

ภาคผนวก จ

เอกสารเทียบเครื่องมือที่ใช้ในการตรวจวิเคราะห์

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รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Equipment for Air Quality Analysis									
1	Analytical Balance	PARTICULATE MATTER (PM10) TOTAL SUSPENDED PARTICULATE	Mettler Toledo	MS204TS/00 / C252436235	National Food Institute, Ministry of Industry, Thailand	2402420-003-01	19/4/2024	18/4/2025	-
2	Microbalance	PARTICULATE MATTER RESPIRABLE DUST TOTAL DUST	Mettler Toledo	XP6 / B322373893	National Food Institute, Ministry of Industry, Thailand	2402420-002-01	19/4/2024	18/4/2025	-

Due Date of Calibration\* : Based on the annual calibration plan. At least 1 time per year.

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
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List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Equipment for Water Quality Analysis									
1	Atomic Absorption Spectrometer	COPPER IRON ZINC	Agilent Technologies	AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30/1/2025	29/1/2026	-
2	Analytical Balance	FAT OIL AND GREASE	Mettler Toledo	AB204-S/FACT / 1129361010	Technology Promotion Association (Thailand-Japan)	24MM292	11/5/2024	10/5/2025	-
			Mettler Toledo	AB204-S/FACT / 1129361010	United Analyst and Engineering Consultant Co., Ltd.	250422 1 BL002 25	23/4/2025	22/4/2026	-
3	Analytical Balance	TOTAL DISSOLVED SOLIDS	Mettler Toledo	XSR205DU / C210685394	National Food Institute,Ministry of Industry, Thailand	2502226-002-01	20/3/2025	19/3/2026	-
4	Analytical Balance	TOTAL SUSPENDED SOLIDS	Mettler Toledo	XSR205DU / C009071872	National Food Institute,Ministry of Industry, Thailand	2502226-001-01	20/3/2025	19/3/2026	-
5	BOD Incubator	BIOCHEMICAL OXYGEN DEMAND	ARCO	UC4-1320 / 1021	Technology Promotion Association (Thailand-Japan)	24TM1114	11/7/2024	10/7/2025	-
6	DO Meter	BIOCHEMICAL OXYGEN DEMAND	YSI	5100 / 11B 101863	Technology Promotion Association (Thailand-Japan)	25TW29	18/2/2025	16/2/2026	-
7	Heating Block	CHEMICAL OXYGEN DEMAND	Hanna Instruments Italia Srl.	HI 839800-02 / H 018500 I	Hanna Instruments (Thailand) Ltd.	HIT-2510-0375	7/3/2025	6/3/2026	-
8	Kjeltec Distillation Unit	TOTAL KJELDAHL NITROGEN	FOSS	KT9 / 91905393	FOSS South East Asia	12875	5/7/2024	4/7/2025	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Equipment for Water Quality Analysis									
9	Kjeltec System Distilling Unit	TOTAL KJELDAHL NITROGEN	Foss Tecator (Labtec)	KT200 / 91790524	FOSS South East Asia	13319	27/1/2025	26/1/2026	-
10	Kjeltec Distillation Unit	TOTAL KJELDAHL NITROGEN	FOSS	Kjeltec 8100 / 91889052	FOSS South East Asia	13854	24/2/2025	23/2/2026	-
11	pH Meter	pH	Horiba	LAQUA-PH210 / HA9M0048	Technology Promotion Association (Thailand-Japan)	25CH586	21/5/2025	19/5/2026	-
12	pH Meter	pH	Horiba	LAQUA-PH210 / HA0A0005	Technology Promotion Association (Thailand-Japan)	24CH1597	26/12/2024	24/12/2025	-
13	pH Meter and pH Electrode	pH	Mettler Toledo	pH S20 SevenEasyTM / 1231155210	National Food Institute Ministry of Industry, Thailand	2501844-001-01	24/2/2025	23/2/2026	-
14	pH Meter	pH	YSI Environmental	pH 100A / JC03335	Technology Promotion Association (Thailand-Japan)	25CH163	5/2/2025	3/2/2026	-
15	UV-VIS Spectrophotometer	NITRATE SULPHATE	Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP25-001	3/1/2025	2/1/2026	-
16	UV/VIS Spectrophotometer	CHEMICAL OXYGEN DEMAND	Hitachi	U-5100 / 23A4-008	DQE Services Co.,Ltd.	SP24-028	11/9/2024	9/9/2025	-

Due Date of Calibration\* : Based on the annual calibration plan. At least 1 time per year.



## Calibration Certificate

**Certificate No.:** 2402420-003-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** MS204TS/00  
**Serial No.:** C252436235  
**ID No.:** UAE.AIR.023/2566  
**Order No.:** 2402420  
**Operation No.:** 2402420-003  
**Date of Receipt:** 19 April 2024  
**Date of Calibration:** 19 April 2024

**Calibrated by** Mr.Pheraphat Tuanjit  
Scientist

**Approved by**   
( Miss Preeyaporn Jaengkarnkit )  
Vice President, Department of Laboratory Services  
Responsible for the Technical Management Team

**Date of Issue:** 23 April 2024

The uncertainties are for a confidence probability of approximately 95%

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

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



## Calibration Report

**Certificate No.:** 2402420-003-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** MS204TS/00

**Resolution:** 0.0001 g

**Serial No.:** C252436235

**ID No.:** UAE.AIR.023/2566

**Capacity:** 220 g

**Date of Calibration:** 19 April 2024

Page 2 of 3

**Environment Condition:** Ambient Temperature: 21.7 ± 1.5 °C Relative Humidity: 65 ± 6.7 %

**Place of Calibration:** Room 206 Balance Room 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

**Condition of Equipment:** Good Condition

**Condition of This Results of Calibration:**

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1-500mg	15880	TCS	M2311181S	28 November 2024
Standard Weight Class E2	1-500g	15882	TCS	M2311182S	28 November 2024

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 019/23	Quality Reborn	QR24-0492	4 March 2025

3. This certification is traceable to SI UNIT

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

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

**Calibration Results:**

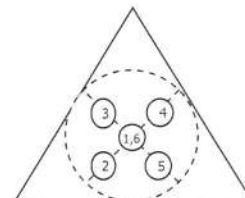
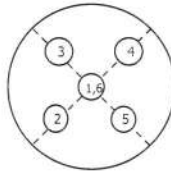
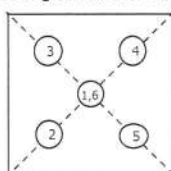
**1. Repeatability of Reading:**

Nominal Value ( g )	Standard Deviation of Reading ( g )
100	0.000074
200	0.000074

**2. Off-Center Error:**

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
( g )	( g )	( g )	( g )	( g )	( g )	( g )
100.0005	100.0006	100.0003	100.0006	100.0003	100.0005	0.0002

*P. Jaenghant*  
23 April 2024



## Calibration Report

**Certificate No.:** 2402420-003-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** MS204TS/00

**Resolution:** 0.0001 g

**Serial No.:** C252436235

**ID No.:** UAE.AIR.023/2566

**Capacity:** 220 g

**Date of Calibration:** 19 April 2024

Page 3 of 3

**Calibration Results:** (Continued)

**Calibration Range:** 0-200 g

**Calibration Adjustment:** Internal Calibration

### 3. Departure from Nominal Value:

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor <i>k</i>
Unload	0.00000	0.0000	0.0000	0.000094	2.00
0.1	0.10000	0.1000	0.0000	0.000094	2.00
1	0.99998	1.0000	0.0000	0.000097	2.00
5	4.99997	5.0000	0.0000	0.000096	2.00
10	10.00002	10.0000	0.0000	0.00012	2.00
20	20.00003	20.0001	-0.0001	0.00014	2.00
50	49.99998	50.0003	-0.0003	0.00012	2.00
70	70.00000	70.0005	-0.0005	0.00017	2.00
100	99.99997	100.0006	-0.0006	0.00017	2.00
150	149.99994	150.0012	-0.0013	0.00022	2.00
200	200.00001	200.0015	-0.0015	0.00028	2.00

*P. Jongsakul*  
23 April 2024

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

----- End -----

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





## Calibration Certificate

**Certificate No.:** 2402420-002-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 3

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** XP6  
**Serial No.:** B322373893  
**ID No.:** UAE.AIR.019/2556  
**Order No.:** 2402420  
**Operation No.:** 2402420-002  
**Date of Receipt:** 19 April 2024  
**Date of Calibration:** 19 April 2024

**Calibrated by** Mr.Pheraphat Tuanjit  
Scientist

**Approved by**   
( Miss Preeyaporn Jaengkarnkit )

Vice President, Department of Laboratory Services  
Responsible for the Technical Management Team

**Date of Issue:** 23 April 2024

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

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

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



## Calibration Report

**Certificate No.:** 2402420-002-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XP6

**Resolution:** 0.000001 g

**Serial No.:** B322373893

**ID No.:** UAE.AIR.019/2556

**Capacity:** 6.1 g

**Date of Calibration:** 19 April 2024

Page 2 of 3

**Environment Condition:** Ambient Temperature: 22.6 ± 1.8 °C Relative Humidity: 48 ± 6.0 %

**Place of Calibration:** Room 206 Balance Room 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

**Condition of Equipment:** Good Condition

**Condition of This Results of Calibration:**

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1-500mg	15880	TCS	M2311181S	28 November 2024
Standard Weight Class E2	1-500g	15882	TCS	M2311182S	28 November 2024

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 019/23	Quality Reborn	QR24-0492	4 March 2025

3. This certification is traceable to SI UNIT

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

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

**Calibration Results:**

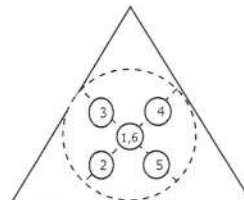
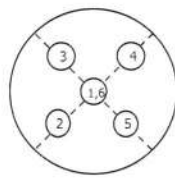
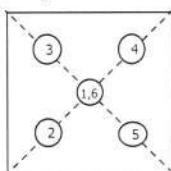
**1. Repeatability of Reading:**

Nominal Value ( g )	Standard Deviation of Reading ( g )
3	0.0000057
6	0.0000019

**2. Off-Center Error:**

A mass of 2 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
( g )	( g )	( g )	( g )	( g )	( g )	( g )
1.999981	1.999983	1.999980	1.999984	1.999983	1.999981	0.000003





## Calibration Report

**Certificate No.:** 2402420-002-01

**Equipment:** Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XP6

**Resolution:** 0.000001 g

**Serial No.:** B322373893

**ID No.:** UAE.AIR.019/2556

**Capacity:** 6.1 g

**Date of Calibration:** 19 April 2024

Page 3 of 3

**Calibration Results:** (Continued)

**Calibration Range:** 0-6 g

**Calibration Adjustment:** Internal Calibration

### 3. Departure from Nominal Value:

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor k
Unload	0.0000000	0.000000	0.000000	0.0000032	2.00
0.01	0.0099970	0.009999	-0.000002	0.0000047	2.00
0.05	0.0500010	0.050003	-0.000002	0.0000048	2.00
0.10	0.1000010	0.100001	0.000000	0.0000069	2.00
0.15	0.1500020	0.150002	0.000000	0.0000083	2.00
0.17	0.1700050	0.170006	-0.000001	0.000012	2.00
0.20	0.1999990	0.200002	-0.000003	0.0000083	2.00
1.50	1.4999750	1.499971	0.000004	0.000027	2.00
3.00	2.9999680	2.999959	0.000009	0.000028	2.00
4.50	4.4999810	4.499967	0.000014	0.000022	2.00
6.00	5.9999490	5.999931	0.000018	0.000032	2.00

*S. Jongsakulkit*  
23 April 2024

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

----- End -----

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



# Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

## Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the installation.

**Note:** While non-current production AA instrument and or accessory models are not covered specifically in this document it can be used as a basic reference.

For more information about Agilent Technologies services please visit our web site using the following URL <http://www.agilent.com/en-us/services>

## Introduction

### Customer Information

- 1 Customers should provide all necessary operating supplies upon request of the engineer.
- 2 A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- 3 Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- 4 If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.

## Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access *Agilent University*, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful *Agilent Resource Center* web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our *Support Home page* at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections:  
Join the *Agilent Community* at <https://community.agilent.com/welcome>

## Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Completion section including the customer's and your signature.

This information is subject to change without notice.



## Instrument Maintenance

### System Information

☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	240 FS AAS
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8432 A	M7 13160001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

### Preparation, Safe operation and Initial performance checks

Revision: 10.00, Issued: November 2021

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- ☐ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

**NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.**

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. *N/A*
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test\_1"
- ☒ Perform a Basic Cu ABS test - "As found test\_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

## Preventive Maintenance Procedures

### FLAME SYSTEM section

☐ *Section not applicable*

#### Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the *SVD Power Supply diagnostic*.
- ☒ For Dual Beam instruments - Confirm RBC frequency using the *SVD RBC frequency diagnostic*.

#### Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
  - ☒ Monochromator drive
  - ☒ Slit drive
  - ☒ Lamp selector
  - ☐ ABA

#### Optics components

- ☒ Check that external optical surfaces are clean – Clean or replace as required.
- ☒ Use SVD and perform *Mono Wavelength Correction*.
- ☒ Use SVD and perform *Slit Calibration*.
- ☒ Use SVD and perform *Grating Squareness Diagnostic*.
- ☒ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☒ Use SVD and perform *Wavelength Repeatability*.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

### Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.
- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery barbs
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☒ Check and clean the igniter electrode

### Gas handling components and safety interlocks

- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the *SVD interlock monitoring diagnostic*.

### Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing "
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.



## FURNACE SYSTEM section

☒ Section not applicable

### Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the *SVD Power Supply diagnostic*.

### Mechanical components

- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
  - ☐ Monochromator drive
  - ☐ Slit drive
  - ☐ Lamp selector

### Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform *Mono Wavelength Correction*.
- ☐ Use SVD and perform *Slit Calibration*.
- ☐ Use SVD and perform *Grating Squareness Diagnostic*.
- ☐ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☐ Use SVD and perform *Wavelength Repeatability*.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

### Gas handling, water system and workhead component checks

- ☐ Inspect the GTA workhead gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workhead water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.

Revision: 10.00, Issued: November 2021

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☐ Check and clean the end windows on the workhead.
- ☐ Check safety interlock operation.

### Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

### PSD autosampler accessory for Furnace systems

☒ *Section NOT Applicable*

- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

### Sample introduction pump system (SIPS) accessory

☒ *Section NOT Applicable*

- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

### Sample preparation system (SPS 4) accessory

☒ *Section NOT Applicable*

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes..
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

**NOTE: The autosampler requires no extra lubrication throughout its lifetime.**

For further details refer to the SPS 4 service manual G8410-90050.

### Sample preparation system (SPS 3) accessory

☒ *Section NOT Applicable*

- ☐ Check the x-axis and z-axis timing belts – Replace if there is are any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 ® Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.



### Vapor generation accessory VGA (hydride generator)

☐ *Section NOT Applicable*

- ☐ Inspect VGA gas supply hose.
- ☐ Inspect/replace VGA pump tubing.
- ☐ Check low gas pressure interlock setting– adjust if required.
- ☐ Check precision orifice gas flow setting – adjust if required.
- ☐ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

### UltrAA lamp accessory (external)

☒ *Section NOT Applicable*

- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

## Restore System

- ☐ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

## Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.



## Signature Page

### Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.

### Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	49%
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.5598
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0	0.2%
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	-
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.15	-
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.10	-
MSR%	≥ 70 %	-

## AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution – Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hivac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica – round (right side)	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica – rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

\* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM

Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

**Service Engineer Comments (optional)**

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

**Service Completion**

Service request number 6007549143

Date service completed 30 Jan 2025

Agilent signature Kanyakorn S.

Customer signature Manida Y.

