

## ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือวิเคราะห์และตรวจวัดคุณภาพสิ่งแวดล้อม



#### Site Information

|                   |                          |               |                        |
|-------------------|--------------------------|---------------|------------------------|
| <b>Location</b> : | TNP Environment Co.,Ltd. | <b>Date</b> : | 21-Nov-23              |
| <b>Serial</b> :   | TNP-F-01-PM10            | <b>Tech</b> : | Mr.Nattachai Triprawat |

#### Site Conditions

|                                     |     |                                    |     |
|-------------------------------------|-----|------------------------------------|-----|
| <b>Barometric Pressure (mmHg)</b> : | 760 | <b>Corrected Pressure (mmHg)</b> : | 760 |
| <b>Temperature (deg C)</b> :        | 29  | <b>Temperature (deg K)</b> :       | 302 |
| <b>Average Press.(mmHg)</b> :       | 760 | <b>Corrected Average (mmHg)</b> :  | 760 |
| <b>Average Temp.(deg C)</b> :       | 29  | <b>Average Temp.(deg K)</b> :      | 302 |

#### Calibration Orifice

|                 |                  |                               |                 |
|-----------------|------------------|-------------------------------|-----------------|
| <b>Make</b> :   | Tish Environment | <b>Slope</b> :                | 1.69297         |
| <b>Model</b> :  | TE-5028A         | <b>Intercept</b> :            | -0.02707        |
| <b>Serial</b> : | 3945             | <b>Calibration Due Date</b> : | October 1, 2023 |

#### Calibration Data

| Plate or<br>Test # | H2O<br>(in) | Qa<br>(m3/min) | I<br>(Chart) | IC<br>(Corrected) | Linear Regression        |           |
|--------------------|-------------|----------------|--------------|-------------------|--------------------------|-----------|
| 1                  | 6.60        | 0.973          | 56.00        | 35.30             | <b>Slope</b>             | : 40.6720 |
| 2                  | 5.50        | 0.889          | 51.00        | 32.15             | <b>Intercept</b>         | : -4.2291 |
| 3                  | 4.60        | 0.815          | 46.00        | 29.00             | <b>Corr. Coeff</b>       | : 0.9984  |
| 4                  | 3.60        | 0.722          | 39.00        | 24.58             | <b># of Observations</b> | : 5       |
| 5                  | 2.40        | 0.593          | 34.00        | 20.17             |                          |           |

Calibrate By : \_\_\_\_\_

Approved By : \_\_\_\_\_



332/173 หมู่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110  
 เบอร์ติดต่อ 02-156-8273 อีเมล tnp3lab.env@gmail.com / tnp.env@gmail.com  
 เลขประจำตัวผู้เสียภาษีอากร 0 1255 8000 8957

#### Site and Calibration Information

|                 |                            |             |                          |
|-----------------|----------------------------|-------------|--------------------------|
| <b>Location</b> | : TNP Environment Co.,Ltd. | <b>Date</b> | : 14-Nov-23              |
| <b>Serial</b>   | : TNP-F-01-TSP             | <b>Tech</b> | : Mr.Nattachai Triprawat |

#### Site Conditions

|                                   |       |                                  |       |
|-----------------------------------|-------|----------------------------------|-------|
| <b>Barometric Pressure (mmHg)</b> | : 759 | <b>Corrected Pressure (mmHg)</b> | : 759 |
| <b>Temperature (deg C)</b>        | : 30  | <b>Temperature (deg K)</b>       | : 303 |
| <b>Average Press.(mmHg)</b>       | : 759 | <b>Corrected Average (mmHg)</b>  | : 759 |
| <b>Average Temp.(deg C)</b>       | : 30  | <b>Average Temp.(deg K)</b>      | : 303 |

#### Calibration Orifice

|               |                    |                       |                   |
|---------------|--------------------|-----------------------|-------------------|
| <b>Make</b>   | : Tish Environment | <b>Qstd Slope</b>     | : 1.69297         |
| <b>Model</b>  | : TE-5028A         | <b>Qstd Intercept</b> | : -0.02707        |
| <b>Serial</b> | : 3945             | <b>Date Certified</b> | : October 1, 2023 |

#### Calibration Information

| Plate or<br>Test # | H2O<br>(In) | Qstd<br>(m3/min) | I<br>(Chart) | IC<br>(Corrected) | Linear Regression        |            |
|--------------------|-------------|------------------|--------------|-------------------|--------------------------|------------|
| 1                  | 7.20        | 1.587            | 56.00        | 56.49             | <b>Slope</b>             | : 34.84626 |
| 2                  | 5.50        | 1.401            | 40.00        | 48.56             | <b>Intercept</b>         | : 0.434914 |
| 3                  | 4.60        | 1.258            | 44.00        | 44.60             | <b>Corr. Coeff</b>       | : 0.9928   |
| 4                  | 3.40        | 1.111            | 39.00        | 37.66             | <b># of Observations</b> | : 5        |
| 5                  | 2.40        | 0.923            | 34.00        | 33.70             |                          |            |

Calibrate By :

Approved By :

## Analyzer Performance Test

Calibrated Date: 31 October 2023

### Instruments Information

Analyzer Type : CO Analyzer  
Model : 48C

Manufacturer : Thermo Environmental  
Serial Number : 48CHL-67713-358

### Calibrator Unit

Dilutor Model : Dasibi Model 5008  
Serial Number : 705  
ZERO AIR Generator : API MODEL 701  
Serial Number : 1924

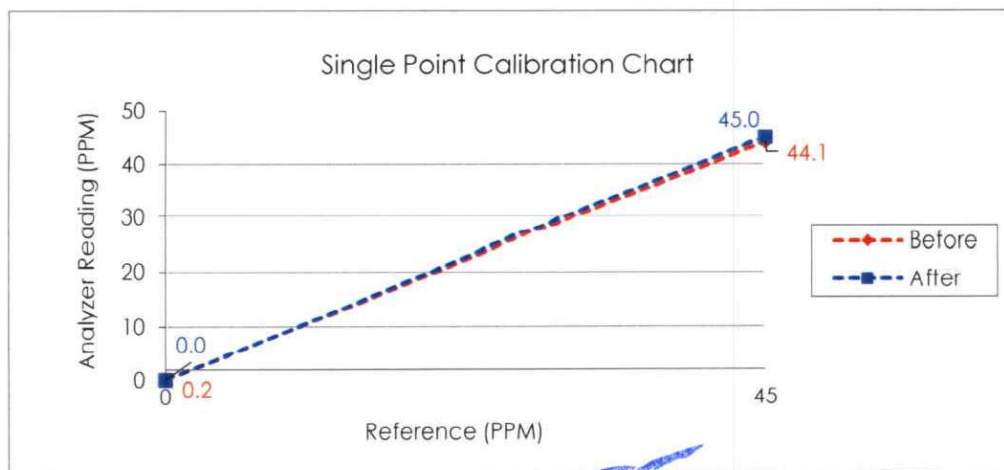
### Standard Gas Concentration

Nitric Oxide (NO) 55.47 PPM  
Sulphur Dioxide (SO<sub>2</sub>) 55.11 PPM  
Carbon Monoxide (CO) 4,535 PPM  
Cylinder number EB0129027  
Expire Date: 29 Oct. 2027

