# ภาคผนวก ช

ห้องปฏิบัติการวิเคราะห์เอกชน



[redacted]

CO.,LTD.

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

*Flow measurement laboratory*
*Calibration services department.*

NSC – TISI – TIS 17025
CALIBRATION 0367

# CERTIFICATE OF CALIBRATION

Certificate No. : COF-014-66



| | |
|---|---|
| **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.<br>332/173 Vision Smart Life Village, Bangrak Phatthana,<br>Bang Bua Thong District, Nonthaburi 11110 |
| **RECEIVED DATE** | : 29 Sep 2023 |
| **MEASUREMENT DATE** | : 01 Oct 2023 |
| **ISSUE DATE** | : 01 Oct 2023 |

***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'*

**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.

[redacted]

THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

**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 $m^3/min$ | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_meter mmHg | Δp_Orifice $inH_2O$ | $Y$ | Standard Flow [$Q_S$] $m^3/min$ |
|---|---|---|---|---|---|---|---|---|
| 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** $m^3/min$

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

| Plate | Flow rate $m^3/min$ | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_meter mmHg | Δp_Orifice $inH_2O$ | $Y$ | Standard Flow [$Q_a$] $m^3/min$ |
|---|---|---|---|---|---|---|---|---|
| 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** $m^3/min$

***End of Certificate of Calibration***

[redacted]

Jiranatee Associates Co., Ltd.

**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:** 17 September 2023

***Instruments Information***

**Analyzer Type :** CO Analyzer
**Model :** 48C
**Manufacturer :** Thermo Environmental
**Serial Number :** 48C-79177-391

**Calibrator Unit**

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

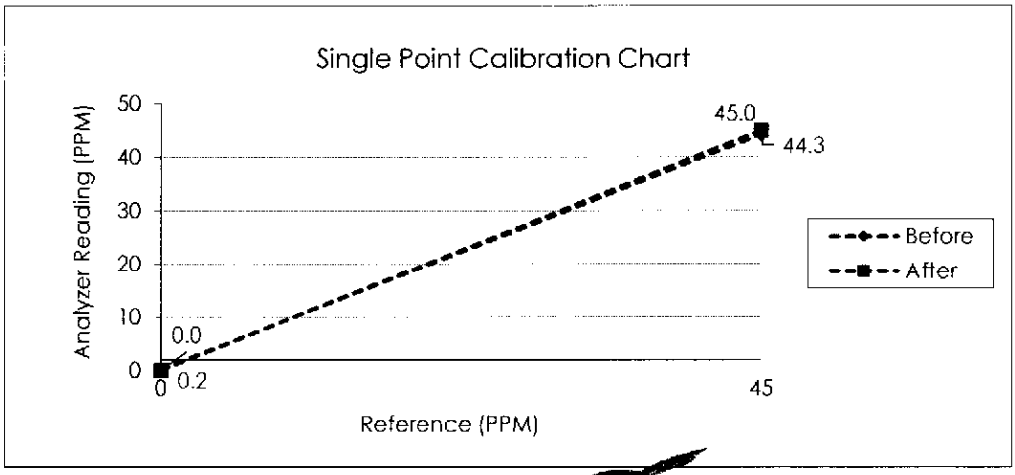
**Standard Gas Concentration**

| | | |
|---|---|---|
| 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***

| | *Zero* | | | *Span* | | |
|---|---|---|---|---|---|---|
| | Reference (PPM) | Reading (PPM) | Drift (PPM) | Reference (PPM) | Reading (PPM) | Drift% |
| **Before** | 0.0 | 0.2 | 0.2 | 45.0 | 44.3 | -1.6 |
| **After** | 0.0 | 0.0 | 0.0 | 45.0 | 45.0 | 0.0 |



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# 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 Genearator :** API MODEL 701
Serial Number : 1924

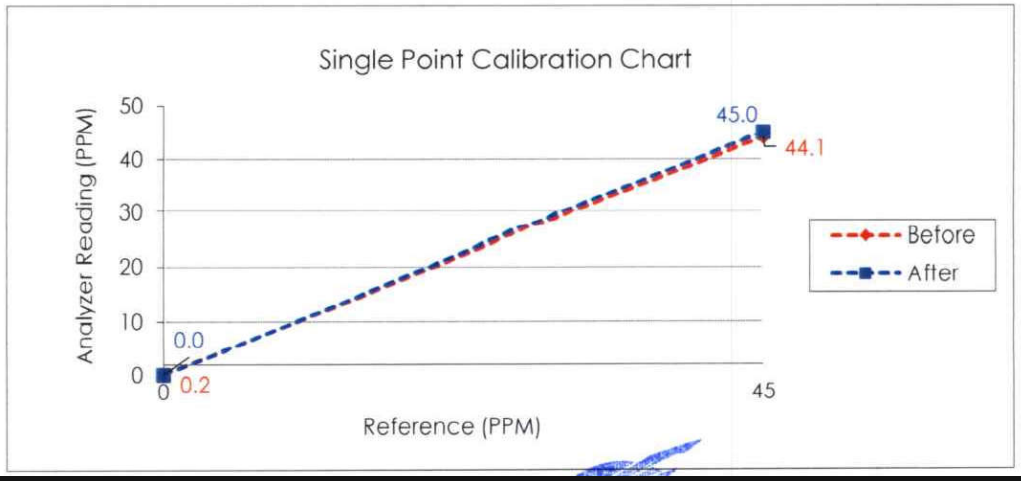
**Standard Gas Concentration**

| | | |
|---|---|---|
| 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***

| | 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 |




[redacted]

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# 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 Genearator :** 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

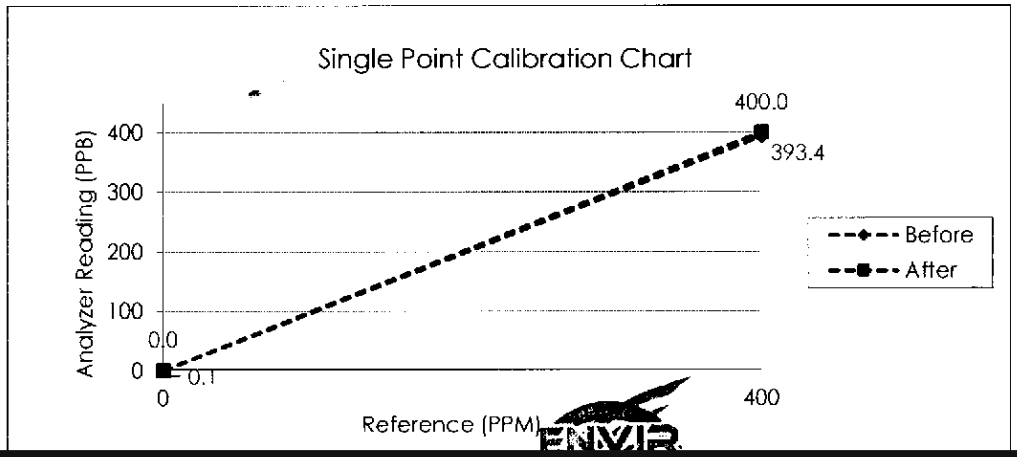
**Environment :** Temperature 25.5 °C Humidity: 51 %RH