Total number of pages in this document 13

# SVD Results Report



**Report ID:** 2 **Diagnostic Start Time:** 1/30/2025 9:14:26 AM **Diagnostic End Time:** 1/30/2025 9:46:06 AM

**Customer:** UAE

**Service Engineer:** Kanyakorn S.

**Address:** Soi Udomsuk 41, Sukhumvit Rd.  
Bangkok

**Contact Details:** 026376363#1

## Instrument Configuration

### Configuration:

<b>Serial Number:</b> MY13160001	<b>Turret Type:</b> Automatic
<b>Instrument Model:</b> Varian AA140/240/280	<b>Number Of Lamps:</b> 4
<b>Flame Instrument:</b> True	<b>Mono Type:</b> Automatic
<b>Furnace Instrument:</b> True	<b>Gasbox Type:</b> 'Y' Gas Box
<b>Zeeman Present:</b> False	<b>Auto Burner Adjuster:</b> False
<b>Internal Zeeman:</b> False	<b>Mains Frequency:</b> 50
<b>Internal UltraAA:</b> False	<b>Firmware Version:</b> 2.11
<b>Optics Type:</b> Double Beam	<b>Photomultiplier Type:</b> Normal(900nm)
<b>D2 BG Correction Filter:</b> True	<b>PWB Version:</b> 45
<b>Boot Block Version:</b> 1.09	

### EEPROM Data:

<b>Instrument Run Hours:</b> 62918.180	<b>D2 Run Hours:</b> 53396.500
<b>Zero Wavelength Offset:</b> 30.133	<b>D2 Serial Number:</b> not set !
<b>Mono Correction:</b> 0.770	<b>D2 Install Date:</b> 1/1/1970
<b>Flame Hours:</b> 32441.834	<b>D2 Original Intensity:</b> 1.000
	<b>D2 Last Intensity:</b> 475.000

Frequency:

Averaging Period: 30.0  
Datapoint Count: 20

Upper Limit: 51.00	Average Frequency: 50.00	Highest Measured Frequency: 50.00
Lower Limit: 49.00		Lowest Measured Frequency: 50.00

Result: **Passed**

Power Supply:

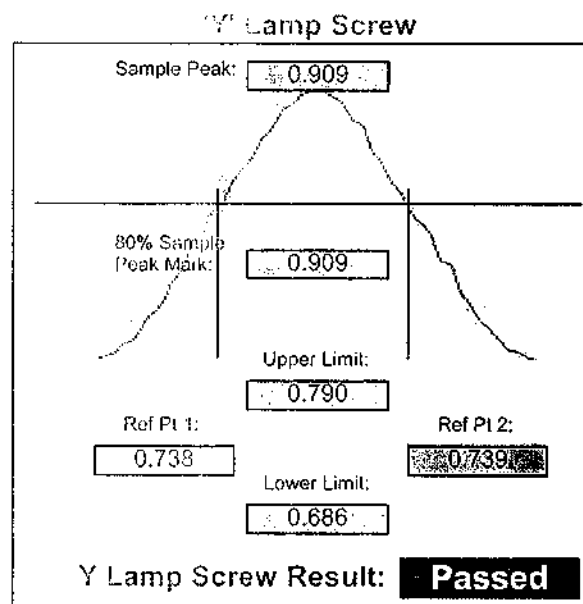
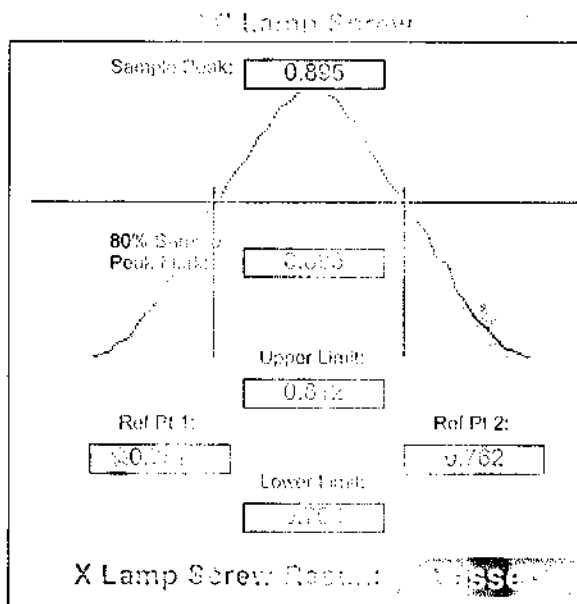
Averaging Period: 30.0  
Datapoint Count: 20

	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.12	13.20	<b>Passed</b>
-12.00 V Rail	-13.20	-11.90	-10.80	<b>Passed</b>
5.00 V Rail	4.50	5.04	5.50	<b>Passed</b>
310.00 V Rail	270.00	320.00	341.00	<b>Passed</b>

## Beam Balance:

Lamp Type: Copper  
Lamp Socket Used: 3

Peak Selected: 324.80  
Lamp Alignment: **Performed**



## Grating Specifications

Lamp Element(s): Copper  
Lamp Turret Position: 3  
Lamp Current(mA): 4.00  
3rd Width (nm): 0.5  
1st Order Wavelength(nm): 324.80  
Lamp Alignment: **Performed**

	Lower Limit (nm)	Central (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.05	0.10	<b>Passed</b>
First Order	324.45	324.75	325.15	<b>Passed</b>
Second Order	648.90	649.51	649.97	<b>Passed</b>



---

**Wavelength Repeated Test:**

Lamp Used: Copper      Lamp Current(mA): 4  
Peak Used(nm): 324.750      Slit Width(nm): 0.2  
Connected to Socket: 3      Slit Height: Normal

Lamp Alignment: 

Lower Limit(nm) 324.758      324.888 Upper Limit(nm)

*(Approach from Zero Order)*

*(Approach from end)*

Sample 1: 324.823

Sample 2: 324.823

Sample 3: 324.823

Sample 4: 324.823

Sample 5: 324.823

Sample 6: 324.819

Sample 7: 324.819

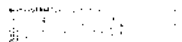
Sample 8: 324.819

Sample 9: 324.823

Sample 10: 324.819

Avg: 324.770

Standard Deviation: 0.003

Result: 

---

## Menu:

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Test:

Passed

## Miscellaneous:

Signal Processing Limiter:

Calculate As To: New Calc Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	1	297	Passed
S1	146	114	191	Passed
S2	271	16	332	Passed
S3	424	7	679	Passed
S4	935	11	1008	Passed
S5	1425	8	1754	Passed
S6	2408	1440	3053	Passed
S7	4747	1113	5313	Passed

Interlocks:

Burner F/W: <b>Working</b>	Flame Detect: <b>Working</b>
HCO Burner F/W: <b>Working</b>	ECU Active: <b>Working</b>
Flame Shield Closed: <b>Working</b>	Oxidant Pressure: <b>Working</b>
Gas Control F/W: <b>Working</b>	Oxidant Changeover: <b>Untested</b>
Pressure Balance Pump F/W: <b>Working</b>	Ignition: <b>Working</b>
Liquid Trap Closed: <b>Working</b>	



### Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected	Lamp 5: Not Supported
Lamp 2: 87 - Silver/Cadmium/Lead/Zinc(UltrAA) (Ag/CLamp 6: Not Supported	
Lamp 3: 14 - Copper (Cu)	Lamp 7: Not Supported
Lamp 4: Uncoded Lamp/Not Connected	Lamp 8: Not Supported

Result: **Passed**

### GTA Temperature Monitoring:

Notes:

Signatures:

UAE

Date

Kanyakorn S.

Kanyakorn S.

30 Jan 2025

Date

## Analyst

Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM

Worksheet Sensitivity Test 01

Comment

Methods Cu

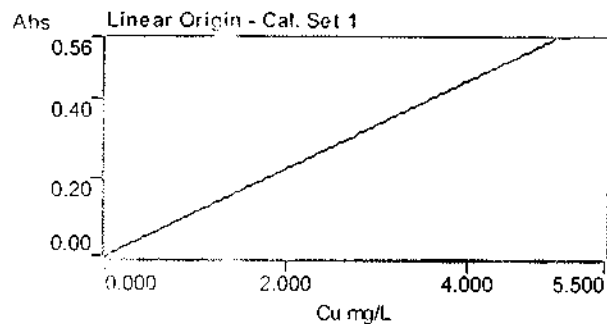
Computer name DESKTOP-R9UIFRS

Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc mg/L	%RSD	Mean Abs
CAL ZERO	0.000	38.8	0.0002
Readings			
	0.0002	0.0003	0.0001
			1/30/2025 10:51:46 AM

STANDARD 1	5.000	0.1	0.5571
Readings			
	0.5574	0.5563	0.5575
			1/30/2025 10:52:22 AM



Curve Fit = Linear Origin  
Characteristic Conc = 0.039 mg/L  
r = 1.0000  
Calculated Conc = 0.002 5 000  
Residuals = -0.002 0.000

$$\text{Abs} = 0.11141 \times C$$

5 ppm Cu	5.025	0.3	0.5598
Readings			
	0.5582	0.5596	0.5615
			1/30/2025 10:52:54 AM

เอกสารไม่ควบคุม

## Analyst

## Date Started

1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM

## Worksheet

Precision Test

## Comment

## Methods

Cu

## Computer name

DESKTOP-R9UIFRS

## Serial Number:

MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs
CAL ZERO	0.000	64.1	-0.0002

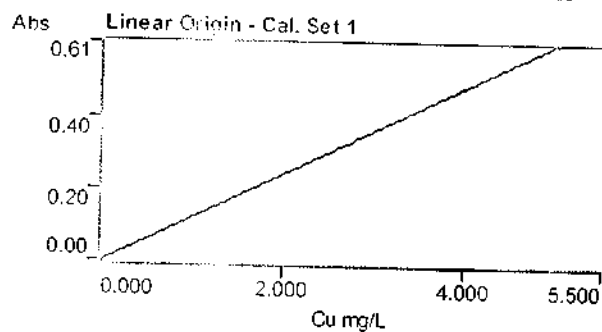
## Readings

-0.0003	-0.0003	-0.0001	1/30/2025	10:46:52 AM
---------	---------	---------	-----------	-------------

STANDARD 1	5.000	0.3	0.6052
------------	-------	-----	--------

## Readings

0.6036	0.6073	0.6047	1/30/2025	10:47:24 AM
--------	--------	--------	-----------	-------------



Curve Fit = Linear Origin

Characteristic Conc = 0.035 mg/L

r = 1.0000

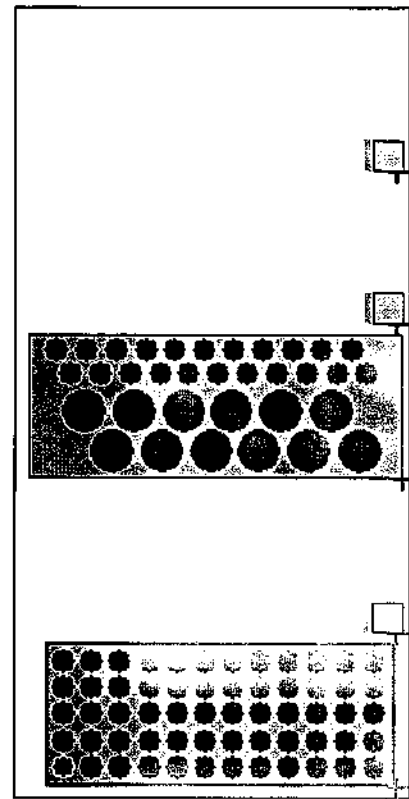
Calculated Conc = -0.002 5.000

Residuals = 0.002 0.000

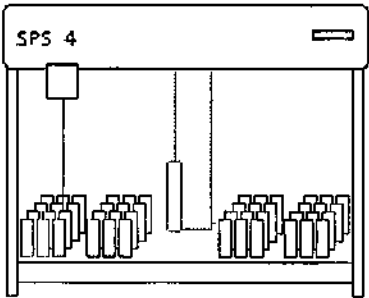
Abs = 0.12105 x C

5 ppm Cu	5.007	0.2	0.6051			
	Readings					
	0.6065	0.6052	0.6047	0.6047	0.6042	0.6079
	0.6055	0.6076	0.6064	0.6079	1/30/2025	10:48:32 AM

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SPS 4



Down height  (mm)

Pump speed

Key to tube colors  
 Sample  
 Calibration  
 Calibration/QC  
 Sample/QC  
 Not Assigned

Sampler Offline

Goto Tube

Rack

Tube

Goto Tube

Align Probe


Rinse

Stop Rinse

Park

Optimization: Lamp

HC Lamp



0.917

Optimize Lamp

Optimize Sign

Rescale

Inst Zero

Gain 49 %

Ok

Sensitivity Check

1.5 mg/L gives about 0.2 Abs at 324.8 nm, A/A burner



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



## Certificate of Calibration

Cert.No.: 24MM292

Page.: 1 of 3

**Equipment :** Electronic Balance

**Manufacturer :** Mettler Toledo

**Model :** AB204-S/FACT

**Serial No. :** 1129361010

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

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

**Location :** Balance Room (108)

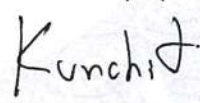
**Received order :** 11 May 2024

**Calibration Date :** 11 May 2024

**Ambient Temperature :** 15 °C to 40 °C

**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Khit Ruttanaprapachai

**Approved by :**   
Approved Signatory

( ) Ponpan Paipim  
( ) Suwit Imjai  
(✓) Kunchit Promprat

**Issue Date :** 15 May 2024

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.

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2405-0166OC-1

Cert.No.: 24MM292

Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-OB01 based on UKAS LAB 14 according to direct measurement method against standard weight.

**Condition of this result of calibration**

1. Reference standard instruments:-

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0013-24	25 Jan 2026

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

3. This result of calibration was made on requested at the point specified by customer.

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

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

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

**Range capacity :** 0 g to 220 g **Resolution** 0.0001 g

**Before Adjustment :**

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
( g )	( g )	( g )	( ± mg )	( k )
100	100.0000	0.0000	0.19	2.03
200	200.0006	-0.0006	0.30	2

**After Adjustment :**

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

<u>Applied Weight</u>	<u>Standard Deviation of Reading ( g )</u>
( g )	
100	0.00007
200	0.00005





Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2405-0166OC-1

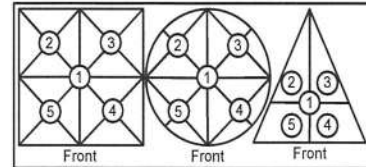
Cert.No.: 24MM292

Page: 3 of 3

**Result of calibration**

**2. Effect of off center loading**

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



**Maximum difference between  
off-center and central loading**

Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )	Maximum difference between off-center and central loading ( g )
-0.0004	-0.0004	-0.0003	-0.0003	-0.0004	0.0001

**3. Departure from nominal value**

<u>Applied Weight</u> ( g )	<u>Balance Reading</u> ( g )	<u>Correction</u> ( g )	<u>Measurement Uncertainty</u> ( ± mg )	<u>Coverage Factor</u> ( k )
Unload	0.0000	0.0000	0.15	2.13
0.01	0.0100	0.0000	0.15	2.13
0.05	0.0500	0.0000	0.15	2.13
0.1	0.1000	0.0000	0.15	2.13
0.5	0.5000	0.0000	0.15	2.13
1	1.0000	0.0000	0.15	2.13
10	10.0000	0.0000	0.15	2.11
50	49.9999	+0.0001	0.17	2.06
100	99.9999	+0.0001	0.19	2.03
150	149.9998	+0.0002	0.29	2
200	199.9990	+0.0010	0.30	2

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 No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 2 of 3

**Equipment:** Electronic Balance  
**Model:** AB204-S/FACT  
**Serial No.:** 1129361010  
**Max. Capacity:** 220 g  
**Calibration Date:** April 23, 2025  
**Condition As-Received:** In Condition

**Manufacturer:** Mettler Toledo  
**Readability:** 0.0001 g  
**ID No.:** UAE.WAS.002/2552

Condition of Equipment:

Condition of This Result of Calibration:

1. Calibration Method: This instrument was calibrated by method UAE.CP.CAL.006 In-House Method based on UKAS Lab 14 : 2022

2. Reference Standards:

Reference Standard:	Model	Serial No.	Calibrated By	Certificate No.	Traceability	Due Date
Standard Weight Class E2 (OIML)	1 mg to 1 kg	B749109122	AMARC	25-009359	Mettler-Toledo	21-Jan-27
Standard Weight Class F1 (OIML)	1 mg to 200 g	11119512	AMARC	24-013840	Mettler-Toledo	04-Feb-26
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Traceability	Due Date
Thermo-Hygro-Baro Meter	MHB-382SD	AK.46457	SUCCESS	SG-H-00997/67	Success Gateway	21-Nov-25
Thermo-Hygro-Baro Meter	MHB-382SD	AK.46457	TPA	25P795	TPA	25-Feb-26

3. This certification is traceable to SI Unit

4. This certification was certified only for the indtrument we calibrated

5. This result of calibration wae found accurate as show on date and place of calibration only.

6. Through the reference standard laboratory of AMARC 25-009359 Calibration 0152

Calibraton Result:

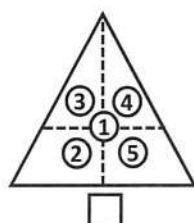
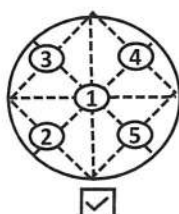
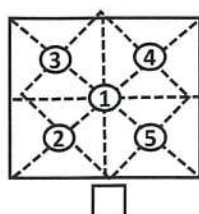
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
200*	0.000045

2. Eccentric or off-center loading

A mass of 100 g was placed and moved to various position on pan

The Balance reading obtained is given in the table.