Environment : Temperature 25.5 °C Humidity: 51 %RH

### Calibration Report

|        | Zero            |               |             | Span            |               |        |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
|        | Reference (PPM) | Reading (PPM) | Drift (PPM) | Reference (PPM) | Reading (PPM) | Drift% |
| Before | 0.0             | 0.2           | 0.2         | 45.0            | 44.1          | -2.0   |
| After  | 0.0             | 0.0           | 0.0         | 45.0            | 45.0          | 0.0    |



Calibrate By :



## ENVIR SERVICE CO., LTD.

42 Ramintra 14 Yeak 9, Tha Raeng, Bang Khen, Bangkok 10230  
Tel. 02-9435814-5 Fax. 02-9438201 www.envirservice.co.th

### Analyzer Performance Test

Calibrated Date: 18 September 2023

#### Instruments Information

Analyzer Type : NO-NO2-NOx Analyzer

Manufacturer : Thermo Environmental

Model : 42C

Serial Number : 0413406269

#### Calibrator Unit

Dilutor Model : Dasibi Model 5008

Serial Number : 705

ZERO AIR Generator : API MODEL 701

Serial Number : 1924

#### Standard Gas Concentration

Nitric Oxide (NO) 55.47 PPM

Sulphur Dioxide (SO2) 55.11 PPM

Carbon Monoxide (CO) 4,535 PPM

Cylinder number EB0129027

Expire Date: 29 Oct. 2027

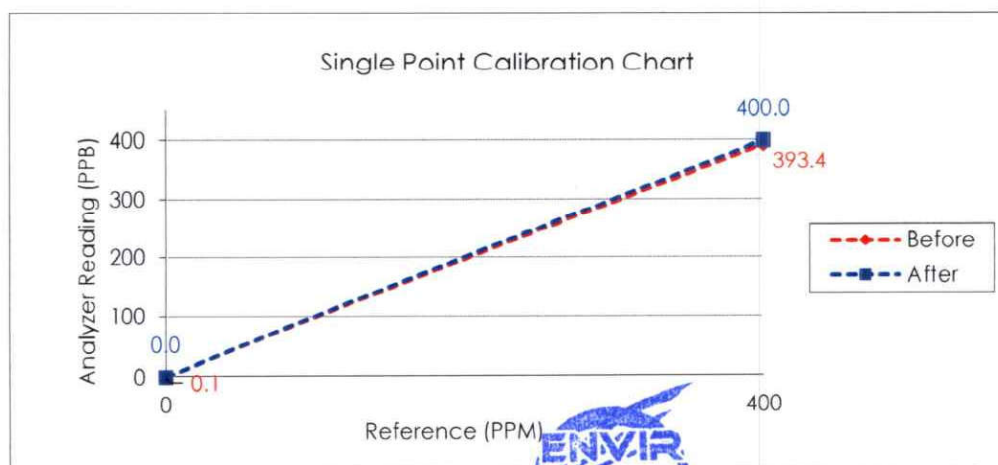
Environment : Temperature 25.5 °C Humidity: 51 %RH

#### Calibration Report (Before Adjust)

| Status | Zero            |               |             | Span            |               |        |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
|        | Reference (PPB) | Reading (PPB) | Drift (PPB) | Reference (PPB) | Reading (PPB) | Drift% |
| NO     | 0.0             | 0.1           | 0.1         | 400.0           | 393.4         | -1.7   |
| NOx    | 0.0             | 0.0           | 0.0         | 400.0           | 394.6         | -1.3   |

#### Calibration Report (After Adjust)

| Status | Zero            |               |             | Span            |               |        |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
|        | Reference (PPB) | Reading (PPB) | Drift (PPB) | Reference (PPB) | Reading (PPB) | Drift% |
| NO     | 0.0             | 0.1           | 0.1         | 400.0           | 400.0         | 0.0    |
| NOx    | 0.0             | 0.0           | 0.0         | 400.0           | 400.0         | 0.0    |



Calibrate By : [REDACTED]

## Analyzer Performance Test

Calibrated Date: 31 October 2023

### Instruments Information

Analyzer Type : SO2 Analyzer  
Model : 43C

Manufacturer : Thermo Environmental  
Serial Number : 0327402325

### Calibrator Unit

Dilutor Model : Dasibi Model 5008  
Serial Number : 705  
ZERO AIR Generator : API MODEL 701  
Serial Number : 1924

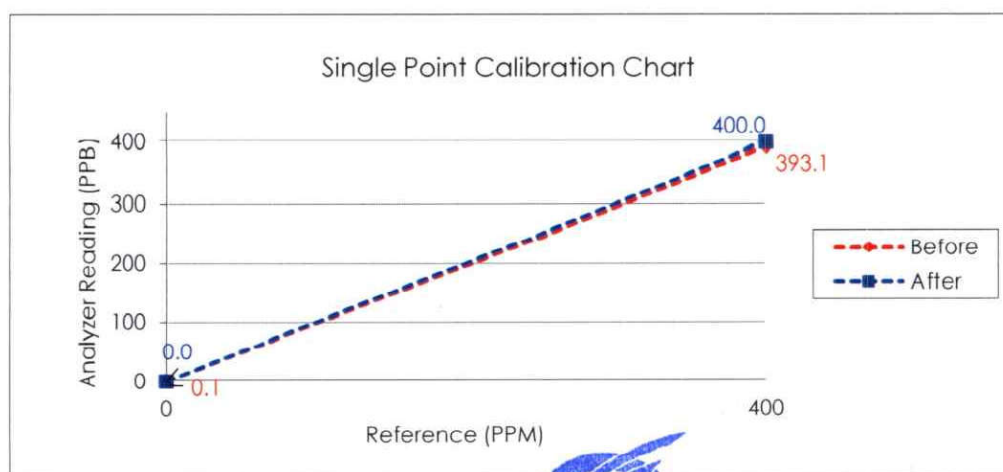
### Standard Gas Concentration

Nitric Oxide (NO) 55.47 PPM  
Sulphur Dioxide (SO2) 55.11 PPM  
Carbon Monoxide (CO) 4,535 PPM  
Cylinder number EB0129027  
Expire Date: 29 Oct. 2027

Environment : Temperature 25.5 °C Humidity: 51 %RH

### Calibration Report

| Status | Zero            |               |             | Span            |               |        |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
|        | Reference (PPB) | Reading (PPB) | Drift (PPB) | Reference (PPB) | Reading (PPB) | Drift% |
| Before | 0.0             | 0.1           | 0.1         | 400.0           | 393.1         | -1.7   |
| After  | 0.0             | 0.0           | 0.0         | 400.0           | 400.0         | 0.0    |



Calibrate By :