***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 |



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# Analyzer Performance Test

**Calibrated Date:** 31 October 2023

***Instruments Information***

**Analyzer Type :** NO-NO2-NOx Analyzer
**Manufacturer :** Thermo Environmental
**Model :** 42C
**Serial Number :** 42C-70987-367

**Calibrator Unit**

**Dilutor Model :** Dasibi Model 5008
Serial Number : 705
**ZERO AIR Genearator :** 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 | |

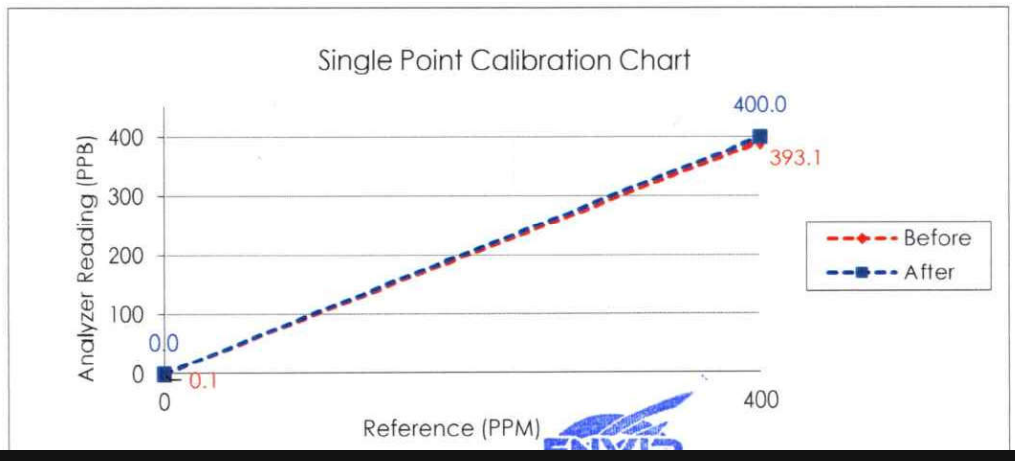
**Environment :** Temperature 25.5 °C Humidity: 51 %RH

***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 | 393.1 | -1.7 |
| NOx | 0.0 | 0.0 | 0.0 | 400.0 | 394.4 | -1.4 |

***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 |




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# Analyzer Performance Test

**Calibrated Date:** 17 September 2023

***Instruments Information***

**Analyzer Type :** SO2 Analyzer
**Model :** 43C
**Manufacturer :** Thermo Environmental
**Serial Number :** 0411405899

**Calibrator Unit**
**Dilutor Model :** Dasibi Model 5008
Serial Number : 705
**ZERO AIR Genearator :** API MODEL 701
Serial Number : 1924

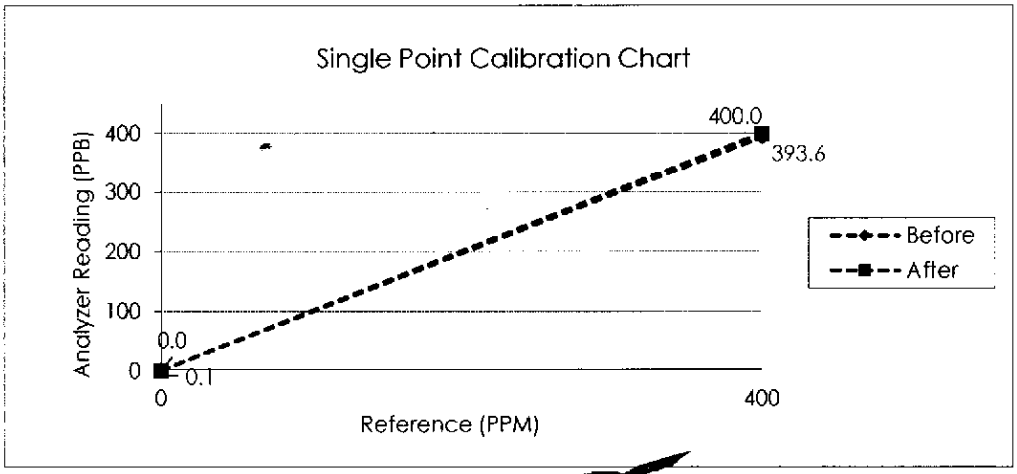
**Standard Gas Concentration**

| | | |
|---|---|---|
| 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 | 393.6 | -1.6 |
| **After** | 0.0 | 0.0 | 0.0 | 400.0 | 400.0 | 0.0 |



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# 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 Genearator :** API MODEL 701
Serial Number : 1924

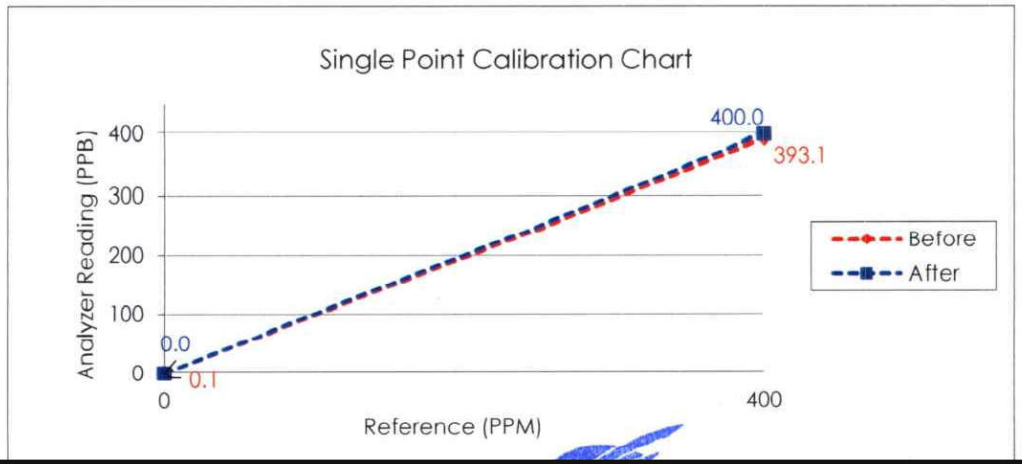
**Standard Gas Concentration**

| | | |
|---|---|---|
| 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 |



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# 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 Genearator :** API MODEL 701
Serial Number : 1924