1 (g)	2 (g)	3 (g)	4 (g)	5 (g)	Maximum Difference (g)
100.0000	99.9996	99.9997	100.0003	100.0005	0.0005

เอกสารไม่ควบคุม

Certificate No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 3 of 3

Equipment: Electronic Balance

Model: AB204-S/FACT

Serial No.: 1129361010

Max. Capacity: 220 g

Calibration Date: April 23, 2025

Manufacturer: Mettler Toledo

Readability: 0.0001 g

ID No.: UAE.WAS.002/2552

Calibration Result: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Error of indication from nominal or conventional mass value:

Nominal Value (g)	Reference Value (g)	Indication (g)	Correction (g)	Uncertainty ( $\pm$ mg)	Coverage Factor <i>k</i>
Unload	0.0000000	0.0000	0.0000	0.10	2.05
0.01	0.0100025	0.0099	0.0001	0.10	2.05
0.05	0.0500056	0.0500	0.0000	0.10	2.05
0.1	0.1000012	0.0999	0.0001	0.10	2.05
0.5	0.5000133	0.5000	0.0000	0.10	2.05
1	1.0000105	1.0000	0.0000	0.10	2.05
10	10.000010	10.0000	0.0000	0.11	2.04
40	40.000076	40.0000	0.0000	0.14	2.00
50	50.000056	50.0000	0.0001	0.13	2.00
80	80.000107	80.0000	0.0001	0.18	2.00
100	100.000109	99.9999	0.0002	0.17	2.00
120	120.00015	119.9999	0.0003	0.21	2.00
150	150.000165	149.9998	0.0003	0.24	2.00
160	160.000175	159.9997	0.0005	0.26	2.00
200	200.000129	199.9998	0.0004	0.30	2.00

4. Effect of Tare test:

Tare Load (g)	Test Load (g)	Indication (g)	Correction (g)
100	20.000041	19.9999	0.0001
	40.000076	39.9998	0.0002
	60.000066	59.9997	0.0003
	80.000107	79.9999	0.0002
	100.000168	100.0004	-0.0003

Remark:

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

เอกสารไม่ควบคุม

o---o-End-o---o


## Calibration Certificate

**Certificate No.:** 2502226-002-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** XSR205DU  
**Serial No.:** C210685394  
**ID No.:** UAE.WAO.010/2565  
**Order No.:** 2502226  
**Operation No.:** 2502226-002  
**Date of Receipt:** 19 March 2025  
**Date of Calibration:** 20 March 2025

**Calibrated by** Mr.Yothin Charoensuk  
Scientist

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

**Date of Issue:** 25 March 2025

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

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

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





# Calibration Report

**Certificate No.:** 2502226-002-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C210685394

**ID No.:** UAE.WAO.010/2565

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 2 of 4

**Environment Condition:** Ambient Temperature: 21.2 ± 0.6 °C Relative Humidity: 48 ± 3.5 %

**Place of Calibration:** 208 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

**Condition of Equipment:** Good Condition

**Condition of This Results of Calibration:**

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	M2404100S	19 April 2025

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 017/23	Quality Reborn	QR25-0542	10 February 2026

3. This certification is traceable to SI UNIT

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

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

**Calibration Results:**

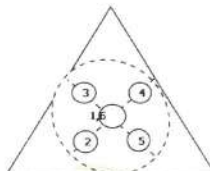
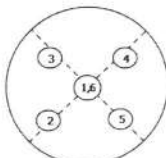
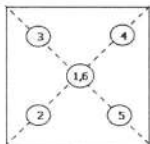
**1. Repeatability of Reading:**

Nominal Value ( g )	Standard Deviation of Reading ( g )
40	0.0000042
80	0.0000042
100	0.0000000
200	0.0000000

**2. Off-Center Error:**

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1 ( g )	2 ( g )	3 ( g )	4 ( g )	5 ( g )	6 ( g )	(Maximum Difference) ( g )
100.0001	100.0001	100.0001	100.0001	100.0001	100.0001	0.0000

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

## Calibration Report

**Certificate No.:** 2502226-002-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C210685394

**ID No.:** UAE.WAO.010/2565

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 3 of 4

**Calibration Results:** (Continued)

**Calibration Range:** 0-80 g

**Calibration Adjustment:** Internal Calibration

**3. Departure from Nominal Value:** (Range: 0 - 82 g ; Resolution: 0.00001 g )

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor k
Unload	0.000000	0.00000	0.00000	0.0000087	2.00
0.001	0.001003	0.00100	0.00000	0.0000090	2.00
0.005	0.005002	0.00501	-0.00001	0.0000092	2.00
0.01	0.010003	0.01002	-0.00002	0.0000089	2.00
0.05	0.049996	0.05001	-0.00001	0.0000096	2.00
0.1	0.100011	0.10002	-0.00001	0.000011	2.00
0.5	0.500016	0.50004	-0.00002	0.000014	2.00
1	1.000003	1.00005	-0.00005	0.000016	2.00
2	2.000023	2.00006	-0.00004	0.000017	2.00
5	5.000015	5.00006	-0.00005	0.000020	2.00
10	10.000009	10.00005	-0.00004	0.000026	2.00
20	20.000030	20.00007	-0.00004	0.000037	2.00
30	30.000039	30.00009	-0.00005	0.000050	2.00
50	50.000028	50.00008	-0.00005	0.000068	2.00
80	80.000067	80.00013	-0.00006	0.00011	2.00





## Calibration Report

**Certificate No.:** 2502226-002-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C210685394

**ID No.:** UAE.WAO.010/2565

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 4 of 4

**Calibration Results:** (Continued)

**Calibration Range:** >80-200 g

**Calibration Adjustment:** Internal Calibration

**3. Departure from Nominal Value:** (Range: >80 - 200 g ; Resolution: 0.0001 g )

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor <i>k</i>
90	90.00010	90.0002	-0.0001	0.00015	2.00
100	100.00006	100.0001	0.0000	0.00016	2.00
110	110.00007	110.0002	-0.0001	0.00017	2.00
120	120.00009	120.0002	-0.0001	0.00018	2.00
130	130.00010	130.0002	-0.0001	0.00019	2.00
140	140.00013	140.0002	-0.0001	0.00019	2.00
150	150.00009	150.0002	-0.0001	0.00021	2.00
160	160.00010	160.0002	-0.0001	0.00022	2.00
170	170.00012	170.0002	-0.0001	0.00023	2.00
200	200.00013	200.0002	-0.0001	0.00028	2.00

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

----- End -----

for N. important

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



## Calibration Certificate

**Certificate No.:** 2502226-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** XSR205DU  
**Serial No.:** C009071872  
**ID No.:** UAE.WAO.012/2563  
**Order No.:** 2502226  
**Operation No.:** 2502226-001  
**Date of Receipt:** 19 March 2025  
**Date of Calibration:** 20 March 2025

**Calibrated by** Mr.Yothin Charoensuk  
Scientist

**Approved by**

*for N. ningsubart*

( Mr.Pheraphat Tuanjit )

Manager, Division of Calibration Laboratory

**Date of Issue:** 25 March 2025

Responsible for the Technical Management Team

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

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

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



# Calibration Report

**Certificate No.:** 2502226-001-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C009071872

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

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 2 of 4

**Environment Condition:** Ambient Temperature: 21.2 ± 0.6 °C Relative Humidity: 48 ± 3.5 %

**Place of Calibration:** 208 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

**Condition of Equipment:** Good Condition

**Condition of This Results of Calibration:**

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	M2404100S	19 April 2025

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 017/23	Quality Reborn	QR25-0542	10 February 2026

3. This certification is traceable to SI UNIT

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

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

**Calibration Results:**

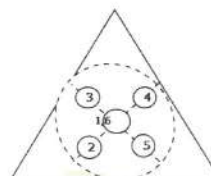
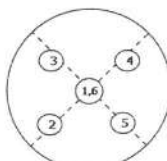
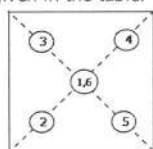
**1. Repeatability of Reading:**

Nominal Value ( g )	Standard Deviation of Reading ( g )
40	0.0000052
80	0.0000042
100	0.0000000
200	0.0000000

**2. Off-Center Error:**

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1 ( g )	2 ( g )	3 ( g )	4 ( g )	5 ( g )	6 ( g )	(Maximum Difference) ( g )
100.0001	100.0001	100.0001	100.0001	100.0001	100.0002	0.0001

for N. mityambut

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



## Calibration Report

**Certificate No.:** 2502226-001-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C009071872

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

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 3 of 4

**Calibration Results:** (Continued)

**Calibration Range:** 0-80 g

**Calibration Adjustment:** Internal Calibration

**3. Departure from Nominal Value:** (Range: 0 - 82 g ; Resolution: 0.00001 g )

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor k
Unload	0.000000	0.00000	0.00000	0.0000089	2.00
0.001	0.001003	0.00100	0.00000	0.0000092	2.00
0.005	0.005002	0.00500	0.00000	0.0000094	2.00
0.01	0.010003	0.01000	0.00000	0.0000091	2.00
0.05	0.049996	0.05000	0.00000	0.0000098	2.00
0.1	0.100011	0.10000	0.00001	0.000011	2.00
0.5	0.500016	0.50000	0.00002	0.000014	2.00
1	1.000003	1.00001	-0.00001	0.000016	2.00
2	2.000023	2.00005	-0.00003	0.000017	2.00
5	5.000015	5.00005	-0.00003	0.000021	2.00
10	10.000009	10.00005	-0.00004	0.000026	2.00
20	20.000030	20.00012	-0.00009	0.000037	2.00
30	30.000039	30.00012	-0.00008	0.000050	2.00
50	50.000028	50.00014	-0.00011	0.000068	2.00
80	80.000067	80.00020	-0.00013	0.00011	2.00

## Calibration Report

**Certificate No.:** 2502226-001-01

**Equipment:**

Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR205DU

**Resolution:** 0.00001 g / 0.0001 g

**Serial No.:** C009071872

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

**Capacity:** 82 g / 220 g

**Date of Calibration:** 20 March 2025

Page 4 of 4

**Calibration Results:** (Continued)

**Calibration Range:** >80-200 g

**Calibration Adjustment:** Internal Calibration

**3. Departure from Nominal Value:** (Range: >80 - 200 g ; Resolution: 0.0001 g )

Nominal Value ( g )	Standard Value ( g )	Average Reading ( g )	Correction ( g )	Uncertainty ( ± g )	Coverage Factor <i>k</i>
90	90.00010	90.0002	-0.0001	0.00015	2.00
100	100.00006	100.0001	0.0000	0.00016	2.00
110	110.00007	110.0001	0.0000	0.00017	2.00
120	120.00009	120.0002	-0.0001	0.00018	2.00
130	130.00010	130.0002	-0.0001	0.00019	2.00
140	140.00013	140.0002	-0.0001	0.00019	2.00
150	150.00009	150.0002	-0.0001	0.00021	2.00
160	160.00010	160.0002	-0.0001	0.00022	2.00
170	170.00012	170.0002	-0.0001	0.00023	2.00
200	200.00013	200.0002	-0.0001	0.00028	2.00

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

----- End -----

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

for N. ingudat





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



## Certificate of Calibration

Cert. No.: 24TM1114

Page : 1 of 3

Equipment : BOD Incubator

Manufacturer : ARCO

Model : UC4-1320

Serial No. : -

ID No. : UAE.WAO.018/2559

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

Location : Lab Floor 2


Received Order : 11 July 2024

Calibration Date : 11 July 2024

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Tawatchai Pama

Approved by :   
Approved Signatory

( ) Ponpan Paipim  
(✓) Suwit Imjai  
( ) Kunchit Promprat

Issue Date : 14 July 2024

**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.

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Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2407-0243OC-2

Cert. No.: 24TM1114

Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1 ) Data Acquisition	MY49023932	23LM122	TPA	26 Jul 2024

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

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

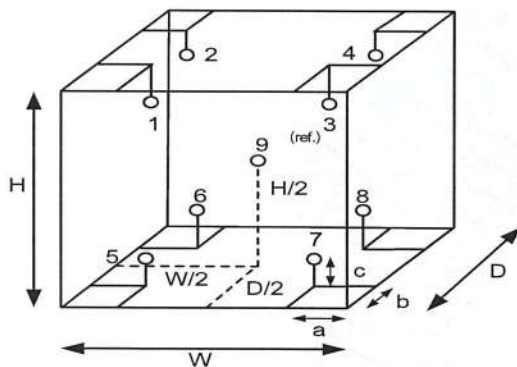
**Remark :** TPA : Technology Promotion Association ( Thailand - Japan )

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

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

**Fresh air setting :** Not Available

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	29	29
REL.Humid. ( % )	78	72
AC Supply ( Volt )	233	234



Position :	Ref. Std. ID No.:
1	20-16RTD-10
2	20-16RTD-02
3	20-16RTD-03
4	23-16RTD-04
5	22-16RTD-05
6	20-16RTD-06
7	20-16RTD-07
8	22-16RTD-08
9 (ref.)	22-16RTD-09

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.62 m  
W = 1.2 m  
H = 1.2 m  
Capacity = 0.89 m<sup>3</sup>



Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2407-0243OC-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 24TM1114

Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor <i>k</i>
20.0	20.0	19.9	0.29	0.81	1.2	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty  ( ± °C )
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.361	19.640	20.312	20.079	19.908	19.872	19.955	19.818	19.758	0.48

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

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**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

**Cert.No.:** 25TW29

**Page.:** 1 of 2

**Equipment :** DO Meter  
**Manufacturer :** YSI  
**Model :** 5100  
**Serial No. :** 11B 101863  
**ID No. :** UAE.WAO.004/2554  
**Received Date :** 14 February 2025  
**Test Date :** 17 February 2025  
**Reference :** 2502-0473DSC-1  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260  
**Laboratory Condition :** Temperature (  $25 \pm 5$  ) °C  
Humidity (  $50 \pm 20$  ) %  
**Test Procedure :** In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
**Tested by :** Walalak Sirithean  
  
**Approved by :** \_\_\_\_\_  
Approved Signatory  
( ) Chakrit Waewwanjua  
( ) Ponpan Paipim  
(✓) Saithip Meangmai  
**Issue Date :** 18 February 2025

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Cert.No.: 25TW29

Page.: 2 of 2

**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).

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1. Burette	-	130BU10	23CG1172	22 Mar 2025
2. Balance	14233821	110RC001	24MM131	04 July 2025

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%

**Result :**        **Dissolved Oxygen Meter Adjustment With Air 100 %**  
                         **Dissolved Oxygen Probe No.: 24F100202**

<b>Titration Method (Azide Modification Method)</b> (mg/L)	<b>DO Meter Reading</b> (mg/L)	<b>Standard Deviation</b> (mg/L)
8.22	8.22	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study  
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-

เอกสารไม่ควบคุม



บันทึกผลการทวนสอบใบรับรองการสอบเทียบ (Verification of Certificate)

Certificate No. : 25TW29				Equipment : Do Meter			
Brand : YSI				Model : 5100			
Serial No. : 11B 101863				ID No. : UAE.WAO.004/2554			
Calibration results							
Titration Method	Standart Deviation	Do meter Reading	Error%	Correction%	Error   Total Error	Judgement	(Total Error < Judgement )
( mg/L)	( mg/L)	( mg/L)	( mg/L)	( mg/L)	( mg/L)	(± mg/L)	( mg/L)
8.22	0.0055	8.22	0.0000	0.0000	0.0	0.02	pass
ผู้บันทึก.....อิสรา.บุญประกอบ.....ผู้ตรวจสอบ..... <b>พ.รังษวิมล</b>							
วันที่.....28/02/2025.....วันที่..... <b>28 ก.พ. 68</b>							
หมายเหตุ :							

เก็บใบนี้เพื่อ.....

...../.....