## Analyzer Performance Test

Calibrated Date: 2023-Nov-1

### Instruments Information

Analyzer Type : CH4-NMHC-THC Analyzer

Manufacturer : HORIBA

Model : APHA-360CE

Serial Number : 423740300209

### Calibrator Unit

Dilutor Model : Dasibi Model 5008

Serial Number : 705

ZERO AIR Generator : API MODEL 701

Serial Number : 1924

### Standard Gas Concentration

Methane (CH<sub>4</sub>) 181.0 PPM

Propane 180.7 PPM

Cylinder number EB0123130

Expire Date: 3 Oct. 2027

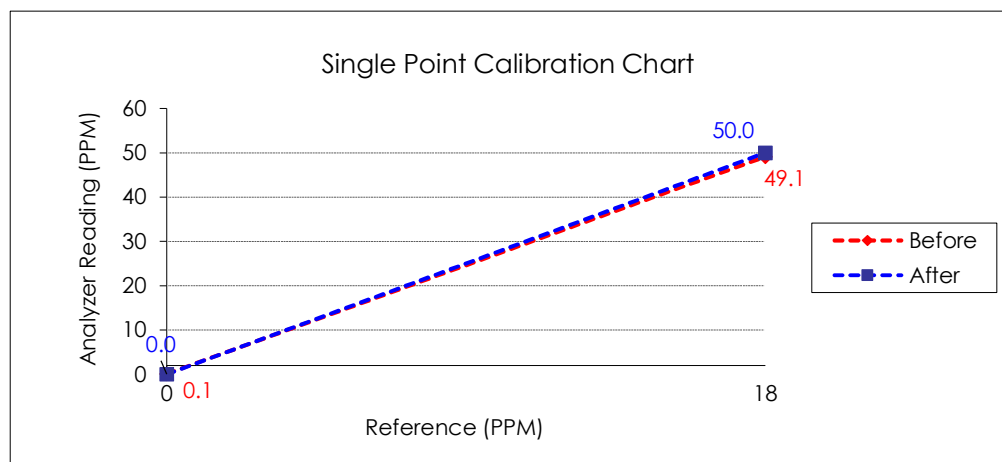
Environment : Temperature 25.5 °C Humidity: 51 %RH

### Calibration Report (Before adjust)

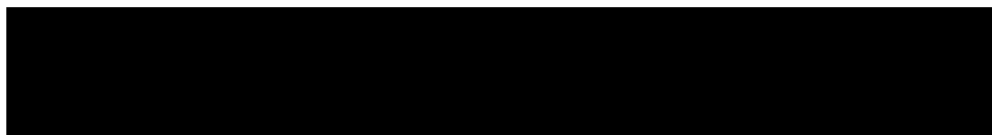
| Status  | Zero            |               |             | Span            |               |        |
|---------|-----------------|---------------|-------------|-----------------|---------------|--------|
|         | Reference (PPM) | Reading (PPM) | Drift (PPM) | Reference (PPM) | Reading (PPM) | Drift% |
| Methane | 0.0             | 0.1           | 0.1         | 50.0            | 49.1          | -1.8   |
| NMHC    | 0.0             | 0.1           | 0.1         | 50.0            | 48.9          | -2.2   |

### Calibration Report (After adjust)

| Status  | Zero            |               |             | Span            |               |        |
|---------|-----------------|---------------|-------------|-----------------|---------------|--------|
|         | Reference (PPM) | Reading (PPM) | Drift (PPM) | Reference (PPM) | Reading (PPM) | Drift% |
| Methane | 0.0             | 0.0           | 0.0         | 50.0            | 50.0          | 0.0    |
| NMHC    | 0.0             | 0.0           | 0.0         | 50.0            | 50.0          | 0.0    |



Calibrate By :





## Certificate of Calibration

Certificate Number : SPR23070550-1

Page : 1 of 3

Customer : TNP ENVIRONMENT CO.,LTD.

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

Equipment Name : Sound Calibrator

Manufacturer : KEPLER

Model : KSM-42C

Serial Number : 160100568

ID. Number : TNP-F-CAL01

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Received Date : 31 Jul 2023

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

Calibration Date : 02 Aug 2023

Location of Calibration : In-Lab

Recommend Due Date : 02 Aug 2024

Calibration Procedure : In-House Method

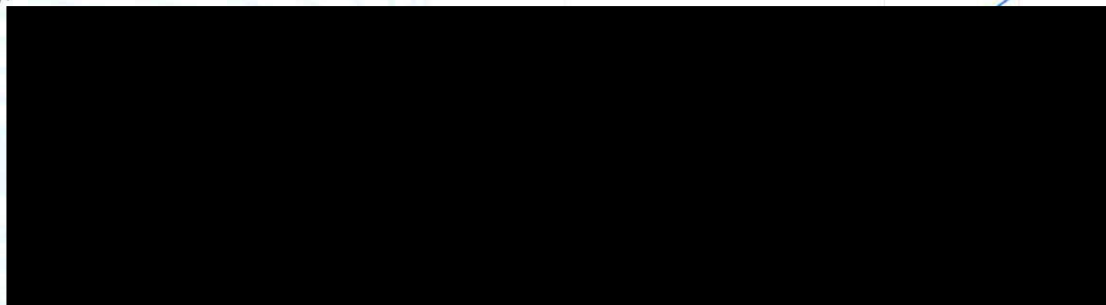
Date of Issue : 03 Aug 2023

### 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.

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :





## Calibration Report

Certificate Number : SPR23070550-1

Page : 2 of 3

### Reference Standards

| Equipment Name     | Model | Serial No. | Certificate No. | Due. Date   |
|--------------------|-------|------------|-----------------|-------------|
| Measuring Receiver | 8902A | 2950A02471 | EF-0001-23      | 12 Jan 2024 |
| AUDIO Analyzer     | 8903B | 3011A09975 | EL05303/23      | 14 Feb 2024 |

### Traceability

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

NIMT - The National Institute of Metrology, Thailand.

PCAL - Professional Calibration & Services Co.,Ltd



## Result of Calibration

Certificate No. : SPR23070550-1

Page : 3 of 3

Function : Sound Level

| UUC Setting<br>( $\pm$ dB ) | Standard Reading<br>( dB ) | Error<br>( dB ) | Uncertainty<br>( $\pm$ dB ) |
|-----------------------------|----------------------------|-----------------|-----------------------------|
| 94                          | 94.0                       | 0.0             | 1.5                         |
| 114                         | 114.0                      | 0.0             | 1.5                         |

**Note:**

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

**Measurement Uncertainty**

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd.  
63/14-15, 67/35-36  
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,  
Bangkok 10600 (Thailand)  
Tel: +6608680812  
Mobile: +66863999453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TISI-TIS 17025  
CALIBRATION 0367

Flow measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : COF-014-66

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Top Load Orifice  
**MANUFACTURER** : TISCH  
**MODEL/TYPE** : TE-5028  
**SERIAL NUMBER** : 3945  
**ID NUMBER** : TNP-F-CAL02  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : TNP Environment Co., Ltd.  
332/173 Vision Smart Life Village, Bangrak Phatthana,  
Bang Bua Thong District, Nonthaburi 11110

**RECEIVED DATE** : 29 Sep 2023  
**MEASUREMENT DATE** : 01 Oct 2023  
**ISSUE DATE** : 01 Oct 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

|                      |               |     |
|----------------------|---------------|-----|
| Temperature          | : 23.0 ± 3.0  | °C  |
| Relative Humidity    | : 55.0 ± 15.0 | %RH |
| Atmospheric Pressure | : 1010 ± 10   | hPa |

### CALIBRATION CONDITION:

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are 25.1 °C and 57.0 %RH.