**Standard Gas Concentration**
Methane (CH4) 181.0 PPM
Propane 180.7 PPM
Cylinder number EB0123130
Expire Date: 3 Oct. 2027

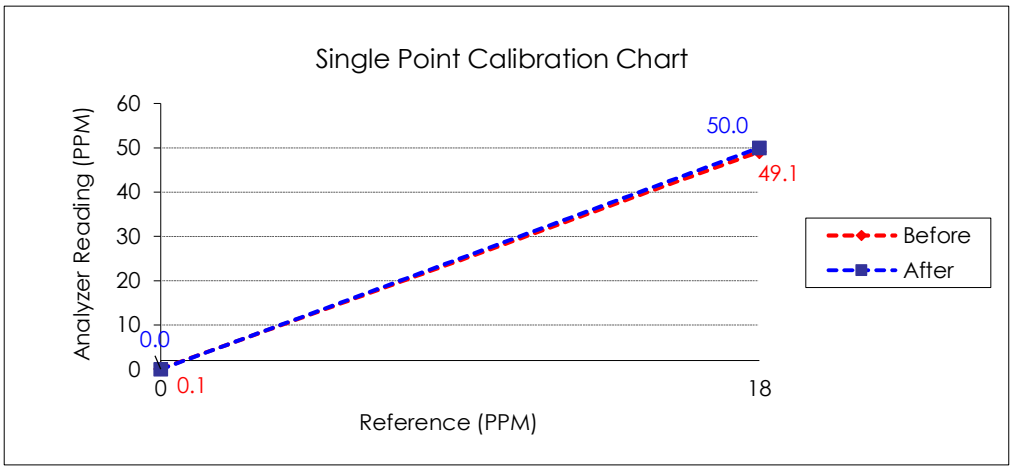
**Environment :** Temperature 25.5 ˚C Humidity: 51 %RH

***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 |



# METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 สายต่อ www.สอบเทียบเครื่องมือวัด.com

# Certificate of Calibration

Certificate Number : SPR23080172-3 Page : 1 of 3

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

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| | | | | | |
|---|---|---|---|---|---|
| Equipment Name | : | Sound Level Meter | | | |
| Manufacturer | : | Scarlet Tech | | | |
| Model | : | ST-25D | | | |
| Serial Number | : | 10340949 | | | |
| ID. Number | : | TNP-F-S30 | | | |
| Environmental Conditions | | | | | |
| Ambient Temperature | : | 23 °C ± 3 °C | Received Date | : | 14 Aug 2023 |
| Relative Humidity | : | 50 % ± 15 % | Calibration Date | : | 14 Aug 2023 |
| Location of Calibration | : | In-Lab | Recommend Due Date | : | 14 Aug 2024 |
| Calibration Procedure | : | SP-CPE-04-01 | Date of Issue | : | 15 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).



METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Calibration Report

Certificate Number : SPR23080172-3



## 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

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 สายงาน www.สอบเทียบเครื่องมือวัด.com

METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Result of Calibration

Certificate No. : SPR23080172-3



Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

| Standard Setting | UUC Reading | | Error | | Uncertainty ( ± ) |
|---|---|---|---|---|---|
| | Fast | Slow | Fast | Slow | |
| 94 | 94.0 | 94.0 | 0.0 | 0.0 | 0.15 |
| 114 | 113.9 | 113.9 | -0.1 | -0.1 | 0.15 |

Select C

Unit : dB

| Standard Setting | UUC Reading | | Error | | Uncertainty ( ± ) |
|---|---|---|---|---|---|
| | Fast | Slow | Fast | Slow | |
| 94 | 94.0 | 94.1 | 0.0 | 0.1 | 0.15 |
| 114 | 113.9 | 113.9 | -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 -

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METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

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# Certificate of Calibration

Certificate Number : SPR23040171-1



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

---

| | | | | | |
|---|---|---|---|---|---|
| Equipment Name | : | Sound Level Meter | | | |
| Manufacturer | : | ACO | | | |
| Model | : | 6236 | | | |
| Serial Number | : | 222233 | | | |
| ID. Number | : | TNP-F-S33 | | | |
| Environmental Conditions | | | | | |
| Ambient Temperature | : | 23 °C ± 3 °C | Received Date | : | 18 Apr 2023 |
| Relative Humidity | : | 50 % ± 15 % | Calibration Date | : | 19 Apr 2023 |
| Location of Calibration | : | In-Lab | Recommend Due Date | : | 19 Apr 2024 |
| Calibration Procedure | : | SP-CPE-04-01 | Date of Issue | : | 20 Apr 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).

[redacted]

METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Calibration Report

Certificate Number : SPR23040171-1



## 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

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 ต่อสาย www.สอบเทียบเครื่องมือวัด.com

METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Result of Calibration

Certificate No. : SPR23040171-1



Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

| Standard Setting | UUC Reading | | Error | | Uncertainty ( ± ) |
|---|---|---|---|---|---|
| | Fast | Slow | Fast | Slow | |
| 94 | 94.0 | 93.4 | 0.0 | -0.6 | 0.15 |
| 114 | 113.5 | 113.6 | -0.5 | -0.4 | 0.15 |

Select C

Unit : dB

| Standard Setting | UUC Reading | | Error | | Uncertainty ( ± ) |
|---|---|---|---|---|---|
| | Fast | Slow | Fast | Slow | |
| 94 | 94.0 | 93.5 | 0.0 | -0.5 | 0.15 |
| 114 | 113.6 | 113.7 | -0.4 | -0.3 | 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 -

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 สายงาน www.สอบเทียบเครื่องมือ.com

METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Certificate of Calibration

Certificate Number : SPR23040172-1



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

---

| | | | | | |
|---|---|---|---|---|---|
| Equipment Name | : | Vibration Meter | | | |
| Manufacturer | : | Instantel | | | |
| Model | : | 721A0501/721A2901 | | | |
| Serial Number | : | UM6150/UM12863 | | | |
| ID. Number | : | TNP-F-V12 | | | |
| Environmental Conditions | | | | | |
| Ambient Temperature | : | 23 °C ± 3 °C | Received Date | : | 18 Apr 2023 |
| Relative Humidity | : | 50 % ± 15 % | Calibration Date | : | 21 Apr 2023 |
| Location of Calibration | : | In-Lab | Recommend Due Date | : | 21 Apr 2024 |
| Calibration Procedure | : | In-House Method | Date of Issue | : | 22 Apr 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).