เอกสารไม่ควบคุม

Certificate No. : HIT-2510-0375

Page : 1 of 2

**CERTIFICATE OF CALIBRATION**

**Equipment :** COD Test Tube Heater

**Meter Model :** HI839800-02      **Serial No. :** H018500I

**Tube Heater :** 25 Vial Capacity      **Resolution :** 0.1°C

**Temperature Range :** (-10 to 160)°C      **Temperature of Reaction :** 150°C

**Manufacturer :** Hanna Instruments      **Made in :** Romania

**Condition As-Received :** Used Product      **Reference :** RE250401

**Ambient Temperature :** (25 ± 2)°C      **Relative Humidity :** (50 ± 15)% RH

**Customer name :** United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,  
Phrakhanong, Bangkok 10260

**Received date :** 5 March 2025

**Calibrate date :** 7 March 2025

**Issue date :** 7 March 2025

**Calibrated Location :** Hanna Instruments (Thailand) Ltd.

**Calibration Procedure :** This calibrator was conducted by using in-house: calibration procedure  
CP-04 by using certified reference standard instruments.

**Calibrated by :** ☒ Mr. Pichit Petthong  
☐ Mr. Channarong Soinak

**Approved by :**   
Mr. Anan Suwanchaisakul

Authorized Signatory

 **HANNA**  
Instruments  
(Thailand) Limited

This certificate was certified only for the instrument we calibrated.

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

\*\* This certificate may not be reproduced other than in full, except with the prior written \*\*

approval of the head of Hanna Instrument (Thailand) **เอกสารไม่ควบคุม**

**Condition of this calibration result:**

Reference Standard Instruments : This certification is traceable to the international unit of unit maintained through:

Instruments	Model	Serial No.	Certificate No.	Traceable
Data Acquisition Switch Unit	34970A	MY44065265	WK2407-141-1	WK Electric Co., Ltd.
Digital Thermo-Hygrometer	HT-771SD	AI.07155	25H171	Technology Promotion Association (Thailand-Japan).

**Calibration Result:**

Measurement Temperature Source Accuracy for COD Reactor.

Capacity (Vial)	Nominal Value (°C)	Average Value (°C)	Uncertainty of Measurement (±°C)
25 Vial	150.0	150.4	0.47

Unit : °C

(1A)	(2A)	(3A)	(4A)	(5A)
150.407	150.377	150.269	150.402	150.422
(1B)	(2B)	(3B)	(4B)	(5B)
150.426	150.394	150.644	150.690	150.542
(1C)	(2C)	(3C)	(4C)	(5C)
150.477	150.303	150.627	150.257	150.176
(1D)	(2D)	(3D)	(4D)	(5D)
150.462	150.456	150.199	150.406	150.102
(1E)	(2E)	(3E)	(4E)	(5E)
150.185	150.513	150.235	150.460	150.442

Figure: Shows the location of the temperature source.

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

**\*\* End of certificate \*\***

**เอกสารไม่ควบคุม**



# FOSS

FOSS South East Asia

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

## Customer Service Report

Report No.:

12875

Date:

July 5, 2024

Customer:

UAE

Job No.:

8335

Address:

Bangkok

Instrument:

KT9 Distillator

Serial:

91905393

Start  
Finish

Travel To Customer (Hrs)

08.30

1

Labour (Hrs)

09.30

14.30

5

Travel From Customer (Hrs)

14.30

16.00

1.5

### Job Type

Application		Special		Standard			
Distributor	x	Courtesy Visit	x	Installation	x	Training	x
Digital Service	x	PMA Onboarding	x	Quote	x	In House	x
Internal	x	Warranty	x	Repair	x	PM	x
Investigate	x	Sales Support	x	Remote	x	Health Check Visit	x

PMA Type

Smartcare

x

Smartcare Pro

x

Fosscore

x

Smartcare Advance

x

Fosscore Pro

x

N/A

x

### Details of Work / Test

- PM -  
- Visual Check -  
+ No leak  
+ No damage

} ok

- Change PM kit x4 set -> ok

- Function Check -

+ Dilution 80 mL →  
+ Alkali 50 mL → 52 mL  
+ Receiver N/A → Not use  
+ Steam / Drain

} Pass

Blank =

Follow up \* Recovery = 100%

SD =

Follow up

Instrument Ready for Use

OK

x


Not OK\*

x

Part No:	Batch	Description	Qty
60100996	03-01-2024	PM kit Kjeltec 9 Distillator	1

I confirm this report is accurate and complete

Signed FOSS



Signed Customer



Name

Anawin / Sarawit

Name

Email:

Customer Contact.:

\*Remark:

เอกสารไม่ควบคุม

# FOSS

FOSS South East Asia

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

## Customer Service Report

Report No.:

13319

Date:

Jan 27, 2025

Customer:

UAE

Job No.:

11675

Address:

Bangkok

Instrument:

KT200

Serial:

91790524

Travel To Customer (Hrs)

09-00

1

Labour (Hrs)

10-00

3

Travel From Customer (Hrs)

-

Start  
Finish

10-00

13-00

-

### Job Type

Application	Special	Standard
Distributor	Courtesy Visit	Installation
Digital Service	PMA Onboarding	Quote
Internal	Warranty	Repair
Investigate	Sales Support	Remote
		Training
		In House
		PM
		Health Check Visit

PMA Type

Smartcare

Smartcare Pro

Fosscore

Smartcare Advance

Fosscore Pro

N/A

### Details of Work / Test

- PM -	- ok
+ Visual Check	- ok
- No leak	- Not ok
- have damage on heater & main switch	- ok
+ replace heater & main switch	- ok
+ replace PM kit & 1 set	- ok
+ Function Check	- ok
- Power on / off	- ok
- Alkali	- ok
- Steam	- ok
- Condenser	- ok
Instrument Ready for Use	OK
	Not OK*

Part No:	Batch	Description	Qty
10069965	11-06-2024	FOSS PM kit KT200 heater Analyser / 2100	1
10003512	29.03.2024	Heating element Steam	1
15630111	19.10.2022	Switch R595kit + 2 Pa	1

I confirm this report is accurate and complete

Signed FOSS

Signed Customer

Name

Name

Email:

Customer Contact.:

\*Remark:

เอกสารไม่ควบคุม



# FOSS

FOSS South East Asia

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

## Customer Service Report

Report No.:

13854

Date:

24 February 2025

Customer:

VAE

Job No.:

11735

Address:

Bangkok

Instrument:

KT8100

Serial:

91889052

Start  
Finish

Travel To Customer (Hrs)

07:00

09:00

2hrs

Labour (Hrs)

09:00-12:00

13:00-14:00

0hrs

Travel From Customer (Hrs)

15:00

17:00

2hrs

### Job Type

Application		Special		Standard	
Distributor	x	Courtesy Visit	x	Installation	x
Digital Service	x	PMA Onboarding	x	Quote	x
Internal	x	Warranty	x	Repair	x
Investigate	x	Sales Support	x	Remote	x
				Training	x
				In House	x
				PM	x
				Health Check Visit	x

PMA Type

Smartcare

x

Smartcare Pro

x

Fosscore

x

Smartcare Advance

x

Fosscore Pro

x

N/A

x

### Details of Work / Test

APM KT8100 12mo

- test before PM
- cleaning KT8100, 36 mo replace
- flushing Alkali pump
- test operation
  - Distillation 80 - 80 ml
  - Distillation 6 min 150 - 170 ml
  - Alkali 50 - 50 ml
  - all pass

Instrument Ready for Use

OK

x

Not OK\*

x

Part No:

Batch

Description

Qty

60031810

08-01-2024

FOSS PM kit KT8100 36 mo

1

I confirm this report is accurate and complete

Signed FOSS

[Signature]

Signed Customer

Suphakorn P.

Name

Name

Email:

Customer Contact.:

\*Remark:

เอกสารไม่ควบคุม

Please scan QR code





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



## Certificate of Calibration

Cert.No.: 25CH586

Page.: 1 of 3

**Equipment :** pH Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-PH210  
**Serial No. :** HA9M0048  
**ID No. :** UAE.EFM.003/2563(EFM.pH.03/63)  
**Condition As-Received:** Used Item  
**Received Date :** 20 May 2025  
**Calibration Date :** 21 May 2025  
**Reference :** 2505-0602WSC-1  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260  
**Ambient Temperature :** (25  $\pm$  2.5) °C  
**Relative Humidity :** (50  $\pm$  15) %  
**Calibration Procedure :** In - house method :  
- CP-CH5 by direct measurement with DC voltage  
standard and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with temperature standard  
**Calibrated by :** Walalak Sirithean  
**Approved by :**   
Approved Signatory  
( ) Chakrit Waewwanjua  
( ) Ponpan Paipim  
(✓) Saithip Meangmai  
**Issue Date :** 23 May 2025

**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.



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



## Certificate of Calibration

Cert.No.: 24CH1597

Page.: 1 of 3

**Equipment :** pH Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-PH210  
**Serial No. :** HA0A0005  
**ID No. :** UAE.EFM.004/2563(EFM.pH.04/63)  
**Condition As-Received:** Used Item  
**Received Date :** 24 December 2024  
**Calibration Date :** 26 December 2024  
**Reference :** 2412-0601WSC-2  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
  
**Ambient Temperature :** (25  $\pm$  2.5) °C  
**Relative Humidity :** (50  $\pm$  15) %  
**Calibration Procedure :** In - house method :  
- CP-CH5 by direct measurement with DC voltage  
standard and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with temperature standard  
  
**Calibrated by :** Warakorn Lerngagtrakul  
  
**Approved by :**   
Approved Signatory  
  
( ) Pornthippa Tameyakul  
( ) Ponpan Paipim  
(✓) Saithip Meangmai  
  
**Issue Date :** 27 December 2024

**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.



☒ PASS  
☐ NOT PASS

Remarks Temp  $\pm 0.5$  (std. thermometer)  
mv  $\pm 30$  (std. voltage input)  
pH  $\pm 0.05$  (std. buffer solution)

nm	nm
( nm )	( nm )
Verify	Approve

6/1/69





Cert.No.: 24CH1597

Page.: 2 of 3

**Condition of this calibration result**

**1. Reference Standard Instrument**

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1)Document Process Calibrator	54030049	130RC116	24E2759	25 Aug 2025
2)Ref. Standard Thermometer	4982054	110RC044	24I757	14 July 2025

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

- 2. Certified Reference Materials** :The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,  
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00  
: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	1034203	27 Sep 2026
pH 7.000	Hach Lenge GmbH	C03185	09 July 2026
pH 10.010	CPA chem	1034205	27 Sep 2025

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

**Calibration Results**

**Function : mV Measurement**

**Performing standard curve by Document Process Calibrator at pH (4,7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: HA0A0005	4.00	177.48	177.4	4.01	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00
	10.00	-177.48	-177.2	10.01	0.058	2.00



Cert.No.: 24CH1597

Page.: 3 of 3

**Calibration Results**

**Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4,7)(7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: -	4.008	4.01	177.2	0.0079	2.00
	7.000	7.00	2.2	0.0092	2.00
	7.000	7.00	2.2	0.0085	2.00
	10.010	10.01	-170.9	0.0095	2.00

**Function : Temperature Measurement**

**( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : -

- Serial No. : -

Dimension of probe

- Length : 112 mm.

- Diameter : 16 mm.

- Immersion Depth : 100 mm.

Calibration Point ( $^{\circ}\text{C}$ )	Standard Temperature ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Error ( $^{\circ}\text{C}$ )	Uncertainty of measurement ( $\pm$ $^{\circ}\text{C}$ )	Coverage factor $k$
15.0	15.003	15.0	-0.003	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
45.0	45.002	45.0	-0.002	0.13	2.00

**Remark** - UUC\* = Unit Under Calibration

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-

## Calibration Certificate

**Certificate No.:** 2501844-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 5

**Equipment:** pH Meter  
**Manufacturer:** METTLER TOLEDO  
**Model:** SevenEasy pH  
**Serial No.:** 1231155210  
**ID No.:** UAE.WAT.010/2553  
**Order No.:** 2501844  
**Operation No.:** 2501844-001  
**Date of Receipt:** 24 February 2025  
**Date of Calibration:** 24 February 2025

**Calibrated by** Mr.Manas Somsak  
Specialist

**Approved by**   
( Mr.Pheraphat Tuanjit )  
Manager, Division of Calibration Laboratory

**Date of Issue:** 27 February 2025

Responsible for the Technical Management Team

The uncertainties are for a confidence probability of approximately 95%.

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

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



## Calibration Report

**Certificate No.:** 2501844-001-01

**Equipment:** pH Meter **Resolution:** 0.01 pH ; 1 mV

**Manufacturer:** METTLER TOLEDO **Model:** SevenEasy pH

**Serial No.:** 1231155210 **Type:** Bench top

**ID No.:** UAE.WAT.010/2553

**Date of Calibration:** 24 February 2025

Page 2 of 5

**Location:** Chemical Calibration Laboratory, National Food Institute

**Environment Condition:** **Ambient Temperature:** ( 23.4 ± 1.5 ) °C **Relative Humidity:** ( 54 ± 3 ) %

**Condition of Equipment:** Good Condition

### Condition of this Results of Calibration

1. Calibration Method W-CC-002 : In house method based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

### 2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	24E1752	30 May 2025
2.2 Digital Thermometer	2709007	Fluke	2500376-002-01	29 October 2025
2.3 Thermo-Hygro Meter	NFI.BTH 013/23	testo	CC 670420-01	21 May 2025
Certified Reference Material	Lot. No.	Manufacturer	Ref N	Expire Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	1016435	CPAchem	PH216.L5	25 July 2026
2.5 pH buffer 6.865 (Primary pH buffer Solution)	949186	CPAchem	PH217.L5	30 November 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	1016437	CPAchem	PH220.L5	25 July 2025
2.7 pH buffer 7.00 (Standard pH buffer Solution)	C03109	HACH LANGE GmbH	S11M004	16 October 2025

### 3. This certification is traceable to The International System of Unit (SI Unit)

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2 to 2.3	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Certified Reference Material No.2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.4 Certified Reference Material No.2.7	traceable to	PTB Certificate Nr. PTB-PHOA-563/30504/23 and Certificate Nr. PTB-PHOB-555/30620/22 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany)

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

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



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





## Calibration Report

**Certificate No.:** 2501844-001-01

**Equipment:** pH Meter **Resolution:** 0.01 pH ; 1 mV

**Manufacturer:** METTLER TOLEDO **Model:** SevenEasy pH

**Serial No.:** 1231155210 **Type:** Bench top

**ID No.:** UAE.WAT.010/2553

**Date of Calibration:** 24 February 2025

Page 3 of 5

### Calibration Results:

#### 1. Calibration of pH Meter ( Manual Temperature Compensation at 25 °C )

Nominal pH	DC Voltage Standard ( mV )	Average Indicator Reading		Uncertainty ( ±mV )	Coverage Factor ( k )
		mV	pH		
0	414.122	414	-0.01	0.58	2.00
2	295.815	296	1.99	0.58	2.00
4	177.463	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.462	-177	10.00	0.58	2.00
12	-295.813	-296	12.00	0.58	2.00
14	-414.121	-414	14.00	0.58	2.00

#### 2. Calibration of pH Meter with Electrode ( Manual Temperature Compensation at 25 °C )

**Equipment:** pH Electrode **Type:** Combined Electrode

**Manufacturer:** METTLER TOLEDO **Model:** InLab Solids

**Serial No.:** 3065701 **ID.No.:** N/A

**Performance of Electrode system** (Three-Point Calibration at pH 4, 7 and 10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty ( ± pH )	Coverage Factor ( k )
	pH	mV			
4.008	4.00	165	-	0.0071	2.00
7.001	7.00	-8	97.5	0.0086	2.00
10.010	10.01	-178	95.5	0.0083	2.00
6.876	6.88	0	-	0.0071	2.00



## Calibration Report

**Certificate No.:** 2501844-001-01

**Equipment:** Digital Thermometer with RTD (pH Meter)

**Resolution:** 0.1 °C      **Model:** SevenEasy pH  
**Serial No.:** 1231155210      **ID No.:** UAE.WAT.010/2553  
**Manufacturer:** METTLER TOLEDO

**Date of Calibration:** 24 February 2025

Page 4 of 5

**Location:** Chemical Calibration Laboratory, National Food Institute

**Environment Condition:**  
**Ambient Temperature** 23.4 °C ± 1.0 °C  
**Relative Humidity** 55.1 % ± 1.7 %

### Condition of this results of Calibration:

1. Calibration Method :
  - In house method: W-TE-025 by comparison with standard thermometer.
  - The Calibration is determined by comparing with a known temperature from a standard resistance thermometer.
  - The temperature scale in use at this laboratory is the International Temperature scale of 1990 ( ITS-90 ).