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The WI-CL-004 was used as a calibration guideline.

### Traceability:

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

### Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor  $k=2$ , Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:



Approved sign

## MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The Humid air was used as a medium in the system. The standard conditions are 25°C (298.15 K) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of  $Q$  Standard calibration data

| Plate | Flow rate<br>m <sup>3</sup> /min | Pressure<br>[Pa]<br>mmHg | Temperature<br>[Ta]<br>°C | Temperature<br>[Tm]<br>°C | $\Delta p_{\text{meter}}$<br>mmHg | $\Delta p_{\text{Orifice}}$<br>inH <sub>2</sub> O | $\gamma$ | Standard Flow [ $Q_s$ ]<br>m <sup>3</sup> /min |
|-------|----------------------------------|--------------------------|---------------------------|---------------------------|-----------------------------------|---------------------------------------------------|----------|------------------------------------------------|
| 1     | 0.705                            | 755.985                  | 24.95                     | 23.76                     | 68.702                            | 1.098                                             | 1.045    | 0.641                                          |
| 2     | 1.005                            | 756.073                  | 24.81                     | 23.66                     | 53.939                            | 2.343                                             | 1.527    | 0.933                                          |
| 3     | 1.122                            | 756.065                  | 24.44                     | 23.62                     | 48.579                            | 2.981                                             | 1.724    | 1.050                                          |
| 4     | 1.166                            | 756.080                  | 24.33                     | 23.58                     | 46.771                            | 3.229                                             | 1.794    | 1.093                                          |
| 5     | 1.421                            | 756.160                  | 24.48                     | 23.64                     | 34.286                            | 4.973                                             | 2.226    | 1.356                                          |

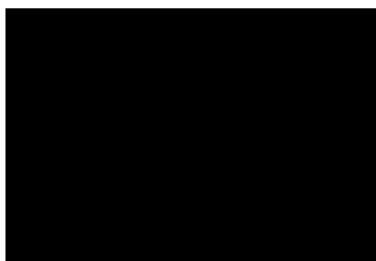
Slope ( $m$ ): 1.65230  
 Intercept ( $b$ ): -0.01279  
 Correlation coefficient ( $r$ ): 0.99984  
 Uncertainty ( $k=2$ ): 0.015 m<sup>3</sup>/min

Table 2: The results of  $Q$  actual calibration data

| Plate | Flow rate<br>m <sup>3</sup> /min | Pressure<br>[Pa]<br>mmHg | Temperature<br>[Ta]<br>°C | Temperature<br>[Tm]<br>°C | $\Delta p_{\text{meter}}$<br>mmHg | $\Delta p_{\text{Orifice}}$<br>inH <sub>2</sub> O | $\gamma$ | Standard Flow [ $Q_s$ ]<br>m <sup>3</sup> /min |
|-------|----------------------------------|--------------------------|---------------------------|---------------------------|-----------------------------------|---------------------------------------------------|----------|------------------------------------------------|
| 1     | 0.705                            | 755.985                  | 24.95                     | 23.76                     | 68.702                            | 1.098                                             | 0.658    | 0.644                                          |
| 2     | 1.005                            | 756.073                  | 24.81                     | 23.66                     | 53.939                            | 2.343                                             | 0.961    | 0.937                                          |
| 3     | 1.122                            | 756.065                  | 24.44                     | 23.62                     | 48.579                            | 2.981                                             | 1.083    | 1.053                                          |
| 4     | 1.166                            | 756.080                  | 24.33                     | 23.58                     | 46.771                            | 3.229                                             | 1.127    | 1.097                                          |
| 5     | 1.421                            | 756.160                  | 24.48                     | 23.64                     | 34.286                            | 4.973                                             | 1.399    | 1.360                                          |

Slope ( $m$ ): 1.03492  
 Intercept ( $b$ ): -0.00806  
 Correlation coefficient ( $r$ ): 0.99984  
 Uncertainty ( $k = 2$ ): 0.015 m<sup>3</sup>/min

\*\*\*End of Certificate of Calibration\*\*\*





## Certificate of Calibration

Certificate Number : SPR23060536-2

Page : 1 of 3

Customer : TNP ENVIRONMENT CO.,LTD.

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

Equipment Name : Sound Level Meter

Manufacturer : Scarlet Tech

Model : ST-25D

Serial Number : 10340943

ID. Number : TNP-F-S26

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

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

Location of Calibration : In-Lab

Calibration Procedure : SP-CPE-04-01

Received Date : 30 Jun 2023

Calibration Date : 11 Jul 2023

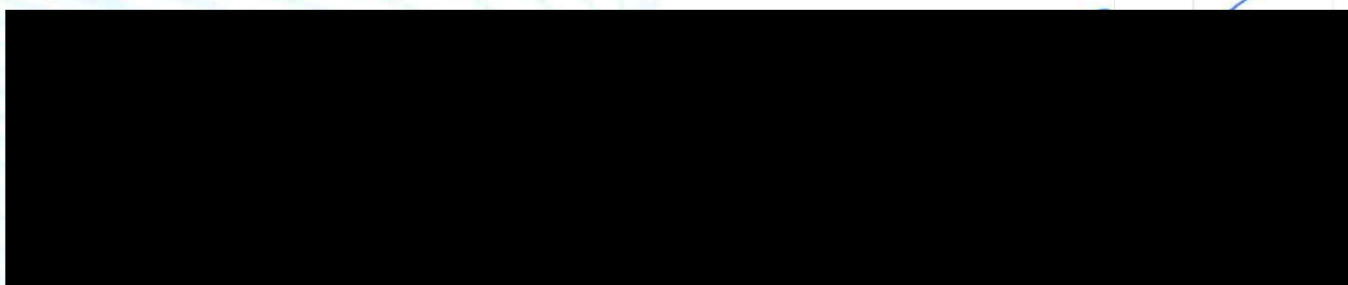
Recommend Due Date : 11 Jul 2024

Date of Issue : 12 Jul 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.

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).





## Calibration Report

Certificate Number : SPR23060536-2

Page : 2 of 3

### Reference Standards

| Equipment Name         | Model  | Serial No. | Certificate No.  | Due. Date   |
|------------------------|--------|------------|------------------|-------------|
| Sound Level Calibrator | ST-120 | 211203773  | EEL.BP. 114/0166 | 17 Jan 2024 |

### Traceability

This certification is traceable to the International System of Unit maintained at :  
TISTR - Thailand Institute of Scientific and Technological Research



## Result of Calibration

Certificate No. : SPR23060536-2

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

| Standard Setting | UUC Reading |       | Error |      | Uncertainty ( ± ) |
|------------------|-------------|-------|-------|------|-------------------|
|                  | Fast        | Slow  | Fast  | Slow |                   |
| 94               | 94.1        | 94.1  | 0.1   | 0.1  | 0.15              |
| 114              | 114.0       | 114.0 | 0.0   | 0.0  | 0.15              |

Select C

Unit : dB

| Standard Setting | UUC Reading |       | Error |      | Uncertainty ( ± ) |
|------------------|-------------|-------|-------|------|-------------------|
|                  | Fast        | Slow  | Fast  | Slow |                   |
| 94               | 94.2        | 94.2  | 0.2   | 0.2  | 0.15              |
| 114              | 114.1       | 114.1 | 0.1   | 0.1  | 0.15              |

### Note:

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -



## Certificate of Calibration

Certificate Number : SPR23030201-1

Page : 1 of 3

Customer : TNP ENVIRONMENT CO.,LTD.