[redacted]



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# Calibration Report

Certificate Number : SPR23040172-1



## 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.

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# Result of Calibration

**Certificate No. :** SPR23040172-1 **Page :** 3 of 3

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

Velocity Performance Test Unit : $mm/s_{pk}$

| Frequency ( Hz ) | STD Reading | UUC. Reading | Error | Uncertainty ( ± ) |
|---|---|---|---|---|
| 80.0 | 1.002 | 1.034 | 0.032 | 0.012 |
| 80.0 | 2.004 | 2.045 | 0.041 | 0.023 |
| 80.0 | 3.001 | 3.056 | 0.055 | 0.035 |
| 80.0 | 4.004 | 4.067 | 0.063 | 0.046 |
| 80.0 | 5.004 | 5.051 | 0.047 | 0.058 |
| 80.0 | 6.003 | 6.069 | 0.066 | 0.069 |
| 80.0 | 7.005 | 7.082 | 0.077 | 0.081 |
| 80.0 | 8.008 | 8.112 | 0.104 | 0.092 |
| 80.0 | 9.011 | 9.184 | 0.173 | 0.10 |
| 80.0 | 10.015 | 10.238 | 0.223 | 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 -

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 สูตร www.สอบเทียบ.com

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (66)0-2116-5860-1 FAX: (66)0-2116-7140



# Certificate of Calibration

**Customer**

**Certificate No :** 22-DPM-236

Name : Innovative Instrument Co.,Ltd.

**Request No :** Req-2022-1811

Address : 7/139 Moo 13, Soi Suntinakorn 11 Tambon Bang Kaeo, Amphoe Bang Phli Samut Prakan Province 10540 Thailand

**Unit Under Calibration Details**

Measurement Item : Bioaerosol Sampler

Resolution : 0.001 inch $H_2O$

Manufacturer : Aquaria

Model : Microflow α

Serial Number : M3290

ID : -

**Calibration Environment and Details**

Temperature : 23 °C ± 3 °C

Humidity : 55 %RH ± 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 providoes 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 confifence approximately 95 %.

[redacted]

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (66)0-2116-5860-1 FAX: (66)0-2116-7140



**Certificate No :** 22-DPM-236

**Request No :** Req-2022-1811

**Calibration Results :** Without Adjustment

**Flow Rate Accuracy**

| Flow Rate (L/min) | $\Delta P$SETRA (inch $H_2O$) | Mean STD Reading (inch $H_2O$) | Error (inch $H_2O$) | | Uncertainty (±) (inch $H_2O$) |
|---|---|---|---|---|---|
| 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 $H_2O$ = 249.0889 Pascal

$\Delta$P = Differential Pressure

**End of Certificate**

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

ENTECH
Where Solutions Begin

# Calibration Certificate

NSC-TISI-TIS 17025
CALIBRATION 0157

**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<br>Temperature : ( 25 ± 15 ) °C<br>Humidity : ( 55 ± 30 ) % RH<br>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

[redacted]



Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

ENTECH
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# Calibration Certificate

NSC-TISI-TIS 17025
CALIBRATION 0157

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

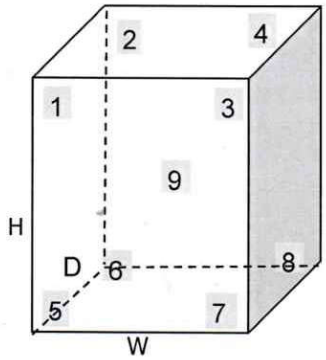
**The Reference Standard Instrument :-**

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

**Measured room conditions**

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

**Sensor Position :**




**Working Space of chamber :**

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

**Sensor Installation Details :**

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

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

( * ) Without adjustment ( ) After adjustment

| UUC* Setting | UUC* Reading | Temperature Reading oF Standard Sensor | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sensor Position | | | | | | | | |
| ( °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 |

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

**UUC* = Unit Under Calibration**

**Remark :-**

- Temperature reading of Standard Sensors shown in the table were taken from the average of Standard reading at each position.
- Temperature Uniformity was calculated from the difference between the maximum and minimum of actual temperature reading from all reference sensors at the same time.
- Temperature Stability was calculated from the maximum stability of nine positions, and formula of Stability is [ ( 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**



Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

# Calibration Certificate

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



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
Calibrated by : Mr.Apiwat Mungsamak
Calibrated Date : 20 January 2023

Ref. Job No. : SO6601-00020
Cert. prepare by : Ms.Nattanicha Panumram
Approved by : Mr.Montree Ruschasetkul

Calibration Place : ห้องปฏิบัติการ2
Environment Condition : Temperature 28.5 ± 2.7 (°c) , Humidity 57.5 ± 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.





44 Soi ChokChai 4 Soi 40 ,LadPrao ,Bangkok ,Tel.: 0-2538-9205 ,0-2935-7096 ,Fax. : 0-2931-4015 ,E

Certificate No. : CT-23-01-23295



**Calibration Result :**

Condition of UUC :

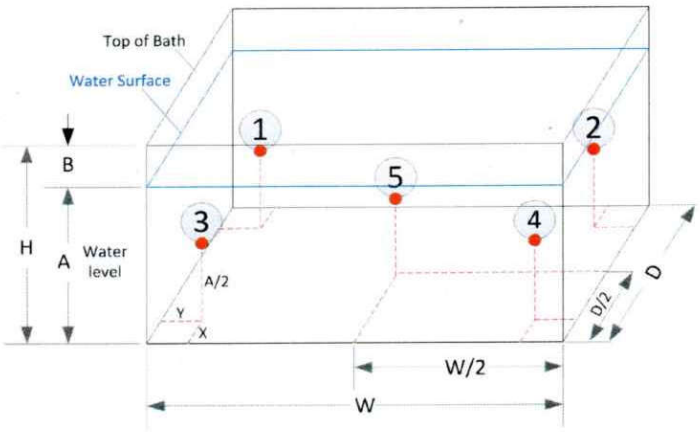
1) Adjust Condition : Without Adjustment
2) Lid Cover : Flat Sheet (Plastic , from
3) Circulation : without circulation
4) X ,Y = 5 cm. , B ~ 3 cm.

(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 througout observation time.




Pic 1 : Position of each sensor No.