### 2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0815/67	24-Jun-25	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (AMETEK RTC-187), Model: RTC-187C , S/N: 670930-00018

3. This certificate is traceable to International System of Units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.

6. Condition of Calibrated item : Good

7. Result of Calibration : ☒ Without adjustment      ☐ After adjustment




## Calibration Report

**Certificate No.:** 2501844-001-01

**Equipment:** Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C      Model: SevenEasy pH

Serial No.: 1231155210      ID No.: UAE.WAT.010/2553

Manufacturer: METTLER TOLEDO

**Date of Calibration:** 24 February 2025

Page 5 of 5

**Calibration point:** 20.0, 25.0 and 30.0 °C

**Calibration result:**

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A      S/N : N/A
- Dimension of probe : Diameter 4 mm., Length 120 mm.,
- Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
20.1	20.001	0.1	0.099
25.1	25.002	0.1	0.099
30.1	30.003	0.1	0.099

Note

- UUC\* : Unit Under Calibration

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

----- End -----



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





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



## Certificate of Calibration

Cert.No.: 25CH163

Page.: 1 of 3

**Equipment :** pH Meter  
**Manufacturer :** EcoSence  
**Model :** pH100A  
**Serial No. :** JC03335  
**ID No. :** UAE.EFM.062/2562(ENV.pH.02/62)  
**Condition As-Received:** Used Item  
**Received Date :** 04 February 2025  
**Calibration Date :** 05 February 2025  
**Reference :** 2502-0105WSC-1  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
  
**Ambient Temperature :** (25 ± 2.5) °C  
**Relative Humidity :** (50 ± 15) %  
**Calibration Procedure :** In - house method :  
- CP-CH5 by direct measurement with DC voltage  
standard and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with temperature standard  
  
**Calibrated by :** Warakorn Lerngagtrakul  
  
**Approved by :** \_\_\_\_\_  
Approved Signatory  
  
( ) Chakrit Waewwanjua  
( ) Ponpan Paipim  
(✓) Saithip Meangmai  
  
**Issue Date :** 06 February 2025

**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.





Cert.No.: 25CH163

Page.: 2 of 3

**Condition of this calibration result**

1. Reference Standard Instrument

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1)Document Process Calibrator	54030049	130RC116	24E2759	25 Aug 2025
2)Ref. Standard Thermometer	4982054	110RC044	24I757	14 July 2025

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,  
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00  
: 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 4.007	CPA chem	1066665	18 Jan 2027
pH 6.999	Hach Lenge GmbH	C03220	29 Oct 2026
pH 10.010	CPA chem	1066669	18 Jan 2026

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

**Calibration Results**

**Function : mV Measurement**

**Performing standard curve by Document Process Calibrator at pH (4,7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: JC03335	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00



Cert.No.: 25CH163

Page.: 3 of 3

### Calibration Results

#### Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7)(7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: 231018SIA605377	4.007	4.01	173	0.0079	2.00
	6.999	7.00	-2	0.0092	2.00
	6.999	7.00	-2	0.0085	2.00
	10.010	10.01	-177	0.0092	2.00

#### Function : Temperature Measurement

##### (\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : -

- Serial No. : 231018SIA605377

Dimension of probe

- Length : 110 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor $k$
15.0	15.003	15.1	0.097	0.13	2.00
30.0	30.002	30.1	0.098	0.13	2.00
45.0	45.002	45.1	0.098	0.13	2.00

**Remark** - UUC\* = Unit Under Calibration

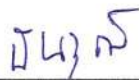
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95 %.

-o0o-

## CERTIFICATE OF CALIBRATION

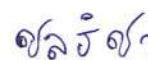
**Certificate No. :** SP25-001

Page 1 of 5

**Customer :** United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 213**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** Hitachi**Model :** U-2900**Serial No. :** 21E22-009**ID No. :** UAE.WAT.051/2564**Received Date :** 3 January 2025**Calibration Date :** 3 January 2025**Issue Date :** 8 January 2025**Condition Instrument :** Good**Calibrated by :**

( Mr.Tanawut Rittidach )

Technical Manager

**Approved by :**

( Ms. Chonthicha Sangngern )

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

**เอกสารไม่ควบคุม**

## REPORT OF CALIBRATION

**Certificate No. :** SP25-001

Page 2 of 5

**Environment Condition :** Ambient Temperature  $25 \pm 5$  °CRelative humidity  $55 \pm 20$  %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

**Traceability :** This certification is traceable to the International System of Unit maintained at National -

Institute of Standards and Technology (NIST) through Starna Scientific Limited

**Spectral Band Width of UUC :** 1.5 nm.**Scan Speed of UUC :** 200 nm/min**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.



## REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.578	0.0000	0.0031	2.00
	1.0484	1.045	0.0034	0.0029	2.00
	2.1876	2.192	-0.0044	0.0075	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.560	-0.0005	0.0034	2.00
	1.0239	1.023	0.0009	0.0035	2.00
	2.1230	2.125	-0.0020	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5230	0.521	0.0020	0.0030	2.00
	0.9633	0.961	0.0023	0.0029	2.00
	1.9753	1.977	-0.0017	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5181	0.518	0.0001	0.0031	2.00
	1.0002	0.998	0.0022	0.0033	2.00
	1.9973	1.993	0.0043	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.552	-0.0003	0.0030	2.00
	1.0803	1.079	0.0013	0.0030	2.00
	2.0373	2.032	0.0053	0.0079	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.559	0.0001	0.0031	2.00
	1.0518	1.050	0.0018	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

เอกสารไม่ควบคุม

## REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 4 of 5

### Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7469	0.744	0.0029	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.863	0.0044	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.290	0.0019	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.640	0.0030	0.0055	2.00

## REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 5 of 5

### Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor <i>k</i>
241.72	241.1	0.62	0.18	2.00
279.45	279.0	0.45	0.18	2.00
287.81	287.3	0.51	0.18	2.00
334.06	333.8	0.26	0.18	2.00
360.93	360.6	0.33	0.18	2.00
418.59	418.2	0.39	0.18	2.00
445.94	445.5	0.44	0.18	2.00
453.66	453.4	0.26	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.6	-0.01	0.18	2.00
637.98	637.7	0.28	0.18	2.00
431.38	431.1	0.28	0.18	2.00
472.50	472.3	0.20	0.18	2.00
513.47	513.4	0.07	0.18	2.00
528.88	528.9	-0.02	0.18	2.00
573.17	573.3	-0.13	0.18	2.00
585.35	585.1	0.25	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.8	-0.25	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.6	-0.32	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement  $U$  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%

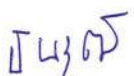
- End of Certificate -

เอกสารไม่ควบคุม

## CERTIFICATE OF CALIBRATION

**Certificate No. :** SP24-028

Page 1 of 5

**Customer :** United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 315**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** HITACHI**Model :** U-5100**Serial No. :** 23A4-008**ID No. :** UAE.WAS.010/2567**Received Date :** 10 September 2024**Calibration Date :** 10 September 2024**Issue Date :** 13 September 2024**Condition Instrument :** Good**Calibrated by :**

( Mr.Tanawut Rittidach )

Technical Manager

**Approved by :**

( Ms. Chonthicha Sangngern )

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

**เอกสารไม่ควบคุม**



## REPORT OF CALIBRATION

**Certificate No. :** SP24-028

Page 2 of 5

**Environment Condition :** Ambient Temperature  $25 \pm 5$  °CRelative humidity  $55 \pm 20$  %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

**Traceability :** This certification is traceable to the International System of Unit maintained at National -  
Institute of Standards and Technology (NIST) through Sarna Scientific Limited

**Spectral Band Width of UUC :** 5.0 nm.**Scan Speed of UUC :** 40**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.

## REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.575	0.0030	0.0031	2.00
	1.0484	1.044	0.0044	0.0029	2.00
	2.1876	2.190	-0.0024	0.0075	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.557	0.0025	0.0034	2.00
	1.0239	1.021	0.0029	0.0035	2.00
	2.1230	2.121	0.0020	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5230	0.519	0.0040	0.0029	2.00
	0.9633	0.961	0.0023	0.0028	2.00
	1.9753	1.975	0.0003	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5181	0.515	0.0031	0.0031	2.00
	1.0002	0.997	0.0032	0.0033	2.00
	1.9973	1.996	0.0013	0.0085	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.549	0.0027	0.0030	2.00
	1.0803	1.078	0.0023	0.0029	2.00
	2.0373	2.031	0.0063	0.0081	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.557	0.0021	0.0031	2.00
	1.0518	1.049	0.0028	0.0029	2.00
	1.9274	1.923	0.0044	0.0080	2.00

## REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 4 of 5

### Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7469	0.743	0.0039	0.0056	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.862	0.0054	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.291	0.0009	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.639	0.0040	0.0055	2.00

## REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 5 of 5

### Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor <i>k</i>
241.00	240.4	0.60	0.18	2.00
279.30	278.7	0.60	0.18	2.00
288.90	288.5	0.40	0.18	2.00
334.50	334.2	0.30	0.18	2.00
361.40	361.1	0.30	0.18	2.00
418.40	418.0	0.40	0.18	2.00
447.20	446.7	0.50	0.18	2.00
459.30	459.6	-0.30	0.18	2.00
537.00	536.6	0.40	0.18	2.00
638.00	637.4	0.60	0.18	2.00
441.29	440.8	0.49	0.18	2.00
479.88	479.6	0.28	0.18	2.00
513.75	513.5	0.25	0.18	2.00
528.59	528.6	-0.01	0.18	2.00
575.10	574.9	0.20	0.18	2.00
585.56	585.3	0.26	0.20	2.00
684.70	684.1	0.60	0.18	2.00
740.51	740.0	0.51	0.20	2.00
747.61	747.2	0.41	0.18	2.00
807.04	806.3	0.74	0.18	2.00
879.68	878.9	0.78	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement  $U$  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%

- End of Certificate -



รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Opacity Training Certification for Opacity Mesurement

No.	Name	Training Couse	Train	Date	Remark
Stack					
1	Mr.Pongthep Laokajorn	Opacity	Pollution Control Department	12-13 March 2015	-
2	Mr.Ronnapob Putragulpattana	Opacity	Pollution Control Department	22-23 March 2018	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate	Apex Instruments, USA.	XC-572-V 0807048	Envi Equipment Service Co., Ltd.	E24-070061	23/7/2024	22/7/2025	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 60899615	Entech Industrial Sulation Co., Ltd.	G 670490	17/7/2024	16/7/2025	-
CEMs Analyzer									
1	NO/NO <sub>2</sub> /NO <sub>x</sub> Analyzer	Nitrogen Dioxide	Thermo Scientific	42i-HL-BNSSDAA 1180540072	Petro-Instruments Corp., Ltd.	JID2400550	18 Oct 24	17 Oct 25	-
2	SO <sub>2</sub> Analyzer	Sulphur Dioxide	Thermo Scientific	43iHL-BNAA 1180540073	Petro-Instruments Corp., Ltd.	JID2400550	18 Oct 24	17 Oct 25	-
3	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo Scientific	48i-BNSAA 1180540070	Petro-Instruments Corp., Ltd.	JID2400550	18 Oct 24	17 Oct 25	-
4	Carbon Dioxide Analyzer with Oxygen Analyzer	Carbon Dioxide / Oxygen	Thermo Scientific	410i-BSPEAA 1180540075	Petro-Instruments Corp., Ltd.	JID2400550	18 Oct 24	17 Oct 25	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Standard Gas for CEMs Analyzer									
1	Standard Gas	CO, CO <sub>2</sub> , NO, NO <sub>x</sub> , SO <sub>2</sub> , BALN 400-800-900 ppm	Airgas	CC715540	Airgas	E05NI83E15A0004	27 Feb 19	27 Feb 27	-
2	Standard Gas	CO, CO <sub>2</sub> , NO, NO <sub>x</sub> , SO <sub>2</sub> , BALN 200-400 ppm	Airgas	CC19340	Airgas	E05NI83E15001C	14 Oct 20	14 Oct 28	-
3	Standard Gas	CO, CO <sub>2</sub> , NO, NO <sub>x</sub> , SO <sub>2</sub> , BALN 100-200 ppm	Airgas	CC429175	Airgas	E05NI91E15A003C	18 Sep 20	18 Sep 28	-
4	Standard Gas	O <sub>2</sub> , BALN 15%	Airgas	CC719418	Airgas	E02NI85E15A3432	15 Oct 18	15 Oct 26	-
5	Standard Gas	O <sub>2</sub> , BALN 7%	Airgas	CC232371	Airgas	E02NI93E15AC00C	12 Jan 21	12 Jan 29	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Tisch Environmental,Inc.	TE-5025A 3540	Jiranatee Associates Co., Ltd.	COF-045-67	4/11/2024	3/11/2025	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	24P1251	11/4/2024	10/4/2025	-
3	Air Flow Meter	Particular Matter (PM <sub>2.5</sub> )	Mesa Labs	DeltaCal DC1 155895	Jiranatee Associates Co., Ltd.	CGF-010-67	16/10/2024	15/10/2025	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24P1369	22/4/2024	21/4/2025	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24H754	10/4/2024	9/4/2025	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920010	UAE Consultant Co.,Ltd.	17102024	17/10/2024	16/10/2025	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920011	UAE Consultant Co.,Ltd.	11102024	11/10/2024	10/10/2025	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1191503035	UAE Consultant Co.,Ltd.	11102024	11/10/2024	10/10/2025	-



รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Ambient									
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1191503036	UAE Consultant Co.,Ltd.	26092024	26/9/2024	25/9/2025	-
10	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NI91E15A0014	6/6/2023	6/6/2031	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920014	UAE Consultant Co.,Ltd.	04092024	4/9/2024	3/9/2025	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	42i 1182920016	UAE Consultant Co.,Ltd.	06092024	6/9/2024	5/9/2025	-
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920017	UAE Consultant Co.,Ltd.	09042024	4/9/2024	3/9/2025	-
14	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1180540065	UAE Consultant Co.,Ltd.	04092024	4/9/2024	3/9/2025	-
15	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NI91E15A0014	6/6/2023	6/6/2031	-
16	Wind Speed/Wind Direction	WS/WD	LSI Lastem	DNA202/E-LOG BQ1705626/17037713	Jiranatee Associates Co., Ltd.	CWS-028-67	7/8/2024	6/8/2025	-
17	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV36 107224	Innovative Instrument Co.,Ltd.	24-ACT-091	26/6/2024	25/6/2025	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
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บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Ambient									
18	Sound Level Meter	L <sub>Aeq</sub> 24 hrs, L <sub>Aeq</sub> 1 hr, L <sub>Amax</sub> , L <sub>A90</sub> , L <sub>Adn</sub>	Larson Davis	LxT1 0007309	Electrical And Electronics Institute Foundation For Industrial Development	CP202340287EA	2/8/2024	1/8/2025	-
		Annoyance Noise							
19	Sound Level Meter	L <sub>Aeq</sub> 24 hrs, L <sub>Aeq</sub> 1 hr, L <sub>Amax</sub> , L <sub>A90</sub> , L <sub>Adn</sub>	Larson Davis	LxT1 0007310	Electrical And Electronics Institute Foundation For Industrial Development	CP20240289EA	5/8/2024	4/8/2025	-
		Annoyance Noise							

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
สำหรับโครงการโรงไฟฟ้าชีวมวลขนาดไม่เกิน 30 เมกะวัตต์ (ระยะดำเนินการ) ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2568  
บริษัท ไทยรุ่งเรือง ไปโอ-เอ็นเนอร์จี้ จำกัด

List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Water									
1	pH Meter	pH	Ecosence	pH100A 24H005160JEN	Technology Promotion Association (Thailand-Japan)	24CH1422	14/11/2024	13/11/2025	-

รายงานผลการปฏิบัติตามมาตรการป้องกัน และแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
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List of Instrument Certificates for Environmental Quality Analysis									
No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Workplace									
1	Primary Flow Calibrator	Calibrate personal pump	TSI.Inc	4146 41462327002	Innovative Instrument Co., Ltd.	24-AFM-156	19/8/2024	18/8/2025	-
2	Aneroid Barometer	Total Dust Respirable Dust	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24P1370	22/4/2024	21/4/2025	-
3	Digital Thermo - Hygrometer	Total Dust Respirable Dust	Digicon	TH-02 435031147	Technology Promotion Association (Thailand-Japan)	24H1486	15/7/2024	14/7/2025	-
4	Thermal Environment Monitor	Heat Meter	TSI QUEST	QuesTemp 34 TEX040015	Innovative Instrument Co.,Ltd.	24-TPM-313	9/7/2024	8/7/2025	-
5	Thermal Environment Monitor	Heat Meter	TSI QUEST	QuesTemp 34 TEX040016	Innovative Instrument Co.,Ltd.	24-TPM-315	9/7/2024	8/7/2025	-
6	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Larson Davis	CAL150 6307	Innovative Instrument Co.,Ltd.	24-ACT-120	10/9/2024	9/9/2025	-
7	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ $L_{Amax}$	Rion, Japan	NL-42 00558037	Innovative Instrument Co.,Ltd.	24-SLM-205	25/6/2024	24/6/2025	-
8	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ $L_{Amax}$	Rion, Japan	NL-42 00409023	Sithiporn Associates Co., Ltd.	ACL24160	4/6/2024	3/6/2025	-



