamhaeng 145,  
Khwaeng/Khet Saphan Sung,  
Bangkok 10240

**Location :** Balance Room

**Received order :** 10 April 2023  
**Calibration Date :** 11 April 2023  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Khit Ruttanaprapachai

**Approved by :**   
Approved Signatory

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

**Issue Date :** 25 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0053464



Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0146OC-12

Cert.No.: 23MM160

Page: 2 of 3

**Procedure used :-**

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

**Condition of this result of calibration**

**1. Reference standard instruments:-**

| <u>Instruments</u>          | <u>Model</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Test report No.</u> | <u>Due date</u> |
|-----------------------------|--------------|-------------------|---------------|------------------------|-----------------|
| 1) Standard Weight Set (E2) | 15884        | 24053             | 70RC007       | MM-0010-22             | 20 Jan 2024     |

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

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

**Range capacity :** 0 g to 210 g **Resolution** 0.0001 g

**Before Adjustment :**

| <u>Applied Weight</u><br>( g ) | <u>Balance Reading</u><br>( g ) | <u>Correction</u><br>( g ) | <u>Measurement Uncertainty</u><br>( ± mg ) | <u>Coverage Factor</u><br>( k ) |
|--------------------------------|---------------------------------|----------------------------|--------------------------------------------|---------------------------------|
| 100                            | 99.9982                         | +0.0018                    | 0.18                                       | 2.00                            |
| 200                            | 199.9965                        | +0.0035                    | 0.29                                       | 2.00                            |

**After Adjustment :**

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

| <u>Applied Weight</u><br>( g ) | <u>Standard Deviation of Reading ( g )</u> |
|--------------------------------|--------------------------------------------|
| 100                            | 0.00007                                    |
| 200                            | 0.00007                                    |

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Equipment : Electronic Balance  
 Condition As-Received : Used Item  
 Reference : 2304-0146OC-12

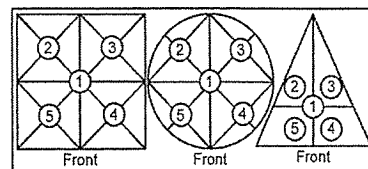
Cert.No.: 23MM160

Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

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



Maximum difference between off-center and central loading

| Position 1<br>(g) | Position 2<br>(g) | Position 3<br>(g) | Position 4<br>(g) | Position 5<br>(g) | (g)    |
|-------------------|-------------------|-------------------|-------------------|-------------------|--------|
| -0.0002           | -0.0002           | -0.0003           | -0.0003           | -0.0002           | 0.0001 |

#### 3. Departure from nominal value

| Applied Weight<br>(g) | Balance<br>Reading<br>(g) | Correction<br>(g) | Measurement<br>Uncertainty<br>( $\pm$ mg) | Coverage<br>Factor<br>(k) |
|-----------------------|---------------------------|-------------------|-------------------------------------------|---------------------------|
| Unload                | 0.0000                    | 0.0000            | 0.14                                      | 2.11                      |
| 0.01                  | 0.0100                    | 0.0000            | 0.14                                      | 2.11                      |
| 0.1                   | 0.1001                    | -0.0001           | 0.14                                      | 2.11                      |
| 0.5                   | 0.5000                    | 0.0000            | 0.14                                      | 2.11                      |
| 1                     | 1.0001                    | -0.0001           | 0.14                                      | 2.11                      |
| 5                     | 5.0000                    | 0.0000            | 0.14                                      | 2.11                      |
| 10                    | 9.9999                    | +0.0001           | 0.14                                      | 2.11                      |
| 25                    | 24.9998                   | +0.0002           | 0.15                                      | 2.07                      |
| 50                    | 49.9998                   | +0.0002           | 0.16                                      | 2.05                      |
| 100                   | 99.9999                   | +0.0001           | 0.18                                      | 2.00                      |
| 200                   | 200.0000                  | 0.0000            | 0.29                                      | 2.00                      |

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

-o-o-

*Maler*





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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23CHO644

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** pH Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-PH1300  
**Serial No. :** B06D0012  
**ID No. :** Ins-LAB-026  
**Condition As-Received:** Used Item  
**Received Date :** 31 October 2023  
**Calibration Date :** 01 November 2023  
**Reference :** 2310-0843OC-7  
**Submitted by :** Thai Environmental Technic Limited  
1/6 Soi Ramkhamhaeng 145,  
Khwaeng/Khet Saphan Sung,  
Bangkok 10240  
**Calibration Place :** Laboratory (Thai Environment Technic Limited)  
**Ambient Temperature :** (25.4 - 24.2) °C  
**Relative Humidity :** (69.3 - 66.7) %  
**Calibration Procedure :** In - house method :  
- CP-OCH2 by direct measurement with standard  
voltage calibrator and direct measurement  
with certified reference material (CRM)  
**Calibrated by :** Khit Ruttanaprapachai