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

Equipment Name : Vibration Meter

Manufacturer : Instatel

Model : 721A3301/721A2601

Serial Number : UM15019/UM14102

ID. Number : TNP-F-V02

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Received Date : 13 Mar 2023

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

Calibration Date : 20 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 20 Mar 2024

Calibration Procedure : In-House Method

Date of Issue : 21 Mar 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).



## Calibration Report

Certificate Number : SPR23030201-1

Page : 2 of 3

### Reference Standards

| Equipment Name       | Model | Serial No. | Certificate No. | Due. Date   |
|----------------------|-------|------------|-----------------|-------------|
| Vibration Calibrator | VC-02 | 2007014    | AV-0050-20      | 10 Dec 2023 |

### Traceability

This certification is traceable to the International System of Unit maintained at :  
NIMT - The National Institute of Metrology, Thailand.



## Result of Calibration

Certificate No. : SPR23030201-1

Page : 3 of 3

Results of Calibration : (\*) Without ( ) After Adjustment

Velocity Performance Test

Unit : mm/s<sub>pk</sub>

| Frequency<br>( Hz ) | STD Reading | UUC. Reading | Error | Uncertainty<br>( ± ) |
|---------------------|-------------|--------------|-------|----------------------|
| 80.0                | 1.002       | 1.036        | 0.034 | 0.012                |
| 80.0                | 2.003       | 2.034        | 0.031 | 0.023                |
| 80.0                | 3.002       | 3.049        | 0.047 | 0.035                |
| 80.0                | 4.004       | 4.058        | 0.054 | 0.046                |
| 80.0                | 5.005       | 5.076        | 0.071 | 0.058                |
| 80.0                | 6.002       | 6.088        | 0.086 | 0.069                |
| 80.0                | 7.003       | 7.124        | 0.121 | 0.081                |
| 80.0                | 8.001       | 8.231        | 0.230 | 0.092                |
| 80.0                | 9.003       | 9.342        | 0.339 | 0.10                 |
| 80.0                | 10.005      | 10.445       | 0.440 | 0.12                 |

### Note:

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2$ , providing a level of confidence approximately 95%

– End of Certificate –



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



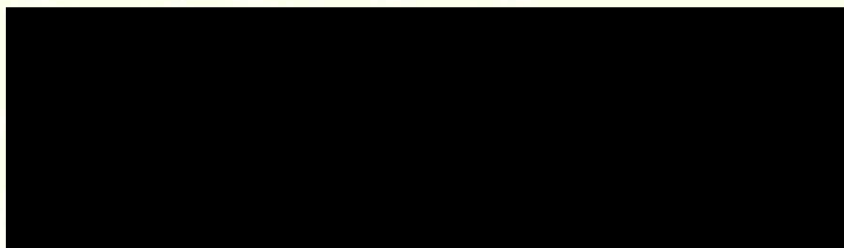
Cert.No.: 23CH126

Page.: 1 of 2

## Certificate of Calibration

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

Calibrated by : Walalāk Sirithean



Issue Date : 31 January 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 0050390



Cert.No.: 23CH126

Page.: 2 of 2

**Condition of this calibration result**

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

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

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

**Calibration Results**

**Function : pH Measurement**

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

| 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.: 1328 | 4.008                       | 4.01              | N/A                    | 0.0085                                  | 2.05                |
|                            | 6.987                       | 6.99              | N/A                    | 0.011                                   | 2.00                |
|                            | 10.008                      | 10.02             | N/A                    | 0.0095                                  | 2.00                |

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

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

-o0o-

## Certificate of Calibration

### Customer

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

Certificate No : 22-DPM-236

Request No : Req-2022-1811

### Unit Under Calibration Details

Measurement Item : Bioaerosol Sampler  
Manufacturer : Aquaria  
Model : Microflow  $\alpha$   
Serial Number : M3290  
ID : -

Resolution : 0.001 inch H<sub>2</sub>O

### Calibration Environment and Details

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

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

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

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

Certificate No : 22-DPM-236

Request No : Req-2022-1811

Calibration Results : Without Adjustment

**Flow Rate Accuracy**

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

**Note :**

Mean : The average standard of 4 values on each Point

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

$\Delta P$  = Differential Pressure

End of Certificate

**Certificate No. T/O 660071**

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

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

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

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

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

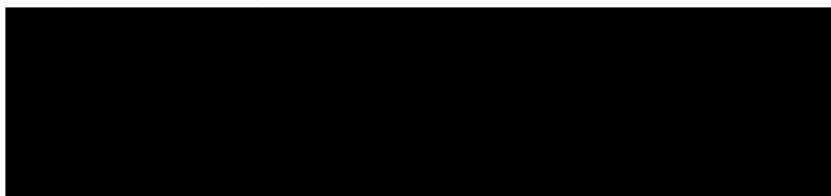
*The expression uncertainty and confidence in measurement.*

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

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

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

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



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

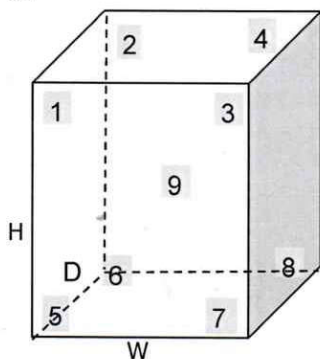
**The Reference Standard Instrument :-**

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

**Measured room conditions**

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

**Sensor Position :**



**Working Space of chamber :**

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

**Sensor Installation Details :**

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

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

( \* ) Without adjustment

( ) After adjustment

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

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

**UUC\* = Unit Under Calibration**

**Remark :-**

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

**End of Report**

# Calibration Certificate

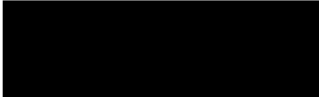
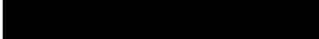
Cert. No. : CT-23-01-23295

Page : 1 of 4

Issued date : 24 January 2023

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

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

Received Date : 20 January 2023      Ref. Job No. : SO6601-00020  
Calibrated by : Mr.Apiwat Mungsamak      Cert. prepare by :   
Calibrated Date : 20 January 2023      Approved by : 

Calibration Place : ห้องปฏิบัติการ2  
Environment Condition : Temperature  $28.5 \pm 2.7$  (°c) , Humidity  $57.5 \pm 14.5$  (%RH)

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

## Reference Standard Instrument :

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

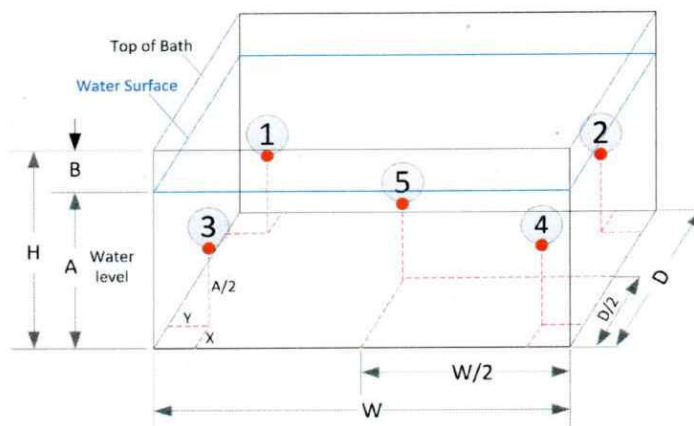
## Condition of certificate :

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

**Calibration Result :**

Condition of UUC :

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



Pic 1 : Position of each sensor No.