ขอมอบประกาศนียบัตรนี้เพื่อแสดงว่า

นายพงศ์เทพ เหล่าขจร

ได้ผ่านการฝึกอบรมและทดสอบผู้ตรวจวัดความทึบแสงของเขม่าควันด้วยสายตา  
และการใช้แผนภูมิเขม่าควันของริงเกิลมานน์

ระหว่างวันที่ ๑๒ - ๑๓ มีนาคม ๒๕๕๘

จัดโดย สำนักจัดการคุณภาพอากาศและเสียง กรมควบคุมมลพิษ

ให้ไว้ ณ วันที่ ๑๓ มีนาคม ๒๕๕๘

กรมควบคุมมลพิษ

(นายวิเชียร จุ่งรุ่งเรือง)

POLLUTION CONTROL DEPARTMENT

อธิบดีกรมควบคุมมลพิษ



กรมควบคุมมลพิษ  
POLLUTION CONTROL DEPARTMENT

ขอมอบประกาศนียบัตรนี้เพื่อแสดงว่า

นายรณภพ ภู์ตระกูลพัฒนา

ได้ผ่านการฝึกอบรมและทดสอบผู้ตรวจวัดความทึบแสงของเขม่าควันด้วยสายตา  
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ระหว่างวันที่ ๒๒ - ๒๓ มีนาคม ๒๕๖๑

จัดโดย สำนักจัดการคุณภาพอากาศและเสียง กรมควบคุมมลพิษ

ให้ไว้ ณ วันที่ ๒๓ มีนาคม ๒๕๖๑

(นางสุณี ปิยะพันธุ์พงศ์)

อธิบดีกรมควบคุมมลพิษ



## Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No.: E24-070061

Page.: 1 of 6

## CERTIFICATE OF CALIBRATION

**Customer** : United Analyst and Engineering Consultant Co., Ltd.

**Address** : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

**Description of Equipment** : Console meter

**Manufacturer** : Apex Instrument

**Model Number** : XC-572-V

**Serial Number** : 0807048

**ID./Control No.** : UAE.ANV. 213/2551

**Environment Conditions** : Temperature (25 ± 2) °C  
: Humidity (50 ± 15) % RH

**Cal. Date** : 23/07/2024

**Issue Date** : 23/07/2024

### Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

This certificate is traceable to national standard, which realize the units of measurement according to the International System of Units (IS).

### Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuekhu)

Technical Manger

เอกสารไม่ควบคุม



**METHOD 5 CONSOLE CALIBRATION  
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425  
5-POINT METRIC UNIT**

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	0807048
DGM Model Number	SK25EX
DGM Serial Number	00003811

Calibration Conditions			
Date	Time	23/07/2024	09:30 AM
Calibration Reference No.		SER24-070026	
Barometric Pressure		755.91	mmHg
Calibration Meter Gamma		1.001	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K <sub>1</sub>	0.386	
Console Leak Check		PASS

Calibration Data									
Run Time	Metering Console					Calibration Meter			
Elapsed	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(Q)	(P <sub>m</sub> )	(V <sub>mi</sub> )	(V <sub>mf</sub> )	(t <sub>mi</sub> )	(t <sub>mf</sub> )	(V <sub>wi</sub> )	(V <sub>wf</sub> )	(t <sub>wi</sub> )	(t <sub>wf</sub> )
min	mm H <sub>2</sub> O	m <sup>3</sup>	m <sup>3</sup>	°C	°C	m <sup>3</sup>	m <sup>3</sup>	°C	°C
12.80	13.0	1571.952	1572.092	30	30	238.20732	238.35208	28	28
12.87	13.0	1572.092	1572.232	30	30	238.35208	238.49672	28	28
8.90	26.0	1572.243	1572.383	29	29	238.51668	238.66174	27	27
8.87	26.0	1572.383	1572.523	29	29	238.66174	238.80612	27	27
14.20	40.0	1572.531	1572.811	30	30	238.81622	239.10386	27	27
14.17	40.0	1572.811	1573.091	30	30	239.10389	239.38968	26	26
10.53	70.0	1573.105	1573.385	30	30	239.40386	239.68674	26	26
10.50	70.0	1573.385	1573.665	31	31	239.68674	239.96910	26	26
9.27	90.0	1573.677	1573.957	31	31	239.97994	240.26246	25	25
9.28	90.0	1573.957	1574.237	31	31	240.26246	240.54548	25	25



เอกสารไม่ควบคุม



**METHOD 5 CONSOLE CALIBRATION  
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425  
5-POINT METRIC UNIT**

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	23/07/2024	09:30 AM	Std Temp	293	K
Console Serial Number	0807048	Calibration Reference No.		SER24-070026		Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure		755.91	mmHg	K <sub>1</sub>	0.386	
DGM Serial Number	00003811	Calibration Meter Gamma		1.001		Console Leak Check		PASS

Calibration Data								
Results								
Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	.0212 m <sup>3</sup> <sub>std</sub> /min	Variation
				Value	Variation	Std & Corr		
(V <sub>m(std)</sub> )	(Q <sub>m(std)</sub> )	(V <sub>w(std)</sub> )	(Q <sub>w(std)</sub> )	(Y)	(ΔY)	(Q <sub>m(std)(corr)</sub> )	(ΔH <sub>@</sub> )	(ΔH <sub>@</sub> )
m <sup>3</sup>	m <sup>3</sup> /min	m <sup>3</sup>	m <sup>3</sup> /min			m <sup>3</sup> /min	mm H <sub>2</sub> O	
0.136	0.011	0.140	0.011	1.032	0.015	0.011	47.552	1.450
0.136	0.011	0.140	0.011	1.031	0.014	0.011	48.128	2.026
0.136	0.015	0.141	0.016	1.032	0.016	0.016	45.752	-0.350
0.136	0.015	0.140	0.016	1.028	0.011	0.016	45.839	-0.263
0.273	0.019	0.279	0.020	1.022	0.006	0.020	45.695	-0.407
0.274	0.019	0.278	0.020	1.016	-0.001	0.020	45.918	-0.184
0.275	0.026	0.275	0.026	1.002	-0.014	0.026	45.607	-0.496
0.275	0.026	0.275	0.026	1.001	-0.016	0.026	45.485	-0.617
0.276	0.030	0.276	0.030	0.999	-0.017	0.030	45.521	-0.581
0.276	0.030	0.276	0.030	1.001	-0.015	0.030	45.524	-0.578
				1.016	Y Average		46.102	ΔH <sub>@</sub> Average

**Note:** For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is  $\pm 0.02$ .

For  $\Delta H_{@}$ , orifice pressure differential that equates to 0.75 cfm (0.0212 m<sup>3</sup>/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is  $\pm 0.2$  inches (5.1mm) H<sub>2</sub>O.

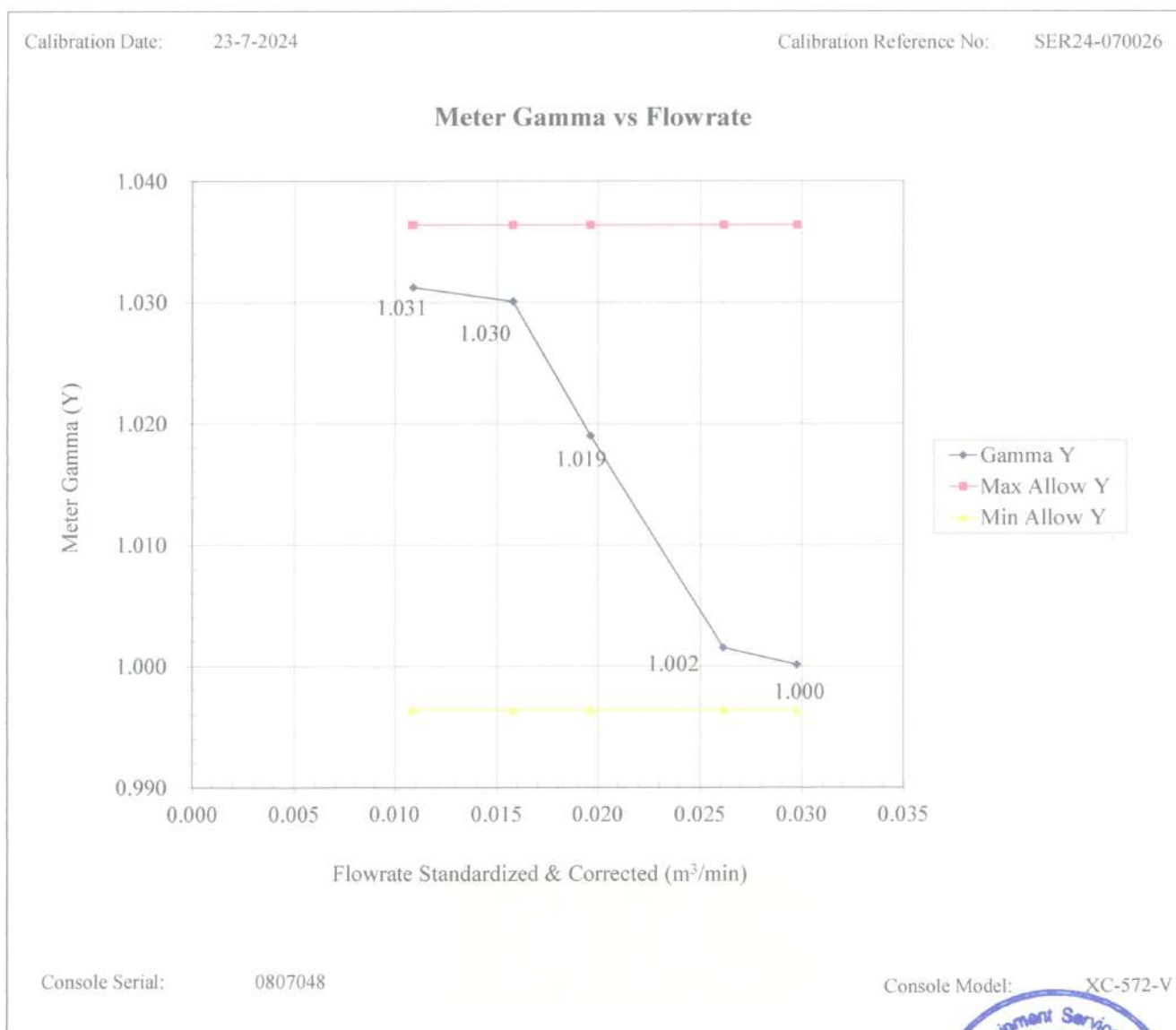


เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	0807048
DGM Model Number	SK25EX
DGM Serial Number	00003811

Calibration Conditions			
Date	Time	23/07/2024	09:30 AM
Calibration Reference No.	SER24-070026		
Barometric Pressure	755.91	mmHg	
Calibration Meter Gamma	1.001		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K <sub>1</sub>	0.386	
Console Leak Check	PASS	



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	0807048
DGM Model Number	SK25EX
DGM Serial Number	00003811

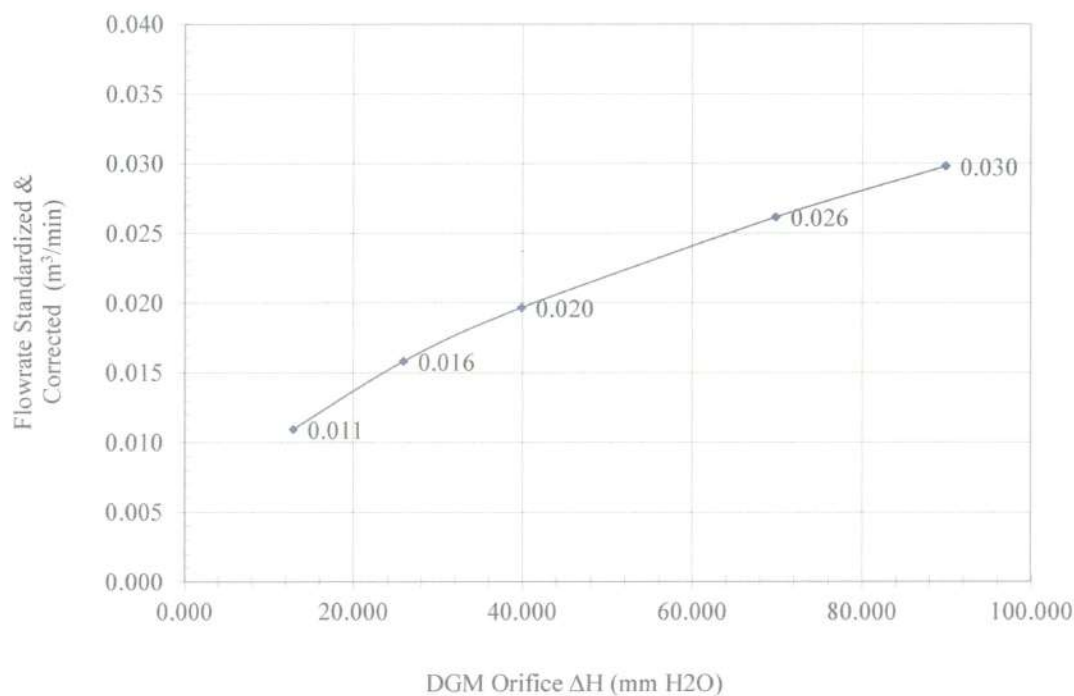
Calibration Conditions			
Date	Time	23/07/2024	09:30 AM
Calibration Reference No.		SER24-070026	
Barometric Pressure		755.91	mmHg
Calibration Meter Gamma		1.001	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K <sub>1</sub>	0.386	
Console Leak Check		PASS

Calibration Date: 23-7-2024

Calibration Reference No: SER24-070026

Meter Pressure vs Flowrate



Console Serial: 0807048

Console Model: XC-572-V



เอกสารไม่ควบคุม



## THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	0807048
DGM Model Number	SK25EX
DGM Serial Number	00003811
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 08944

Calibration Conditions			
Date	Time	23/07/2024	11:45 AM
Calibration Reference No.		SER24-070026	
Reference Thermometer		DIGICON	
Serial Number		183169105	

Results											
Console Thermocouple Simulator											
Channel and test point	Meter Box Channel Temperature Reading ( °C )										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-18.0	24.0	37.0	92.0	148.0	258.0	371.0	482.0	594.0	816.0	1039.0
Aux	-18.0	24.0	37.0	92.0	148.0						
Probe	-18.0	24.0	37.0	92.0	148.0						
Filter	-18.0	24.0	37.0	92.0	148.0						
Exit	-18.0	24.0	37.0								

Tolerance Range

Stack     ± 1.50%     Absolute  
Probe     ± 3.0 °C  
Filter     ± 3.0 °C

Meter     ± 3.0 °C  
Exit       ± 2.0 °C



เอกสารไม่ควบคุม



**Certificate No:** G 670490

**Date of issue :** 17-Jul-24

**Instrument description :** Flue Gas Analyzer  
**Instrument model :** Testo 350 New  
**Control unit serial no. :** 03099401/701  
**Instrument serial no. :** 60899615/701  
**ID no. or control no. :** UAE.EFM. 006/2560  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial no. :** -  
**Customer name :** United Analyst and Engineering Consultant Co., Ltd.  
**Customer address :** 81 Soi Udomsuk 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260

**Total pages of certificate :** 2 Pages  
**Receiving no. :** L-242678  
**Receiving date. :** 15-Jul-24  
**Parameter of calibration :** Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitrogen Dioxide 30.34,81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurment ware caried out the stabilized labotary  
Temperature : 23  $\pm$  5  $^{\circ}$ C  
Humidity : 55  $\pm$  15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no. :** This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.*

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

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

*This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).*

**Date of calibration :** 17-Jul-24



Mr. Kwanchai Khamdoun

**Calibration Technician**



Mrs. Nongluck Wongsettee

**Technical Manager**

Certificate No.: G 670490

**Standard References (Table 1)**

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.18 ppm	CG-0002-24	Nimt	11-Jan-29
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide ( CO ) 1007 ppm	1870/24	Linde	17-Jun-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 81.32 ppm	3546/23	Linde	14-Jan-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide ( NO ) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

**Measured room conditions**

Temperature : 23.1 °C Humidity : 66.3 %RH Pressure : 1010.2 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1014.5 mbar

**Calibration Results (Without adjustment) (Table 2)**

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.50	2.55	0.05	0.15
O <sub>2</sub> (%Vol)	10.04	10.12	0.08	0.20
O <sub>2</sub> (%Vol)	21.02	21.13	0.11	0.30
CO (ppm)	80.18	81	0.82	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1007	1009	2	12
NO <sub>2</sub> (ppm)	30.34	32.5	2.16	8.0
NO <sub>2</sub> (ppm)	81.32	82.7	1.38	8.0
NO <sub>2</sub> (ppm)	201.9	202.8	0.9	12
NO (ppm)	30.01	31	0.99	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO <sub>2</sub> (ppm)	50.36	50	-0.36	6.0
SO <sub>2</sub> (ppm)	100.8	100	-0.8	6.0
SO <sub>2</sub> (ppm)	600.8	603	2.2	13

**Remark :** 1 cmol/mol = 1 %vol. 1 μmol/mol = 1 ppm.

**End of Report**

**Test Date :** Mar 4, 2024

**Equipment :** Gas Analyzer (NO-NO<sub>2</sub>-NO<sub>x</sub>)

**Model :** 42i-HL

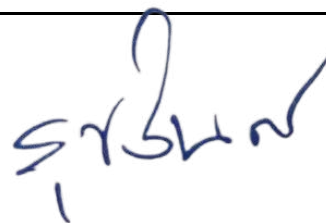
**Manufacturer :** Thermo Scientific

**Serial Number :** 1180540072

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
NO	250	ppm	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			100.20	100.50	0.30	
High level (Span)			200.50	201.40	0.45	
Offset(BKG)	0.098					
Slope(COEF)	0.867					
Remark : Percent error not over +/- 2 %						

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
NOX	250	ppm	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			100.40	100.90	0.50	
High level (Span)			200.50	201.80	0.65	
Offset(BKG)	0.132					
Slope(COEF)	1.010					
Remark : Percent error not over +/- 2 %						

Calculate by



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United Analyst and Engineering Consultant Co., Ltd.