**Approved by :**

Approved Signatory

- (✓) Saithip Meangmai  
( ) Warakorn Lerngagtrakul  
( ) Ponpan Paipim

**Issue Date :** 10 November 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0060438



Cert. No.: 23CHO644

Page.: 2 of 2

**Condition of this calibration result**

1. Reference Standard Instrument :-

| <u>Instrument</u>              | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 43160066          | 130RC092      | 23E1284          | 10 Apr 2024     |
| 2) Digital Thermometer         | -                 | 130RC018      | 23T1595          | 13 Sep 2024     |

This certification is traceable to the International System of Unit maintained through:-  
- Technology Promotion Association (Thailand - Japan)

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

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 1.679               | CPA chem            | 823319         | 20 Jun 2024      |
| pH 4.008               | CPA chem            | 931958         | 01 Oct 2025      |
| pH 6.865               | CPA chem            | 788996         | 01 Jan 2024      |
| pH 9.181               | CPA chem            | 931960         | 01 Oct 2024      |
| *pH 12.45              | Hach Lenge GmbH     | C02902         | 19 Nov 2023      |

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

**Calibration Results****Function : mV Measurement****Performing standard curve by Fluke at pH (1.7,4,7,10)**

| Unit Under Calibration     | Nominal Value | Standard Voltage Input | Actual Reading |        | Uncertainty of Measurement ( $\pm$ mV) | Coverage factor $k$ |
|----------------------------|---------------|------------------------|----------------|--------|----------------------------------------|---------------------|
|                            | pH            | mV                     | mV             | pH     |                                        |                     |
| pH Meter<br>S/N.: B06D0012 | 1.680         | 314.73                 | 314.7          | 1.680  | 0.058                                  | 2.00                |
|                            | 4.000         | 177.48                 | 177.4          | 4.000  | 0.058                                  | 2.00                |
|                            | 6.860         | 8.28                   | 8.3            | 6.860  | 0.058                                  | 2.00                |
|                            | 7.000         | 0.00                   | 0.0            | 7.000  | 0.058                                  | 2.00                |
|                            | 9.180         | -128.97                | -129.0         | 9.180  | 0.058                                  | 2.00                |
|                            | 10.000        | -177.48                | -177.4         | 10.000 | 0.058                                  | 2.00                |

**Function : pH Measurement****Performing four buffers standard curve by using buffer nominal pH (1.7,4,7,9)**

| Unit Under Calibration         | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH measurement ( $\pm$ ) | Coverage factor $k$ |
|--------------------------------|-----------------------------|-------------------|------------------------|-----------------------------------------|---------------------|
| pH Electrode<br>S/N.: 9X3D0537 | 1.679                       | 1.686             | 296.3                  | 0.0071                                  | 2.13                |
|                                | 4.008                       | 3.992             | 159.1                  | 0.0089                                  | 2.25                |
|                                | 6.865                       | 6.845             | -10.1                  | 0.015                                   | 2.20                |
|                                | 9.181                       | 9.138             | -143.9                 | 0.014                                   | 2.00                |
|                                | *12.45                      | 12.427            | -335.9                 | 0.056                                   | 2.00                |

**Remark:** \* : Not NSC-ONSC Accredited

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

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*Saitip*

a 1188741



## Certificate of Calibration

Certificate Number : SPR23010143-5

Page : 1 of 3

Customer : Thai Environmental Technic Limited.

1/6 Soi Ramkhamhaeng 145, Khwaeng Saphan Sung, Khet Saphan  
Sung, Bangkok 10240, Thailand.

Equipment Name : DO Meter

Manufacturer : Horiba

Model : OM-71G

Serial Number : D75J0012

ID. Number : No.07

### Environmental Conditions

Ambient Temperature :  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$

Received Date : 13 Jan 2023

Relative Humidity :  $50\% \pm 15\%$

Calibration Date : 14 Jan 2023

Location of Calibration : In-Lab

Recommend Due Date : 14 Jan 2024

Calibration Procedure : In-House Method

Date of Issue : 15 Jan 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Kijja Visitsilp

Approved by :

Calibration Officer

( Ms.Bussakorn Chaikaew )

Authorized Signatory



## Calibration Report

Certificate Number : SPR23010143-5

Page : 2 of 3

### Reference Standards

| Equipment Name       | Model    | Serial No.    | Certificate No. | Due. Date   |
|----------------------|----------|---------------|-----------------|-------------|
| Zero Oxygen Solution | HI7040L  | Lot. S0066/21 | 01B24           | 31 Jan 2027 |
| Electronic Balance   | N/A      | 14246789      | SPR22110015-7   | 10 Nov 2023 |
| Standard Weight Set  | Class E2 | B746971965    | C02221902       | 16 Sep 2023 |

### Traceability

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

HANNA - Hanna Instruments (Thailand) Ltd.