- (1) The quoted uncertainty include with "Stability".  
 (2) Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors , for at least half an hour after reaching sted state.  
 (3) Uniformity = The maximum difference of measured temperatures at two any sensor which are observed at the same time.  
 (4) Overall variation = The difference of the maximum and the minimum measured temperature throughtout observation time.

**Section 1 : Report of Temperature distribution**

Unit : ( °c )

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

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

**Section 2 : Report of Chamber Performance**

Unit : ( °c )

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

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

Approved Signatory :

Certificate No. : CT-23-01-23295

Page : 3 of 4

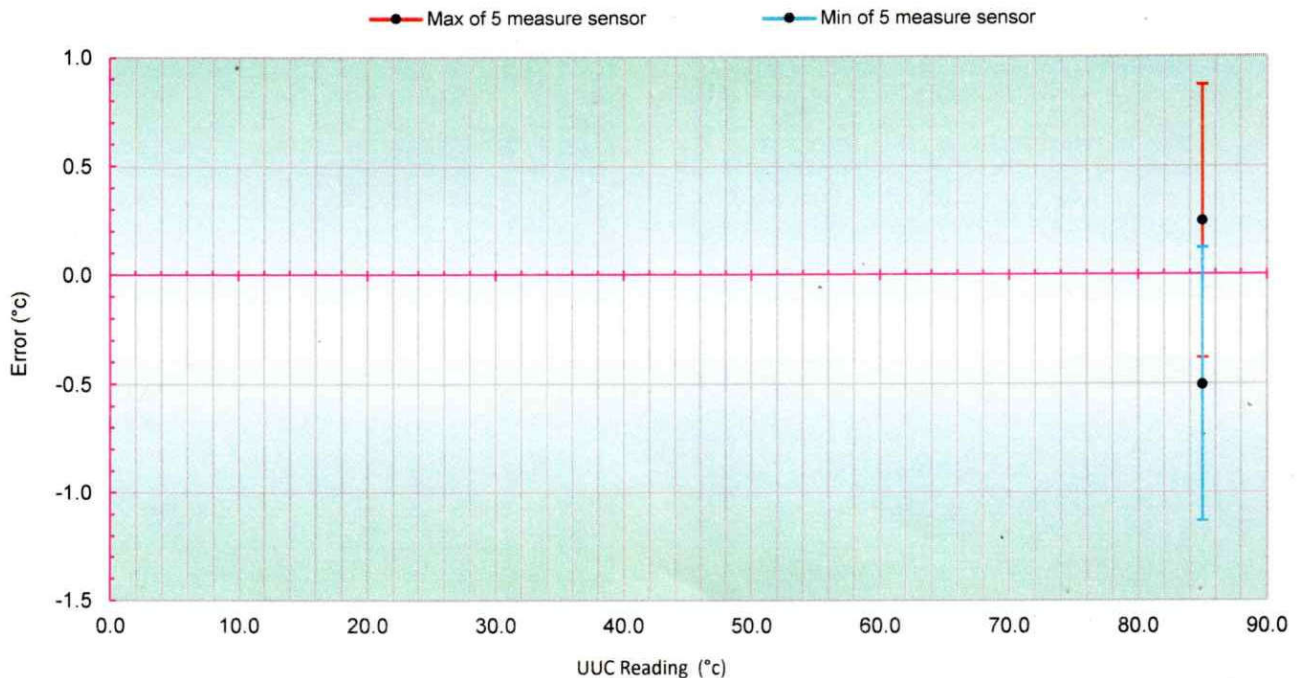
**Section 3 :** Possible of temperature in chamber. Show minimum and maximum of the average values and Include with uncertainty of measurement. , The average values is average of each position standard sensor throughtout observation time.

Unit : ( °c )

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

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

**Section 4 :** Trend of accuracy



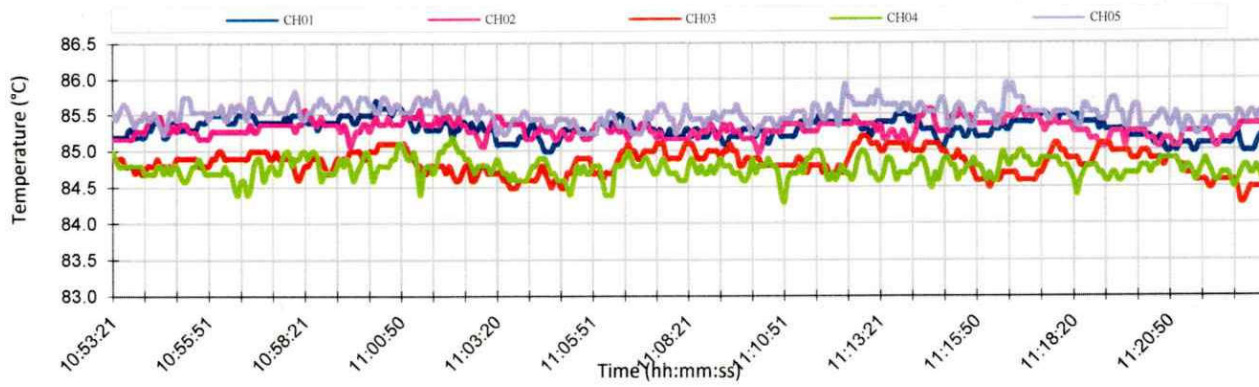
Approved Signatory :

Certificate No. : CT-23-01-23295

Page : 4 of 4

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

(5.1) Temperature Distribution at UUC Reading 85.0 °C



Approved Signatory :



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TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23T238

Page : 1 of 2

Equipment : Liquid-in Glass Thermometer

Manufacturer: SK

Model : -

Serial No.: -

ID No.: TNP.LAB.12

Condition As-Received: Used Item

Received Date: 27 January 2023

Calibration Date: 07 February 2023  
to 10 February 2023

Reference: 2301-0937WN

Submitted by: TNP ENVIRONMENT CO.,LTD

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-T02 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u>                             | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Digital Thermometer                        | 1529         | A7A609            | 22I1274                | 17 Oct 2023     |
| 2) Industrial Platinum Resistance Thermometer | 5627-12      | 571975            | 22I1274                | 17 Oct 2023     |

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

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

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

-National Institute of Metrology Thailand (NIMT)



Cert. No.: 23T238

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement.