## 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

[redacted]

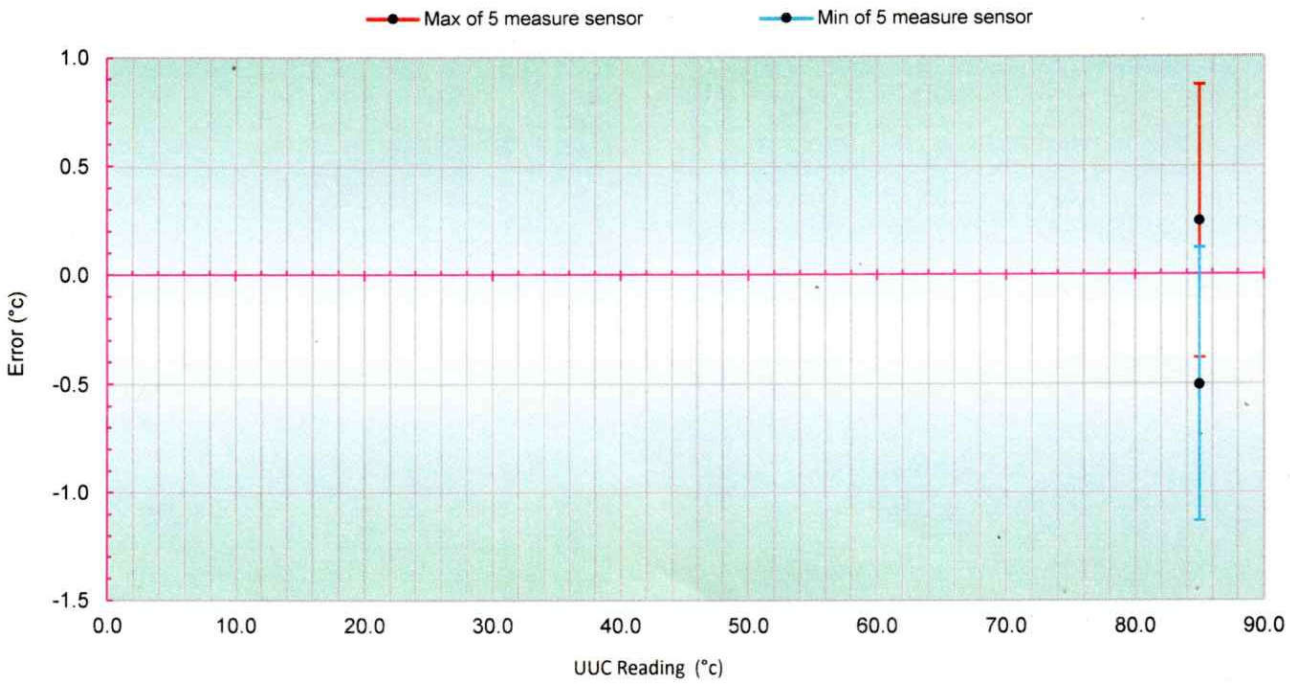
## Section 3 : Possible of temperature in chamber. Show minimium and maximum of the average values and Include with uncertainty of measurement. , The average values is average of each position standard sensor througout observation time.

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

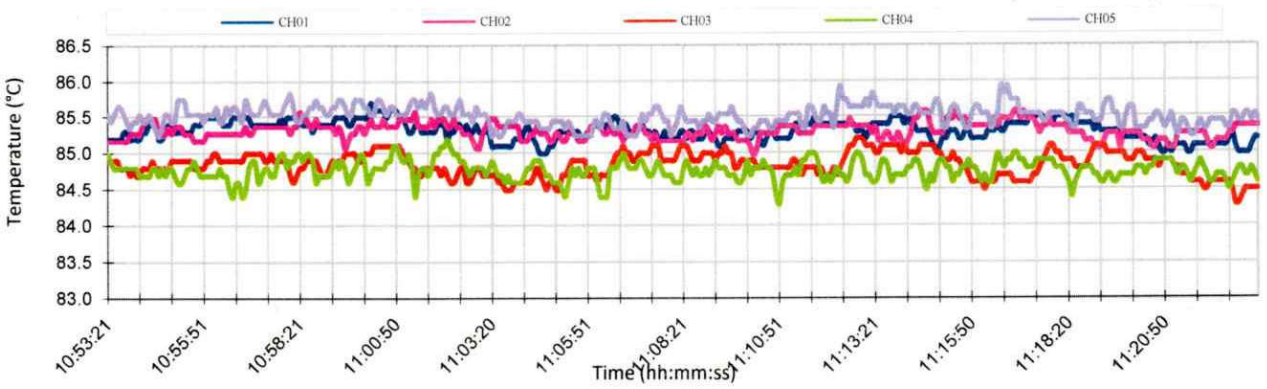
## Section 4 : Trend of acuuracy




[redacted]

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

(5.1) Temperature Distribution at UUC Reading 85.0 °c




[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com

CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17025 CALIBRATION AND DIMENSIONAL MEASUREMENT ACDM-2814

# CERTIFICATE OF CALIBRATION

## FOR

| | | |
|---|---|---|
| NOMENCLATURE | : | pH METER |
| MANUFACTURER | : | SMART SENSOR |
| MODEL / TYPE | : | AS218 |
| SERIAL NO. | : | 6766085/TIZZ9744 |
| CLID. NO. | : | 272302598 |
| JOB CONTROL NO. | : | 230911100491 |

CUSTOMER : TNP ENVIRONMENT CO., LTD.
332/173 MOO 3 TAMBON BANG RAK PHATTANA,
AMPHOE BANG BUA THONG, NONTHABURI 11110

DATE OF RECEIVED : 11 September 2023 DATE OF ISSUED : 14 September 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

[redacted]



@clccalibration

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com

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ACCREDITED
ISO/IEC 17025
CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

# REPORT OF CALIBRATION

# FOR

| | | |
|---|---|---|
| **NOMENCLATURE** | : | **pH METER** |
| **MANUFACTURER** | : | **SMART SENSOR** |
| **MODEL / TYPE** | : | **AS218** |
| **SERIAL NO.** | : | **6766085/TIZZ9744** |
| **DATE OF CALIBRATION** | : | **12 September 2023** |

## ENVIRONMENT CONDITIONS :

**Temperature :** **(25 ± 2.5) °C** **Relative Humidity :** **(50 ± 15) % RH**

## PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPCH-01.** The calibration was performed by direct measurement with Certified Reference Material (CRM).