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

SPC - SPC Calibration Center Co;Ltd.







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



Cert. No.: 23TM673

Page : 1 of 3

## Certificate of Calibration

**Equipment :** BOD Incubator

**Manufacturer :** Accuplus

**Model :** i250

**Serial No. :** 0408-0115-0008

**ID No. :** TET.LAB.BOD05

**Submitted by :** Thai Environmental Technic Limited  
1/6 Soi Ramkhamhaeng 145,  
Khwaeng/Khet Saphan Sung,  
Bangkok 10240

**Location :** Laboratory (Thai Environmental Technic Limited)

**Received Order :** 10 April 2023

**Calibration Date :** 11 April 2023

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Khit Ruttanaprapachai

**Approved by :**

*Malee*

Approved Signatory

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

**Issue Date :**

25 April 2023

**The Uncertainties are for a confidence probability of approximately 95%**

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

A 0053455



Equipment : BOD Incubator  
 Condition As-Received : Used Item  
 Reference : 2304-0146OC-2

Cert. No.: 23TM673

Page : 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

| Instrument           | Model  | Serial No. | Cert. No. | Due Date    |
|----------------------|--------|------------|-----------|-------------|
| 1 ) Data Acquisition | 34972A | MY57013711 | 22LM93    | 02 Jul 2023 |

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

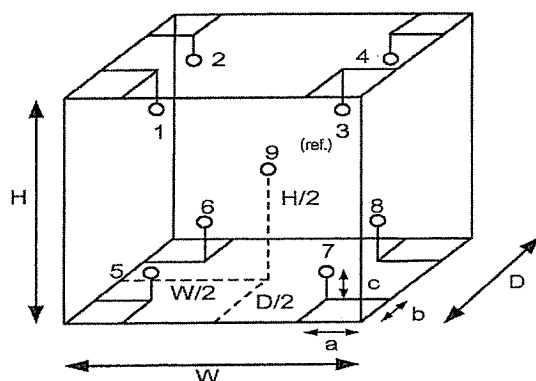
3. This certification is traceable to the International System of Unit.

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

Function of UUC\* : Temperature Source

Fresh air setting : Not Available

| Environment during calibration |           |          |
|--------------------------------|-----------|----------|
|                                | Beginning | Finished |
| Temp. ( °C )                   | 25        | 26       |
| REL.Humid. ( % )               | 51        | 54       |
| AC Supply ( Volt )             | 221       | 221      |



| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1          | 18-18RTD-01       |
| 2          | 18-18RTD-02       |
| 3          | 18-18RTD-03       |
| 4          | 18-18RTD-04       |
| 5          | 18-18RTD-05       |
| 6          | 18-18RTD-06       |
| 7          | 18-18RTD-07       |
| 8          | 22-18RTD-08       |
| 9 (ref.)   | 18-18RTD-09       |

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.48 m  
 W = 0.50 m  
 H = 1.1 m  
 Capacity = 0.26 m<sup>3</sup>

*Malu.*



Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2304-01460C-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 23TM673

Page : 3 of 3

| Calibration Point<br>( °C ) | UUC* Setting<br>( °C ) | UUC* Reading<br>( °C ) | Temperature stability<br>( ± °C ) | Temperature uniformity<br>( °C ) | Overall Variation<br>( °C ) | Coverage Factor<br><i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-----------------------------|
| 20.0                        | 19.8                   | 19.7                   | 0.54                              | 0.37                             | 1.1                         | 2                           |

| Calibration<br>Point<br>( °C ) | Measured Temperature ( °C ) |        |        |        |        |        |        |        |          | Uncertainty<br><br>( ± °C ) |
|--------------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|-----------------------------|
|                                | Position                    |        |        |        |        |        |        |        |          |                             |
|                                | 1                           | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9 (ref.) |                             |
| 20.0                           | 20.121                      | 20.227 | 19.983 | 20.098 | 19.992 | 19.953 | 19.936 | 19.914 | 20.048   | 0.72                        |