**Type:**

Total Immersion

**Scale Division:**

1 °C

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

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

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

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

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

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TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 23H486

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer  
Manufacturer: EXTECH  
Model : 448515  
Serial No.: PONPE5899554  
ID No.: TNP.LAB.21

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 07 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

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

### Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u>                      | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|----------------------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Hygro-M2 Dew Point Monitor          | 5112         | 2360195           | 20703                  | 02 Aug 2023     |
| 2) Standard Humidity/Temperature Meter | 400          | 10203027          | TH-0082-22             | 22 Aug 2023     |

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

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

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)



Cert. No.: 23H486

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity Measurement

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

**Result of Calibration:-**

Without Adjustment

Function:

Temperature Measurement

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

**UUC\*** : Unit Under Calibration

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

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## Certificate of Calibration

Certificate No. : 23H487

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer

Manufacturer: EXTECH

Model : 448515

Serial No.: PONPE5899555

ID No.: TNP.LAB.22

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 07 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

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

Relative Humidity: ( 50  $\pm$  20 ) %

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

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

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

### Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u>                      | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|----------------------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Hygro-M2 Dew Point Monitor          | 5112         | 2360195           | 20703                  | 02 Aug 2023     |
| 2) Standard Humidity/Temperature Meter | 400          | 10203027          | TH-0082-22             | 22 Aug 2023     |

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

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

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

B 0310048



Cert. No.: 23H487

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity Measurement

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

**Result of Calibration:-**

Without Adjustment

Function:

Temperature Measurement

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

**UUC\*** : Unit Under Calibration

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

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



## Certificate of Calibration

Certificate No. : 23M455

Page : 1 of 2

Equipment : Standard Weight Set

Manufacturer: -

Model : Class:F1

Serial No.: 15022021-01

ID No.: TNP.LAB.25

Condition As-Received: Used Item

Received Date: 02 March 2023

Calibration Date: 04 March 2023

Reference: 2303-0104WN

Submitted by: TNP ENVIRONMENT CO.,LTD.

Ambient Temperature: ( 23  $\pm$  2 ) °C

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

Atmospheric Pressure: 1015.25 mbar

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

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

### Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u>           | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Standard Weight Set (E2) | 73336        | 20026             | MM-0018-22             | 28 Feb 2024     |
| 2) Standard Weight Set (E2) | 73338        | 20028             | MM-0019-22             | 28 Feb 2024     |

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

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

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

-National Institute of Metrology Thailand (NIMT)



Cert No.: 23M455

Page: 2 of 2

**Result of calibration**

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

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

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# THAI CALIBRATION SERVICES CO., LTD.

19/8 Moo 9 Soi Raiking 30 Puttamonthon 5 Rd., Sampran, Nakornpatom 73210

Tel. 0-3439-7682-5 Fax: 0-3439-7687

www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



## CALIBRATION CERTIFICATE

Certificate No.S2306518S

page 1 of 2

**Customer :** TNP ENVIRONMENT CO., LTD.  
332/173 Moo 3 Tambon Bang Rak Phatthana,  
Amphoe Bang Bua Thong, Nonthaburi 11110

**Equipment :** Non-automatic weighing instrument (Electronic instrument)

**Manufacturer :** Shimadzu **Order No. :** 66S2523-1

**Model :** AP225WD **Ambient temperature :**  $(26.9 \pm 5.0) ^\circ\text{C}$

**Accuracy class :** - **Relative humidity :**  $(52.0 \pm 10.0) \%$

**Capacity :** 10 g / 220 g **Received date :** 21-Jun-2023

**Resolution :** 0.00001 g / 0.0001 g **Date of calibration :** 21-Jun-2023

**Serial No. :** D316301848 **Date of issue :** 24-Jun-2023

**ID No. :** TNP.LAB.30 **Condition of the balance :** Good working conditions

**Place of calibration :** ห้อง LAB

### Calibration method

This instrument was calibrated according to the EURAMET Calibration Guide No. 18.

### Condition of reference standard weight

| <u>Instrument</u>     | <u>Nominal value</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due-date</u> | <u>Density (kg/m<sup>3</sup>)</u> |
|-----------------------|----------------------|-------------------|------------------------|-----------------|-----------------------------------|
| 1 Standard weight set | 1 mg to 2 kg         | 15885+15849       | M2210001S              | 8-Oct-2023      | 7950                              |

### Traceability of the reference standard weight

This certificate is traceable to SI unit through Mass Calibration Laboratory Thai Calibration Services Co., Ltd., NSC-ONSC accredited no. Calibration 0189.

This calibration certificate may not be reproduced other than in full,  
except with the prior written approval of the head of TCS calibration laboratory.



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www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



## CALIBRATION CERTIFICATE

Certificate No.S2306518S

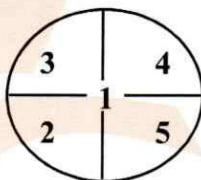
page 2 of 2

### The repeatability of indication

| Nominal Value<br>( g ) | Standard Deviation of reading<br>( g ) | Maximum difference between<br>suscensive reading ( g ) | n |
|------------------------|----------------------------------------|--------------------------------------------------------|---|
| 100                    | 0.000005                               | 0.00001                                                | 5 |
| 200                    | 0.00005                                | 0.0001                                                 | 5 |

### The effect of eccentric application of a load on the indication (test load : 100 g)

| Position        | Balance Reading<br>( g ) |
|-----------------|--------------------------|
| Point 1         | 100.0000                 |
| Point 2         | 100.0002                 |
| Point 3         | 100.0001                 |
| Point 4         | 100.0000                 |
| Point 5         | 100.0001                 |
| Eccentric Value | 0.0002                   |



### The error of indication

| Nominal Value<br>( g ) | Value of Reference<br>Standard Weight<br>( g ) | Balance Reading<br>( g ) | Correction<br>( g ) | Uncertainty (±)<br>( g ) | k    |
|------------------------|------------------------------------------------|--------------------------|---------------------|--------------------------|------|
| Unload                 | 0.00000                                        | 0.00000                  | 0.00000             | 0.000016                 | 2.32 |
| 0.1                    | 0.10000                                        | 0.10003                  | -0.00003            | 0.000019                 | 2.10 |
| 0.5                    | 0.50000                                        | 0.50001                  | -0.00001            | 0.000023                 | 2.04 |
| 1                      | 1.00001                                        | 1.00000                  | +0.00001            | 0.000026                 | 2.00 |
| 5                      | 5.00000                                        | 5.00001                  | -0.00001            | 0.000038                 | 2.00 |
| 10                     | 9.99999                                        | 10.00001                 | -0.00002            | 0.000046                 | 2.00 |
| 20                     | 20.0000                                        | 20.0000                  | 0.0000              | 0.000085                 | 2.00 |
| 50                     | 50.0000                                        | 50.0001                  | -0.0001             | 0.00011                  | 2.00 |
| 100                    | 100.0000                                       | 100.0000                 | 0.0000              | 0.00018                  | 2.00 |
| 200                    | 200.0000                                       | 200.0004                 | -0.0004             | 0.00034                  | 2.00 |