## REFERENCE STANDARD USED :

1. pH Standard Solution, NIMT TRM CODE TRM-S-2003, TRM CODE TRM-S-2007.
2. pH Standard Solution, Control Company Catalog Number 06664263,11784256, Lot Number CC752722.

## TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand). Lot Number. 040822 , 230822. Due Date 26 April 2024.
2. The measurements are traceable to International System of Units (SI) , through Control Company. Certificate No. 4288-13355261 , Due Date 06 May 2024.

## UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"



@clccalibration

**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment**

The table in the following gives the calibration results and associated measurement uncertainties of pH meter.

## CALIBRATION DATA

**pH METER RESULT @ 25 °C**

| Standard pH Buffer Solution (pH) | pH Meter Reading (pH) | pH Meter Reading (mV) | Correction (pH) | Uncertainty of pH Measurement (± pH) | *k* Factor |
|---|---|---|---|---|---|
| 4.003 | 4.02 | - | -0.017 | 0.013 | 2,15 |
| 7.000 | 7.02 | - | -0.020 | 0.015 | 2,06 |
| 10.003 | 10.02 | - | -0.017 | 0.016 | 2,05 |

Technical Note. Setting function CAL 3 point ( 4,6.86,9.18 ).

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 2,3 of 54

**This report is valid for the above stated instrument/s only.**

**### End of Certificate ###**

# CERTIFICATE OF CALIBRATION

## CENTER ON INDUSTRIAL INSTRUMENT CALIBRATION

Classroom Building 4, 2nd Floor
**King Mongkut's University of Technology Thonburi**
126 Pracha-u-thit Road, Bangmod,Thungkru, Bangkok 10140
Tel : 0 2872 5281-2, 0 2470 8311-2 Fax : 0 2872 5283
E-mail : cic.cal@kmutt.ac.th www.cic.kmutt.ac.th

NSC-TISI-TIS 17025
CALIBRATION 0179



Certificate No. CM230219 Date of Issue 24 March 2023

| | | |
|---|---|---|
| Customer | : | TNP ENVIRONMENT CO.,LTD. |
| Address | : | 332/173 Moo 3, Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11110 |
| Instrument No. | : | IM230219 |
| Instrument Name | : | Weight |
| Manufacturer | : | LS |
| Model | : | Class F1 |
| Serial No. | : | S1K30-23 |

[redacted]

[redacted]

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.
This result relates only to the item calibrated. The certificate shall not be reproduced except in full, without the written approval of the laboratory.

CENTER ON INDUSTRIAL INSTRUMENT CALIBRATION
KING MONGKUT 'S UNIVERSITY OF TECHNOLOGY THONBURI

# Certificate No. CM230219



## INSTRUMENT DESCRIPTION:

| | | | |
|---|---|---|---|
| Instrument Name: | Weight | Manufacturer: | LS |
| Model: | Class F1 | Serial No. : | S1K30-23 |
| Environment: | Temperature: (20 ± 2) °C | | |
| | Relative humidity: (44 ± 10)% RH | | |
| | Air pressure: 100.9 kPa | | |
| Received Date: | 23 March 2023 | | |
| Condition As-Received: | New Item | | |
| Calibrated Date: | 24 March 2023 | | |
| Calibration Reference: | W0908 : in-house method based on OIML R111-1:2004(E) | | |

## MEASUREMENTS:

Determination of conventional mass value was done by direct comparison with the standard weight class E2 on a Mass Comparator according to the in-house method based on OIML R 111-1: 2004(E) at ambient conditions.

All reference standards are traceable to recognized National standards which realize the unit of measurement according to the International System of Units (SI).

## TRACEABILITY OF CERTIFICATE:

National Institute of Metrology Thailand (NIMT) through

1. NIMT Certificate Number MM-0194-18 for Standard Weight Serial No. 90332845

## REFERENCE STANDARDS:

1. Standard Weight Model YCS 01- 652 - 02 Serial No. 90332845 Due. Date 29 October 2024

## MEASUREMENT RESULTS:

| Nominal Value | Marking | Conventional Mass Value | Measurement Uncertainty | Maximum permissible error |
|---|---|---|---|---|
| 1 kg | None | 1 kg + 1.4 mg | ± 1.6 mg | ± 5.0 mg |

End of Certificate

[redacted]

# METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 สายงาน www.สอบเทียบเครื่องมือวัด.com

# Certificate of Calibration

Certificate Number : SPR23100181-1 Page : 1 of 3

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

---

| | | | | | |
|---|---|---|---|---|---|
| Equipment Name | : | Digital Thermometer | | | |
| Manufacturer | : | Extech | | | |
| Model | : | 39240 | | | |
| Serial Number | : | 0721B | | | |
| ID. Number | : | TNP.LAB.34-2564 | | | |
| Environmental Conditions | | | | | |
| Ambient Temperature | : | 23 °C ± 2 °C | Received Date | : | 12 Oct 2023 |
| Relative Humidity | : | 50 % ± 15 % | Calibration Date | : | 13 Oct 2023 |
| Location of Calibration | : | In-Lab | Recommend Due Date | : | 13 Oct 2024 |
| Calibration Procedure | : | SP-CPT-04-06 | Date of Issue | : | 14 Oct 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

[redacted]

# Calibration Report

Certificate Number : SPR23100181-1



## Reference Standards

| Equipment Name | Model | Serial No. | Certificate No. | Due. Date |
|---|---|---|---|---|
| Super Thermometer with PRT | 1575/3850-40-392 | 58087/100288 | PSL-T 0400/66 | 15 Feb 2024 |

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 คู่สาย www.สอบเทียบเครื่องมือวัด.com

METROLOGY SYSTEM ( THAILAND ) CO.,LTD.