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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

Test Date : Mar 4, 2024

Equipment : Gas Analyzer (SO<sub>2</sub>)

Model : 43i-HL

Manufacturer : Thermo Scientific

Serial Number : 1180540073

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
SO2	250	ppm				
Low level (zero)			0.00	0.00	0.00	
Mid level			100.00	101.10	1.10	
High level (Span)			201.70	202.10	0.20	
Offset(BKG)	1.760					
Slope(COEF)	1.008					
Remark : Percent error not over +/- 2 %						

Calculate by

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**Test Date :** Mar 4, 2024

**Equipment :** Gas Analyzer (NO-NO<sub>2</sub>-NO<sub>x</sub>)

**Model :** 42i-HL

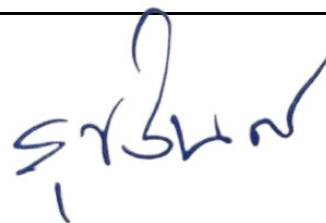
**Manufacturer :** Thermo Scientific

**Serial Number :** 1180540072

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
NO	250	ppm	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			100.20	100.50	0.30	
High level (Span)			200.50	201.40	0.45	
Offset(BKG)	0.098					
Slope(COEF)	0.867					
Remark : Percent error not over +/- 2 %						

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
NOX	250	ppm	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			100.40	100.90	0.50	
High level (Span)			200.50	201.80	0.65	
Offset(BKG)	0.132					
Slope(COEF)	1.010					
Remark : Percent error not over +/- 2 %						

Calculate by



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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

Test Date : Mar 4, 2024

Equipment : Gas Analyzer (CO)

Model : 48i

Manufacturer : Thermo Scientific

Serial Number : 1180540070

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
CO	900	ppm		Gas	Response	
Low level (zero)			0.00	0.00	0.00	
Mid level			199.20	201.90	1.36	
High level (Span)			399.70	400.00	0.08	
Offset(BKG)	0.455					
Slope(COEF)	0.925					
Remark : Percent error not over +/- 2 %						

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**Test Date :** Mar 4, 2024

**Equipment :** Gas Analyzer (CO2 With O2)

**Model :** 410i

**Manufacturer :** Thermo Scientific

**Serial Number :** 1180540075

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
CO2	20	% vol	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			7.98	7.99	0.08	
High level (Span)			16.02	16.00	-0.12	
Offset(BKG)	0.145					
Slope(COEF)	1.100					
Remark : Percent error not over +/- 0.5 %						

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
O2	25	% vol	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			7.00	7.01	0.17	
High level (Span)			14.99	15.02	0.20	
Offset(BKG)	2.940					
Slope(COEF)	0.974					
Remark : Percent error not over +/- 0.5 %						

Calculate by



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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

Test Date : Mar 4, 2024

Equipment : Gas Analyzer (CO)

Model : 48i

Manufacturer : Thermo Scientific

Serial Number : 1180540070

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
CO	900	ppm		Gas	Response	
Low level (zero)			0.00	0.00	0.00	
Mid level			199.20	201.90	1.36	
High level (Span)			399.70	400.00	0.08	
Offset(BKG)	0.455					
Slope(COEF)	0.925					
Remark : Percent error not over +/- 2 %						

Calculate by

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**Test Date :** Mar 4, 2024

**Equipment :** Gas Analyzer (CO2 With O2)

**Model :** 410i

**Manufacturer :** Thermo Scientific

**Serial Number :** 1180540075

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
CO2	20	% vol	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			7.98	7.99	0.08	
High level (Span)			16.02	16.00	-0.12	
Offset(BKG)	0.145					
Slope(COEF)	1.100					
Remark : Percent error not over +/- 0.5 %						

Reference Method Analyzer Calibration Direct Report						
Parameter	Range	Unit	Standard	Analyzer Calibration	Calibration Error	Remark
O2	25	% vol	Gas	Response	(% percent of span)	
Low level (zero)			0.00	0.00	0.00	
Mid level			7.00	7.01	0.17	
High level (Span)			14.99	15.02	0.20	
Offset(BKG)	2.940					
Slope(COEF)	0.974					
Remark : Percent error not over +/- 0.5 %						

Calculate by



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## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number:	E05NI83E15A0004	Reference Number:	82-401427550-1
Cylinder Number:	CC715540	Cylinder Volume:	154.0 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2015 PSIG
PGVP Number:	B52019	Valve Outlet:	660
Gas Code:	CO <sub>2</sub> , CO, NO, NOX, SO <sub>2</sub> , BALN	Certification Date:	Feb 27, 2019

**Expiration Date: Feb 27, 2027**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	400.0 PPM	405.0 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
NITRIC OXIDE	400.0 PPM	405.0 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
CARBON MONOXIDE	800.0 PPM	794.4 PPM	G1	+/- 0.7% NIST Traceable	02/21/2019
SULFUR DIOXIDE	900.0 PPM	913.4 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
CARBON DIOXIDE	16.00 %	16.09 %	G1	+/- 0.8% NIST Traceable	02/19/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15010127	KAL004357	494.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Sep 01, 2021
PRM	12367	APEX1099237	9.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
GMIS	1114201601	CC506710	4.971 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 14, 2019
NTRM	14060148	CC436850	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 18, 2019
NTRM	11010354	KAL004922	968.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	May 30, 2023
NTRM	12061504	CC354684	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801933 CO <sub>2</sub>	FTIR	Feb 07, 2019
Siemens Ultramat 6 J3-599 COLOW	NDIR	Feb 19, 2019
Nicolet 6700 AHR0801933 NO	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 NO <sub>2</sub>	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 SO <sub>2</sub>	FTIR	Feb 14, 2019

#### Triad Data Available Upon Request

#### NOTES:

Gross Weight: 28291.4 grams

Net Weight: 5516.6 grams

PO# 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

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Page 1 of 1 82-401427550



# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E05NI83E15A001C      Reference Number: 160-401892912-1A  
Cylinder Number: CC19340      Cylinder Volume: 153.9 CF  
Laboratory: 124 - Plumsteadville - PA      Cylinder Pressure: 2015 PSIG  
PGVP Number: A12020      Valve Outlet: 660  
Gas Code: CO,CO2,NO,NOX,SO2,BALN      Certification Date: Oct 14, 2020

Expiration Date: Oct 14, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	200.0 PPM	200.8 PPM	G1	+/- 0.8% NIST Traceable	10/06/2020, 10/13/2020
NITRIC OXIDE	200.0 PPM	200.8 PPM	G1	+/- 0.8% NIST Traceable	10/06/2020, 10/13/2020
SULFUR DIOXIDE	200.0 PPM	206.3 PPM	G1	+/- 0.9% NIST Traceable	10/06/2020, 10/13/2020
CARBON MONOXIDE	400.0 PPM	389.0 PPM	G1	+/- 0.6% NIST Traceable	10/14/2020
CARBON DIOXIDE	16.00 %	16.29 %	G1	+/- 1.0% NIST Traceable	10/06/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	03161237	KAL004403	243.4 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	May 26, 2026
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15060660	CC450677	248.1 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 17, 2020
NTRM	042012	ND48548	495.4 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jul 03, 2024
NTRM	060118	K008735	23.04 % CARBON DIOXIDE/NITROGEN	+/- 0.1%	Jun 27, 2022

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
HORIBA VA5011 T5V6VU9P NDIR CO2	NDIR	Oct 02, 2020
SIEMENS ULTRAMAT6E N1-C8-180	NDIR	Oct 06, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 28.1 Kg, Net Weight: 5.1 Kg. PO#5220003826.



*Michael A. Miller*  
Approved for Release



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Page 1 of 160-401892912-1A

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number:	E05NI91E15A003C	Reference Number:	160-401892911-1
Cylinder Number:	CC429175	Cylinder Volume:	148.7 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	660
Gas Code:	CO <sub>2</sub> , CO, NO, NO <sub>x</sub> , SO <sub>2</sub> , BALN	Certification Date:	Sep 18, 2020

**Expiration Date: Sep 18, 2028**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	100.5 PPM	G1	+/- 0.5% NIST Traceable	09/09/2020, 09/18/2020
NITRIC OXIDE	100.0 PPM	100.5 PPM	G1	+/- 0.5% NIST Traceable	09/09/2020, 09/18/2020
SULFUR DIOXIDE	100.0 PPM	100.1 PPM	G1	+/- 0.7% NIST Traceable	09/09/2020, 09/18/2020
CARBON MONOXIDE	200.0 PPM	200.3 PPM	G1	+/- 0.3% NIST Traceable	09/10/2020
CARBON DIOXIDE	8.000 %	8.023 %	G1	+/- 0.7% NIST Traceable	09/09/2020
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	18060111	KAL004089	249.9 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	18060111	KAL004089	250.1 PPM NO <sub>x</sub> /NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	15060607	CC449760	248.1 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 17, 2020
NTRM	15060620	CC450449	248.1 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 17, 2020
NTRM	041812	KAL003160	246.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.2%	Oct 16, 2024
NTRM	13060703	CC411728	16.939 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 14, 2025

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CO <sub>2</sub> - 000928781	FTIR	Aug 13, 2020
SIEMENS ULTRAMAT6E N1-C8-180	NDIR	Sep 09, 2020
MKS FTIR - NO - 000928781	FTIR	Sep 17, 2020
MKS FTIR - NO <sub>x</sub> - 000928781	FTIR	Sep 17, 2020
MKS FTIR - SO <sub>2</sub> - 000928781	FTIR	Sep 03, 2020

Triad Data Available Upon Request

NOTES: Gross Weight: 27.1 Kg, Net Weight: 4.6 Kg. PO# 5220003826.



*Michael A. Fisher*  
Approved for Release

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Page 1 of 160-401892911-1



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number:	E02NI85E15A3432	Reference Number:	82-401312965-1
Cylinder Number:	CC719418	Cylinder Volume:	145.7 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2015 PSIG
PGVP Number:	B52018	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Oct 15, 2018

**Expiration Date: Oct 15, 2026**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	15.00 %	15.07 %	G1	+/- 0.6% NIST Traceable	10/15/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09061420	CC273671	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA 510-O2-7TWMJ041	Paramagnetic	Oct 05, 2018

Triad Data Available Upon Request

**NOTES:**

Gross Weight: 60.8 lbs.

Net Weight: 11.3 lbs.

PO#5218004553

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Approved for Release

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number:	E02NI93E15AC00C	Reference Number:	160-401972175-1
Cylinder Number:	CC232371	Cylinder Volume:	145.0 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Jan 12, 2021

Expiration Date: Jan 12, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	7.000 %	6.998 %	G1	+/- 0.4% NIST Traceable	01/12/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010602	1D38055	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Dec 17, 2020

Triad Data Available Upon Request

### NOTES:

Gross Weight: 27.8 Kg  
Net Weight: 4.7 Kg  
PO# 5220005732  
150 Aluminum Cylinder  
CGA 590



Approved for Release



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Page 1 of 160-401972175-1





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

Flow measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : COF-045-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice  
MANUFACTURER : TISCH  
MODEL/TYPE : TE-5025A  
SERIAL NUMBER : 3540  
ID NUMBER : UAE.EFM.176/2561  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,  
Bangkok 10260

RECEIVED DATE : 24 Oct 2024  
MEASUREMENT DATE : 04 Nov 2024  
ISSUE DATE : 05 Nov 2024

### 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 NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0063-23.

### 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	$23.0 \pm 3.0$	°C
Relative Humidity	$55.0 \pm 15.0$	%RH
Atmospheric Pressure	$1010 \pm 10$	hPa

### CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.  
Measurement Condition : The average values during measurement are 23.7 °C and 49.7 %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.

### Calibrated by:

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

**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	$\Delta p_{meter}$ mmHg	$\Delta p_{Orifice}$ inH <sub>2</sub> O	$\gamma$	Standard Flow [ $Q_s$ ] $m^3/min$
1	0.702	755.241	23.67	22.27	57.134	1.612	1.268	0.651
2	1.000	755.312	23.55	22.71	61.321	3.248	1.801	0.920
3	1.117	755.324	23.36	22.72	41.180	4.309	2.075	1.057
4	1.163	755.361	23.37	22.77	30.028	4.806	2.192	1.119
5	1.417	755.397	23.65	23.10	29.199	7.191	2.680	1.363

Slope ( $m$ ): 1.98270  
 Intercept ( $b$ ): -0.02316  
 Correlation coefficient ( $r$ ): 0.99988  
 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	$\Delta p_{meter}$ mmHg	$\Delta p_{Orifice}$ inH <sub>2</sub> O	$\gamma$	Standard Flow [ $Q_s$ ] $m^3/min$
1	0.702	755.241	23.67	22.27	57.134	1.612	0.796	0.652
2	1.000	755.312	23.55	22.71	61.321	3.248	1.129	0.921
3	1.117	755.324	23.36	22.72	41.180	4.309	1.301	1.058
4	1.163	755.361	23.37	22.77	30.028	4.806	1.374	1.119
5	1.417	755.397	23.65	23.10	29.199	7.191	1.681	1.365

Slope ( $m$ ): 1.24186  
 Intercept ( $b$ ): -0.01454  
 Correlation coefficient ( $r$ ): 0.99988  
 Uncertainty ( $k=2$ ): 0.015  $m^3/min$

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



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## Certificate of Calibration

Certificate No. : 24P1251

Page : 1 of 2

Equipment : U Tube Manometer

Manufacturer: Dwyer

Model : 1221-36-W/M

Serial No.: -

ID No.: UAE.EFM.077/2566

Condition As-Received: Used Item

Received Date: 03 April 2024

Calibration Date: 11 April 2024

Reference: 2404-0118WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1012 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**Procedure used:** The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

### 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) Pressure Calibrator	PC106P	1189	MP-0176-23	12 Sep 2024

2.This result of calibration was made on requested at the point specified by customer.

3.Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

4.This instrument was used clean air as pressure media.

5.This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.

6.This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.