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

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*Mlu.*

a 1158204





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



Cert. No.: 23TM604

Page : 1 of 3

## Certificate of Calibration

**Equipment :** Incubator

**Manufacturer :** Memmert

**Model :** INE 500

**Serial No. :** E505.0595

**ID No. :** TET.LAB.INC 01

**Submitted by :** Thai Environmental Technic Limited  
1/6 Soi Ramkhamhaeng 145,  
Khwaeng/Khet Saphan Sung,  
Bangkok 10240

**Location :** Laboratory (Thai Environmental Technic Limited)

**Received Order :** 10 April 2023

**Calibration Date :** 10 April 2023

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Man Pattanapongpaiboon

**Approved by :**

Approved Signatory

- ( / ) Pornthippa Tameyakul  
( ✓ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :**

25 April 2023

**The Uncertainties are for a confidence probability of approximately 95%**

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

A 0053457



**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2304-0146OC-4  
**Procedure Used :-**

**Cert. No.:** 23TM604  
**Page :** 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ).  
 The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

| <u>Instrument</u>    | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|----------------------|--------------|-------------------|------------------|-----------------|
| 1 ) Data Acquisition | 34970A       | MY41021843        | 22LM172          | 27 Dec 2023     |

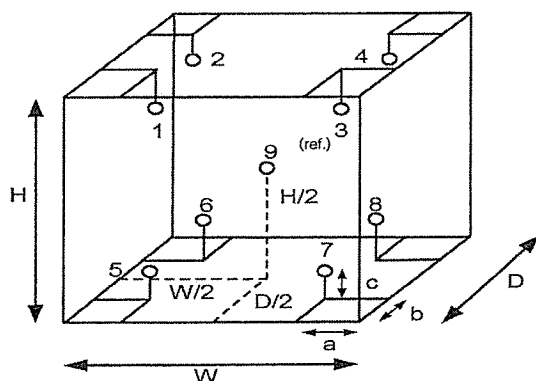
2. This certificate is valid only to the item calibrated on date and place of calibration.  
 3. This certification is traceable to the International System of Unit.

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

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

**Fresh air setting :** Close

| Environment during calibration |           |          |
|--------------------------------|-----------|----------|
|                                | Beginning | Finished |
| Temp. ( °C )                   | 25        | 25       |
| REL.Humid. ( % )               | 54        | 57       |
| AC Supply ( Volt )             | 223       | 219      |



| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1          | 18-04RTD-01       |
| 2          | 18-04RTD-02       |
| 3          | 18-04RTD-03       |
| 4          | 18-04RTD-04       |
| 5          | 18-04RTD-05       |
| 6          | 18-04RTD-06       |
| 7          | 18-04RTD-07       |
| 8          | 18-04RTD-08       |
| 9 (ref.)   | 18-04RTD-09       |

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.40 m  
 W = 0.56 m  
 H = 0.48 m  
 Capacity = 0.11 m<sup>3</sup>

*Malu.*



**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2304-0146OC-4  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

**Cert. No.:** 23TM604

**Page :** 3 of 3

| Calibration Point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Temperature stability ( ± °C ) | Temperature uniformity ( °C ) | Overall Variation ( °C ) | Coverage Factor <i>k</i> |
|--------------------------|---------------------|---------------------|--------------------------------|-------------------------------|--------------------------|--------------------------|
| 35.0                     | 35.0                | 35.0                | 0.065                          | 0.32                          | 0.67                     | 2                        |
| 41.5                     | 41.5                | 41.5                | 0.032                          | 0.49                          | 0.63                     | 2                        |
| 44.5                     | 44.5                | 44.5                | 0.086                          | 0.60                          | 0.86                     | 2                        |

| Calibration<br>Point<br>( °C ) | Measured Temperature ( °C ) |        |        |        |        |        |        |        |          | Uncertainty<br><br>( ± °C ) |
|--------------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|-----------------------------|
|                                | Position                    |        |        |        |        |        |        |        |          |                             |
|                                | 1                           | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9 (ref.) |                             |
| 35.0                           | 34.870                      | 34.847 | 34.722 | 34.860 | 34.744 | 35.047 | 34.842 | 35.288 | 35.026   | 0.30                        |
| 41.5                           | 41.625                      | 41.612 | 41.461 | 41.733 | 41.300 | 41.428 | 41.418 | 41.874 | 41.758   | 0.30                        |
| 44.5                           | 44.744                      | 44.708 | 44.553 | 44.862 | 44.205 | 44.476 | 44.352 | 44.931 | 44.778   | 0.30                        |

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

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

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

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

**UUC\* :** Unit Under Calibration

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

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

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*Mali*