# Result of Calibration

Certificate No. : SPR23100181-1



Unit : °C

| Setting Value | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---|---|---|---|---|
| 0.0 | 0.006 | 0.2 | 0.194 | 0.070 |
| 20.0 | 20.007 | 20.0 | -0.007 | 0.070 |
| 30.0 | 30.011 | 30.0 | -0.011 | 0.070 |
| 50.0 | 50.013 | 49.9 | -0.113 | 0.070 |

**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 -

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 ( Thailand ) Tel: (662) 193-2220 5 คู่สาย www.สอบเทียบเครื่องมือวัด.com

**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 FAX. 0-2719-9484



# Certificate of Testing

| | |
|---|---|
| **Equipment :** | DO Meter |
| **Manufacturer :** | Horiba |
| **Model :** | LAQUA-DO210 |
| **Serial No. :** | HE0G0013 |
| **ID No. :** | - |
| **Received Date :** | 20 January 2023 |
| **Test Date :** | 23 January 2023 |
| **Reference :** | 2301-0699WN-1 |
| **Submitted by :** | TNP ENVIRONMENT CO.,LTD<br>332/173 Moo 3, Bang Rak Phatthana,<br>Bang Bua Thong, Nonthaburi 11110 |
| **Laboratory Condition :** | Temperature ( 25 ± 5 ) °C<br>Humidity (50 ± 20) % |
| **Test Procedure :** | In - house method : CP-CH9 |

[redacted]cation Method

**Issue Date :** 24 January 2023

B 0305903

**Condition of this result of calibration**

1. Reference Standard Instruments :
   This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center,Technology Promotion Association (Thailand-Japan).

| Instruments | Serial No. | ID No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 1) Burette | - | 130BU10 | 21CG1389 | 25 Mar 2023 |
| 2) Balance | 1126143764 | 140RC004 | 22MM50 | 20 Sep 2023 |

2. Standard Material :-

| Material | Manufacturer | Lot.No. | Assay |
|---|---|---|---|
| Sodium Thiosulfate pentahydrate | Merck | AM1763316 | 100.2% |

**Result :** **Dissolved Oxygen Meter Adjustment With Air 100 %**

**Dissolved Oxygen Probe No.:** 9K0E0106

| **Titration Method (Azide Modification Method)** (mg/L) | **DO Meter Reading** (mg/L) | **Standard Deviation** (mg/L) |
|---|---|---|
| 8.14 | 8.15 | 0.000 |

This report was certified only for the instrument we tested.It is allowable to use for study the system efficiency,The environmental impact control and present to organization it may concerned Intend to use for advertising and referral purpose is prohibited.This report may not be reproduced other in full,without written approval of the laboratory

-o0o-

[redacted]

ENTECH
Where Solutions Begin

# Calibration Certificate

NSC-TISI-TIS 17025
CALIBRATION 0157

**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<br>Temperature : ( 25 ± 15 ) °C<br>Humidity : ( 55 ± 30 ) % RH<br>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)*

[redacted]



Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

ENTECH
Where Solutions Begin

# Calibration Certificate

NSC-TISI-TIS 17025
CALIBRATION 0157

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

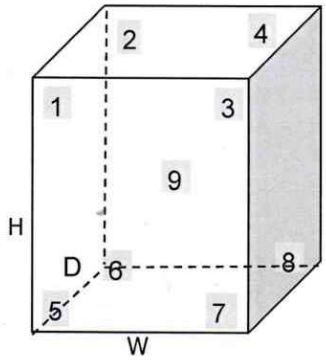
**The Reference Standard Instrument :-**

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

**Measured room conditions**

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

**Sensor Position :**




**Working Space of chamber :**

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

**Sensor Installation Details :**

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

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

( * ) Without adjustment ( ) After adjustment

| UUC* Setting | UUC* Reading | Temperature Reading oF Standard Sensor | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sensor Position | | | | | | | | |
| ( °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 |

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

**UUC* = Unit Under Calibration**

**Remark :-**

- Temperature reading of Standard Sensors shown in the table were taken from the average of Standard reading at each position.
- Temperature Uniformity was calculated from the difference between the maximum and minimum of actual temperature reading from all reference sensors at the same time.
- Temperature Stability was calculated from the maximum stability of nine positions, and formula of Stability is [ ( 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**



Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

# Calibration Certificate

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



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
Calibrated by : Mr.Apiwat Mungsamak
Calibrated Date : 20 January 2023

Ref. Job No. : SO6601-00020
Cert. prepare by : Ms.Nattanicha Panumram
Approved by : Mr.Montree Ruschasetkul

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

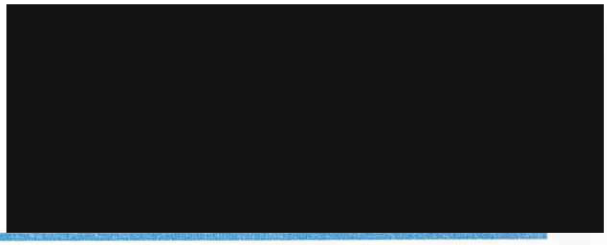
Calibration Method : In-house method based on ASTM E715-80 (Reapproved 2006) , (MTEC WI No. # WICAL-02-003-R01 )

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.





44 Soi ChokChai 4 Soi 40 ,LadPrao ,Bangkok ,Tel.: 0-2538-9205 ,0-2935-7096 ,Fax. : 0-2931-4015 ,Email : contact@mtec.co.th , www.mtec.co.th

Certificate No. : CT-23-01-23295



**Calibration Result :**

Condition of UUC :

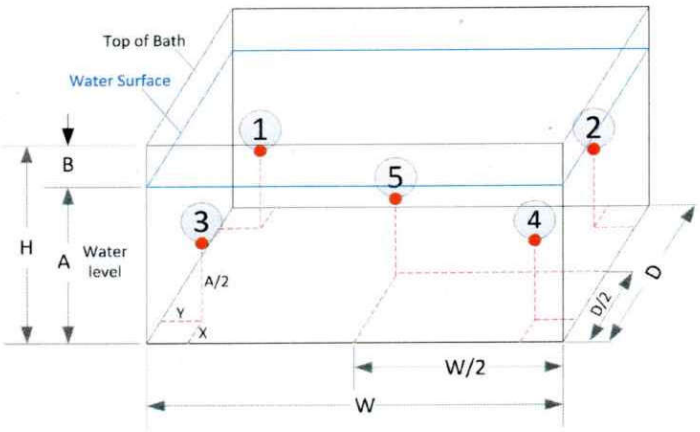
1) Adjust Condition : Without Adjustment
2) Lid Cover : Flat Sheet (Plastic , from
3) Circulation : without circulation
4) X ,Y = 5 cm. , B ~ 3 cm.

(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 througout observation time.




Pic 1 : Position of each sensor No.