Remark : Adjustment, External weight nominal value 100 g, Standard weight of Lab

### Uncertainty of measurement

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor ( $k$ ), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

**This report will certify of the calibrated equipment only.**

--End--



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## CALIBRATION CERTIFICATE

Certificate No.S2306519S

page 1 of 2

**Customer :** TNP ENVIRONMENT CO., LTD.  
332/173 Moo 3 Tambon Bang Rak Phatthana,  
Amphoe Bang Bua Thong, Nonthaburi 11110

**Equipment :** Non-automatic weighing instrument (Electronic instrument)

**Manufacturer :** Sartorius **Order No. :** 66S2523-2

**Model :** SECURA224-1S **Ambient temperature :**  $(26.8 \pm 5.0) ^\circ\text{C}$

**Accuracy class :** - **Relative humidity :**  $(52.0 \pm 10.0) \%$

**Capacity :** 220 g **Received date :** 21-Jun-2023

**Resolution :** 0.0001 g **Date of calibration :** 21-Jun-2023

**Serial No. :** 0041305301 **Date of issue :** 24-Jun-2023

**ID No. :** TNP.LAB.31 **Condition of the balance :** Good working conditions

**Place of calibration :** ห้อง LAB

### Calibration method

This instrument was calibrated according to the EURAMET Calibration Guide No. 18.

### Condition of reference standard weight

| <u>Instrument</u>     | <u>Nominal value</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due-date</u> | <u>Density (kg/m<sup>3</sup>)</u> |
|-----------------------|----------------------|-------------------|------------------------|-----------------|-----------------------------------|
| 1 Standard weight set | 1 mg to 2 kg         | 15885+15849       | M2210001S              | 8-Oct-2023      | 7950                              |

### Traceability of the reference standard weight

This certificate is traceable to SI unit through Mass Calibration Laboratory Thai Calibration Services Co., Ltd., NSC-ONSC accredited no. Calibration 0189.

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Tel. 0-3439-7682-5 Fax: 0-3439-7687

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## CALIBRATION CERTIFICATE

Certificate No.S2306519S

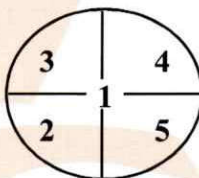
page 2 of 2

### The repeatability of indication

| Nominal Value<br>( g ) | Standard Deviation of reading<br>( g ) | Maximum difference between<br>successive reading ( g ) | n |
|------------------------|----------------------------------------|--------------------------------------------------------|---|
| 200                    | 0.00000                                | 0.0000                                                 | 5 |

### The effect of eccentric application of a load on the indication (test load : 100 g)

| Position        | Balance Reading<br>( g ) |
|-----------------|--------------------------|
| Point 1         | 100.0000                 |
| Point 2         | 100.0000                 |
| Point 3         | 100.0000                 |
| Point 4         | 99.9998                  |
| Point 5         | 99.9998                  |
| Eccentric Value | 0.0002                   |



### The error of indication

| Nominal Value<br>( g ) | Value of Reference<br>Standard Weight<br>( g ) | Balance Reading<br>( g ) | Correction<br>( g ) | Uncertainty (±)<br>( g ) | k    |
|------------------------|------------------------------------------------|--------------------------|---------------------|--------------------------|------|
| Unload                 | 0.0000                                         | 0.0000                   | 0.0000              | 0.000082                 | 2.00 |
| 0.1                    | 0.1000                                         | 0.1000                   | 0.0000              | 0.000083                 | 2.00 |
| 0.5                    | 0.5000                                         | 0.5000                   | 0.0000              | 0.000084                 | 2.00 |
| 1                      | 1.0000                                         | 0.9999                   | +0.0001             | 0.000085                 | 2.00 |
| 5                      | 5.0000                                         | 5.0000                   | 0.0000              | 0.000090                 | 2.00 |
| 10                     | 10.0000                                        | 10.0000                  | 0.0000              | 0.000094                 | 2.00 |
| 20                     | 20.0000                                        | 20.0001                  | -0.0001             | 0.00011                  | 2.00 |
| 50                     | 50.0000                                        | 50.0001                  | -0.0001             | 0.00013                  | 2.00 |
| 100                    | 100.0000                                       | 100.0000                 | 0.0000              | 0.00019                  | 2.00 |
| 200                    | 200.0000                                       | 199.9998                 | +0.0002             | 0.00033                  | 2.00 |

Remark : Without adjustment

### Uncertainty of measurement

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor ( $k$ ), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

**This report will certify of the calibrated equipment only.**

--End--

CERT.No.: HS-U039F

**Harikul Science Co.,Ltd.**  
 694 Soi Ratchadanivet 24, Pracharatbamphen,  
 Samsaennok, Huaikhwang, Bangkok 10310  
 Tel: 0-2274-2456 Fax: 0-2274-2443  
 Email: info@harikul.com www.harikul.com

**Certificate of Calibration**

Calibration Date : 20 Jun 23  
 Submitted by : TNP ENVIRONMENT COMPANY LIMITED.  
 332/173 Moo. 3, Tambon Bang Rak Phatthana,  
 Amphoe Bang Bua Thong, Nonthaburi 11110

Model : YSI 4010-2W  
 S/N : 22051520  
 Probe : YSI 4100  
 S/N : 22C102711  
 ID NO. : -  
 Air Temp ref : S/N. E00522  
 Barometric ref : S/N. E00522  
 Water Temp ref : S/N. 11431  
 Technician : Kittipong M.

Avg Room Temp : 20 °C  
 Avg Water Temp : 20 °C  
 Air Pressure : 757.00 mmHg  
 Salinity : 0 ppt

**Calibration Details**

| Calibration Point     | 100% air sat.<br>(@20 °C, DO = 9.09 mg/l) | (status) | (status) | (status) |
|-----------------------|-------------------------------------------|----------|----------|----------|
| Measurement 1 (mg/l)  | 9.05                                      | (PASS)   | -        | -        |
| Measurement 2 (mg/l)  | 9.05                                      | (PASS)   | -        | -        |
| Measurement 3 (mg/l)  | 9.04                                      | (PASS)   | -        | -        |
| Measurement 4 (mg/l)  | 9.03                                      | (PASS)   | -        | -        |
| Measurement 5 (mg/l)  | 9.04                                      | (PASS)   | -        | -        |
| Measurement 6 (mg/l)  | 9.04                                      | (PASS)   | -        | -        |
| Measurement 7 (mg/l)  | 9.04                                      | (PASS)   | -        | -        |
| Measurement 8 (mg/l)  | 9.03                                      | (PASS)   | -        | -        |
| Measurement 9 (mg/l)  | 9.03                                      | (PASS)   | -        | -        |
| Measurement 10 (mg/l) | 9.03                                      | (PASS)   | -        | -        |
| Mean Measurement      | 9.04                                      | mg/l     | -        | -        |
| Inaccuracy            | 0.05                                      | mg/l     | -        | -        |
| Overall Status        | (PASS)                                    |          |          |          |

**Manufacturer Specification**

Accuracy = +/- 0.2 mg/l

- 1) This certificate is issued based on the result that are found as shown on date and place of test only.
- 2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- 3) This result shall not be used for advertising purpose.