## 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

[redacted]

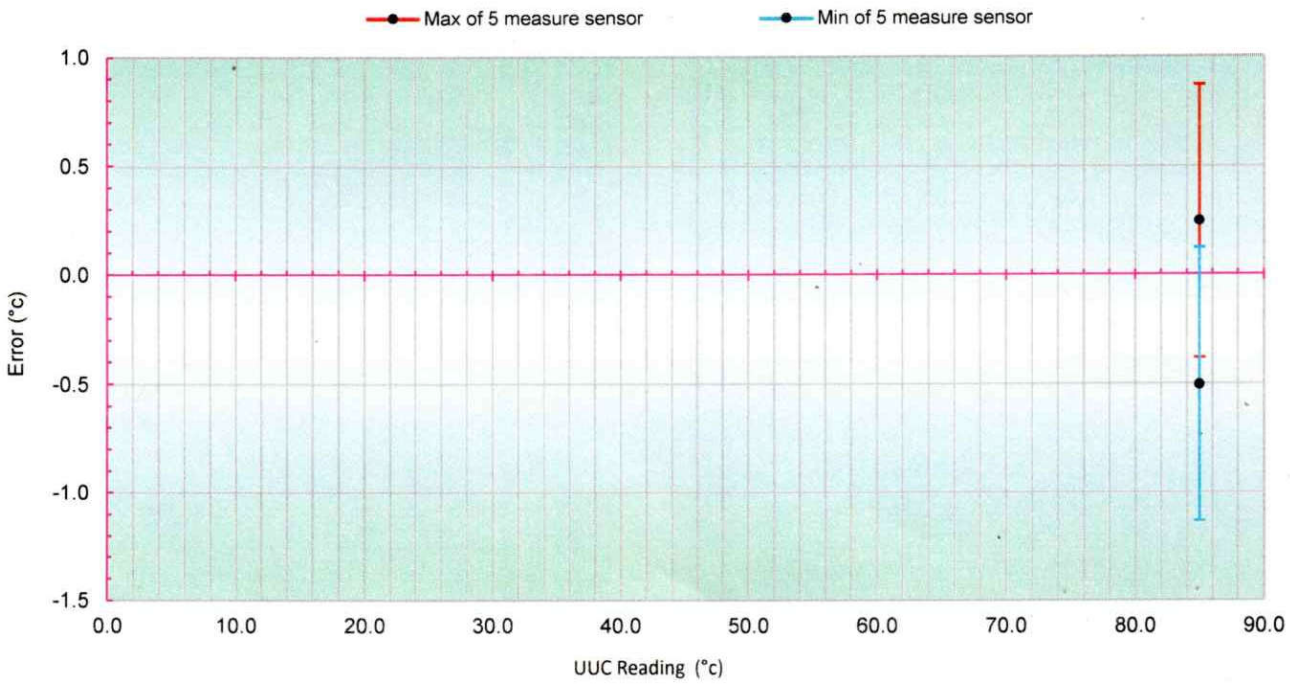
## Section 3 : Possible of temperature in chamber. Show minimium and maximum of the average values and Include with uncertainty of measurement. , The average values is average of each position standard sensor througout observation time.

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 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

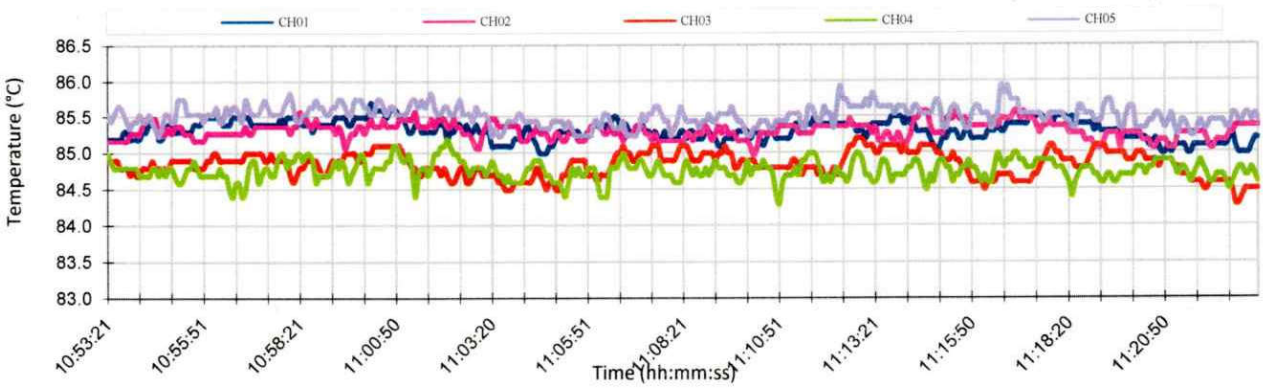
(*) = The average of 30 values in each point

## Section 4 : Trend of acuuracy



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

(5.1) Temperature Distribution at UUC Reading 85.0 °c




[redacted]

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

NSC-TISI-TIS17025
CALIBRATION 0008

# 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 |
| **Ambient Temperature:** | ( 25 ± 3 ) °C |
| **Relative Humidity:** | ( 50 ± 20 ) % |

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

**Submitted by:** TNP ENVIRONMENT CO.,LTD

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 instuments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 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)

[redacted]

B 0307331

**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 ± 0.16 °C

| UUC* Reading ( °C ) | Standard Temperature ( °C ) | Error ( °C ) | Uncertainty of Measurement ( ± °C ) |
|---|---|---|---|
| 20 | 21.4342 | -1.4342 | 0.16 |
| 30 | 31.5544 | -1.5544 | 0.16 |
| 40 | 41.1382 | -1.1382 | 0.16 |

**Note:** UUC* : Unit Under Calibration
The UUC* readings were made under magnification and resolved to one tenth of one scale division.

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

**-o0o-**

[redacted]

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL. 0-2717-3000-29 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

**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 voltage calibrator and direct measurement with certified reference material (CRM) |

[redacted]

**Issue Date :** 31 January 2023

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

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

A 0050390

**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

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|---|---|---|---|
| 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 (±) | Coverage factor *k* |
|---|---|---|---|---|---|
| pH Electrode | 4.008 | 4.01 | N/A | 0.0085 | 2.05 |
| S/N.: 1328 | 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-**

[redacted]

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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NSC-TISI-TIS17025
CALIBRATION 0008

# Certificate of Calibration

**Certificate No. :** 23H486
**Page :** 1 of 2

| | |
|---|---|
| **Equipment :** | Digital Thermo-Hygrometer |
| **Manufacturer:** | EXTECH |
| **Model :** | 448515 |
| **Serial No.:** | PONPE5899554 |
| **ID No.:** | TNP.LAB.21 |
| **Condition As-Received:** | Used Item |
| **Received Date:** | 02 March 2023 |
| **Calibration Date:** | 07 March 2023 |
| **Reference:** | 2303-0104WN |
| **Ambient Temperature:** | ( 25 ± 3 ) °C |
| **Relative Humidity:** | ( 50 ± 20 ) % |

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**Submitted by:** TNP ENVIRONMENT CO.,LTD.

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 instuments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 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)

[redacted]

B 0310047