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

8.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144

Calibrated by : Suksan Khankaew

Issue Date : 17 April 2024

Approved Signatory :

[ ] Phalinee Prabpaipal

[ ] Sura Suwannasri

[✓] Attapol Panurach

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Cert.No.: 24P1251

Page: 2 of 2

**Result of calibration:- Without adjustment**

**Range :** 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O

**Function:- Pressure Measurement**

**Scale Interval :** 0.1 inH<sub>2</sub>O ( The Second Estimate )

**Increasing Pressure**

		UUC Indication			
Applied Pressure	High-port side	Low-port side	$\Delta P$	Error	
0.00	0.00	0.00	0.00	0.00	
2.00	1.00	-1.00	2.00	0.00	
4.00	2.00	-2.00	4.00	0.00	
6.00	3.00	-3.00	6.00	0.00	
8.00	4.00	-4.00	8.00	0.00	
10.00	5.00	-5.00	10.00	0.00	
12.00	6.00	-6.00	12.00	0.00	
14.00	7.05	-7.05	14.10	0.10	
16.00	8.05	-8.05	16.10	0.10	
18.00	9.05	-9.05	18.10	0.10	
20.00	10.05	-10.05	20.10	0.10	
22.00	11.05	-11.05	22.10	0.10	
24.00	12.05	-12.05	24.10	0.10	
26.00	13.05	-13.05	26.10	0.10	
28.00	14.05	-14.05	28.10	0.10	
30.00	15.05	-15.05	30.10	0.10	
32.00	16.05	-16.10	32.15	0.15	
34.00	17.05	-17.10	34.15	0.15	
35.80	18.00	-18.00	36.00	0.20	

The uncertainty of measurement was  $\pm 0.11$  inH<sub>2</sub>O

\*  $\Delta P$  = High-port side - Low-port side

\* UUC = Unit Under Calibration

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 %.

-oOo-

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Accredited calibration laboratory  
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NSC-TISI-TIS 17025  
CALIBRATION 0367

Flow measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Certificate No. : CGF-010-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Volumetric Air Flow Calibrator  
MANUFACTURER : BGI Incorporated  
MODEL/TYPE : DeltaCal DC1  
SERIAL NUMBER : 155895  
ID NUMBER : UAE.EFM.076/2560  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,  
Bangkok 10260

RECEIVED DATE : 07 Oct 2024  
MEASUREMENT DATE : 16 Oct 2024  
ISSUE DATE : 16 Oct 2024

### CONDITION OF THIS RESULT OF CALIBRATION:

- 1.The Unit Under Calibration was preconditioning 24 hours at ambient conditions prior to calibration being performed.
- 2.The Unit Under Calibration was reading under actual conditions.
- 3.Calibration condition:

Flow transmitting medium	: Air	
$t_{Amb}$ average during calibration	: (23.9±0.7)	°C
$H_{Amb}$ average during calibration	: (49.7±0.2)	%RH
$P_{Amb}$ average during calibration	: (1010.40.39±0.6)	hPa

- 4.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 Gas flow meter was calibrated against Standard Gas Flow Meter (Piston Prover) Model ML-800-44. The WI-CL-005 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 NIMT (National Institute of Metrology Thailand) via Certificate number: MW-0046-24.

### 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:

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jittrapon Lertsomphol



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

## MEASUREMENT RESULTS:

The Gas flow meter was calibrated by comparison method with the Standard Gas Flow Meter (Piston Prover). The air was used as a medium in the system.

Calibration in the range of : 15 L/min to 18.3 L/min ☒ Without adjustment ☐ With adjustment

The results of calibration and associated measurement uncertainties are reported in the table below.

Standard Reading	UUC Reading	Error	Uncertainty (k=2)
(L/min)	(L/min)	(%)	(%)
15.228	15.00	-1.52	0.48
16.084	15.82	-1.62	0.48
16.943	16.67	-1.64	0.48
17.802	17.50	-1.72	0.48
18.615	18.30	-1.69	0.48

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



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NSC-TISI-TIS 17025  
CALIBRATION 0367

Temperature measurement laboratory  
Calibration services department.



NSC – TISI – TIS 17025  
CALIBRATION 0367

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-179-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Temperature sensor with display  
**MANUFACTURER** : BGI Incorporated  
**MODEL/TYPE** : DeltaCal DC1  
**SERIAL NUMBER** : 155895  
**ID NUMBER** : UAE.EFM.076/2560  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**RECEIVED DATE** : 07 Oct 2024  
**MEASUREMENT DATE** : 16 Oct 2024  
**ISSUE DATE** : 16 Oct 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %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 temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

### Traceability:

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0101-23

### Reference Used During Calibration:

1. Standard Temperature Probe  
Model: STS-100 A500, Serial No.: 667682-09
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591

### 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:

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol  
☐ Miss Ruangrumpai Phoommit



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

**Result of Calibration:** ☒ Without Adjustment    ☐ With Adjustment

**Calibration Range:**    20 °C to 40 °C

**Function:**

Table 1: This equipment was connected with Ambient temperature sensor probe (Ta) Model: - S/N: -  
Dimension: Diameter 2.0 mm. Length 44.0 mm.

<u>Immersion Depth</u> (mm)	<u>Standard Reading</u> (°C)	<u>UUC Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
40	20.033	20.0	0.0	0.099
40	30.014	30.1	0.1	0.099
40	35.008	35.1	0.1	0.099
40	40.000	40.2	0.2	0.099
40	49.997	49.9	-0.1	0.099

Table 2: This equipment was connected with Filter temperature sensor probe (Tf) Model: - S/N: -  
Dimension: Diameter 7.97 mm. Length 102 mm.

<u>Immersion Depth</u> (mm)	<u>Standard Reading</u> (°C)	<u>UUC Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
90	20.033	20.0	0.0	0.099
90	30.013	30.0	0.0	0.099
90	35.008	35.0	0.0	0.099
90	40.000	40.0	0.0	0.099
90	49.998	49.7	-0.3	0.099

UUC\*: Unit Under Calibration

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



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NSC-TISI-TIS 17025  
CALIBRATION 0367

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-026-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer with display  
MANUFACTURER : BGI by Mesa Labs  
MODEL/TYPE : DeltaCal DC1  
SERIAL NUMBER : 155895  
ID NUMBER : UAE.EFM.076/2560  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

RECEIVED DATE : 07 Oct 2024  
MEASUREMENT DATE : 16 Oct 2024  
ISSUE DATE : 16 Oct 2024

### Calibration procedure:

The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

### Traceability:

The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

### 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'

### CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0009-24	27 Dec 2024

1. Calibration effort for calibration sequence C

2. The UUC\* was installed in vertical orientation above reference standard instrument and center of UUC\* was used as the reference level.

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal  
Pressure transmitting medium : Air  
 $\rho_{F1}$  (20°C, 1 bar) : 1.19 kg/m<sup>3</sup>  
 $H_{amb}$  : (55±15) %  
 $t_{amb}$  : (23±3) °C  
 $p_{amb}$  : (1010±10) mbar

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

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager





JIRANATEE ASSOCIATES CO., LTD.

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

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-026-67

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☐ Without adjustment ☒ With adjustment

CALIBRATION IN THE RANGE OF : 740 mmHg to 765 mmHg

The results of calibration and associated measurement uncertainties are reported in the table below.

STD (mmHg)	UUC* (mmHg)	Error (mmHg)	Uncertainty (k=2) (mmHg)
740.08	739.7	-0.3	0.49
745.08	744.8	-0.3	0.49
750.07	750.0	-0.1	0.44
755.06	755.0	-0.1	0.45
760.07	760.0	-0.1	0.45
765.06	765.0	-0.1	0.45

Note: UUC\* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 133.32

\*End of certificate\*



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## Certificate of Calibration

Certificate No. : 24P1369

Page : 1 of 2

Equipment : Aneroid Barometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE.ANV.013/2547

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 22 April 2024

Reference: 2404-0243WSC

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1007 mbar

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**Procedure used:** The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

### 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 Barometer	DPI142	1422505046	MP-0094-23	03 May 2024

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

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

8.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew

Issue Date : 23 April 2024

Approved Signatory :

[ ] Phalinee Prabpaipal

[ ] Sura Suwannasri

[✓] Attapol Panurach

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Cert.No.: 24P1369

Page: 2 of 2

**Result of calibration:- Without adjustment**

**Range :** 720 mmHg to 780 mmHg

**Function:- Absolute Pressure Measurement**

**Scale Interval :** 1 mmHg ( The Fifth Estimate )

**Increasing Pressure**

Applied Pressure (mmHg)	718.40	729.71	740.61	751.07	761.97	773.05	786.91
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.60	0.29	-0.61	-1.07	-1.97	-3.05	-6.91

**Decreasing Pressure**

Applied Pressure (mmHg)	786.91	772.99	761.71	750.69	740.13	729.35	718.44
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-6.91	-2.99	-1.71	-0.69	-0.13	0.65	1.56

The uncertainty of measurement was  $\pm 0.24$  mmHg

\* UUC = Unit Under Calibration

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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เอกสารไม่ควบคุม





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



## Certificate of Calibration

Certificate No. : 24H754

Page : 1 of 2

Equipment : Dial Thermo-Hygrometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE.ANV.129/2550

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 10 April 2024  
to 18 April 2024

Reference: 2404-0247WSC

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: United Analyst and Engineering Consultant Co.,Ltd.

81 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 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) Chilled Mirror Hygrometer	Dew Master	44730	21656	02 Aug 2024
2) Handheld Thermometer With Sensor	1521	A5A339	2311238	16 Oct 2024

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 through:-

- Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0
- Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Chakrit Waewwanjua  
Issue Date : 18 April 2024

Approved Signatory : \_\_\_\_\_  
[ ] Chakrit Waewwanjua  
[ ✓ ] Viporn Tantiyawutti  
[ ] Unnopphol Harachai

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Cert. No.: 24H754

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Humidity Measurement.

<u>Reference Temperature</u> (°C)	<u>Standard Humidity</u> (%R.H.)	<u>UUC* Reading</u> (%R.H.)	<u>Error</u> (%R.H.)	<u>Uncertainty of Measurement</u> (±%R.H.)
25.0	40.1	42	1.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	76	-4.0	1.8

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature Measurement.

<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty of Measurement</u> (±°C)
20.007	21.0	0.993	0.72
25.032	25.5	0.468	0.72
29.997	30.0	0.003	0.72
35.010	35.0	-0.010	0.72
40.019	39.5	-0.519	0.72

**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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### MULTI-POINT GAS TEST REPORT

**Test Date : Oct 17, 2024**

**Equipment :** Gas Analyzer (NO<sub>2</sub>)

**Model :** 42i

**Manufacturer :** Thermo Scientific

**Serial Number :** 1182920010

#### Standard Gas Concentration

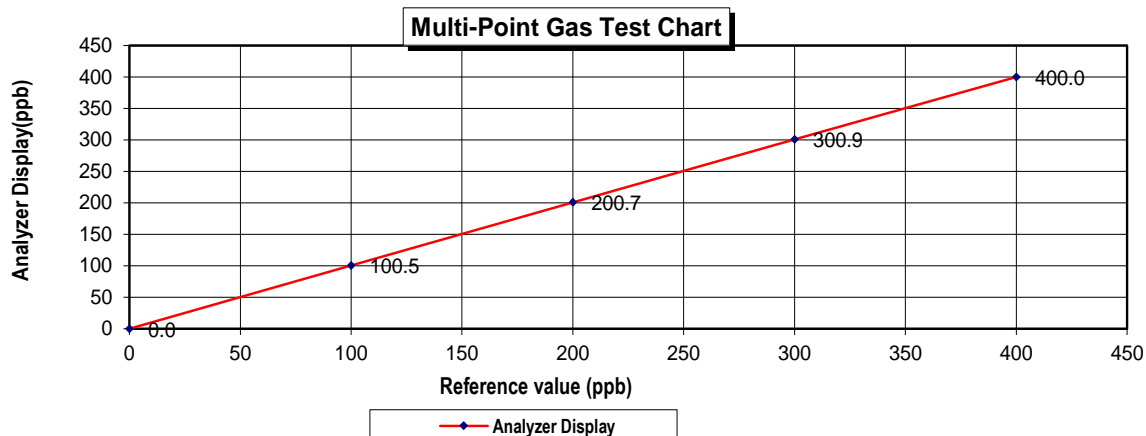
Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB0159156
Expiration Date :	Nov 6, 2026

#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.23
:Acceptable Limit $\pm 5\%$						



Calculate by

17 / 10 / 2567

Approve by

17 / Oct / 2024

### MULTI-POINT GAS TEST REPORT

**Test Date : Oct 11, 2024**

**Equipment :** Gas Analyzer (NO<sub>2</sub>)

**Model :** 42i

**Manufacturer :** Thermo Scientific

**Serial Number :** 1182920011

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB0159156
Expiration Date :	Nov 6, 2026

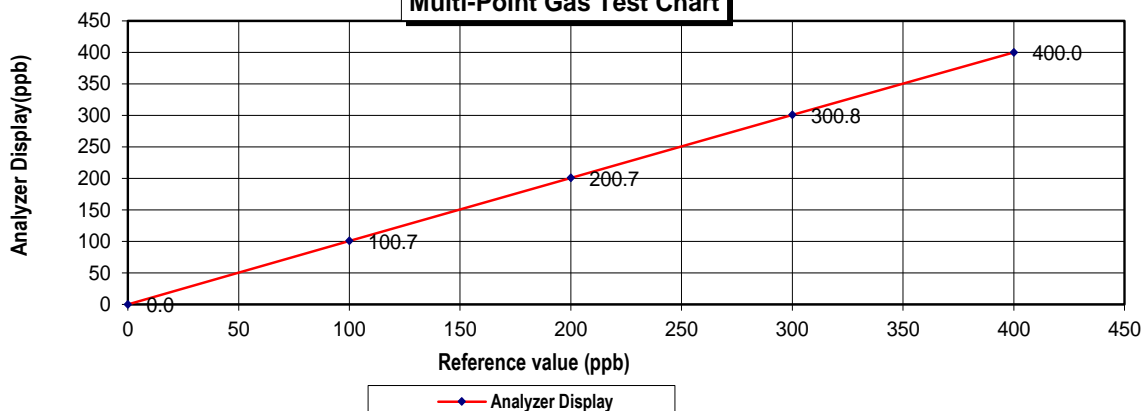
#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[ % Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70	0.70
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	300.8	0.80	0.27	0.27
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.26

**Multi-Point Gas Test Chart**



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11 / 10 / 2567

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11 / Oct / 2024

### MULTI-POINT GAS TEST REPORT

**Test Date : Oct 11, 2024**

**Equipment :** Gas Analyzer (NO<sub>2</sub>)

**Model :** 42i

**Manufacturer :** Thermo Scientific

**Serial Number :** 1191503035

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB0159156
Expiration Date :	Nov 6, 2026

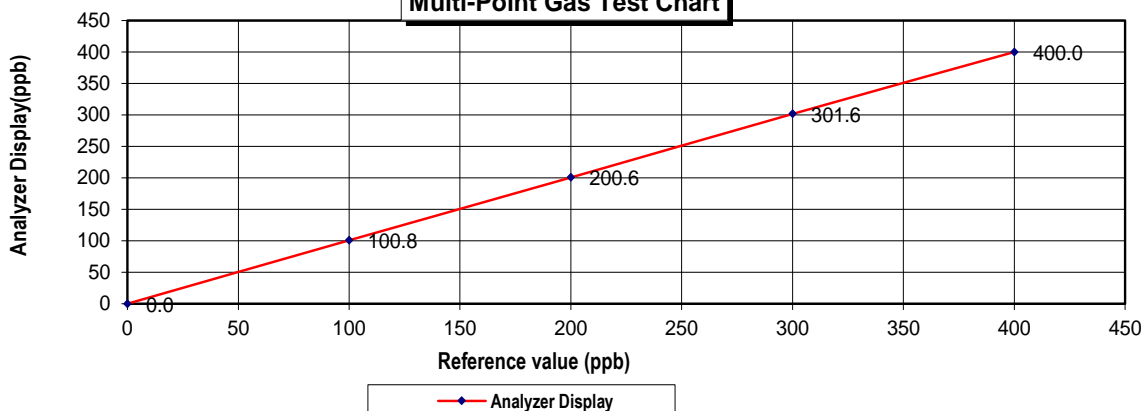
#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79	0.79
Level 3	40.00%	200.0	200.6	0.60	0.30	0.30
Level 4	60.00%	300.0	301.6	1.60	0.53	0.53
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.32

**Multi-Point Gas Test Chart**



Calculate by

*Sirchai G.*  
11 / 10 / 2567

Approve by

*P. K.*  
11 / Oct / 2024

### MULTI-POINT GAS TEST REPORT

**Test Date** : Sep 26,2024

**Equipment** : Gas Analyzer (NO<sub>2</sub>)

**Model** : 42i

**Manufacturer** : Thermo Scientific

**Serial Number** : 1191503036

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB0159156
Expiration Date :	Nov 6,2026

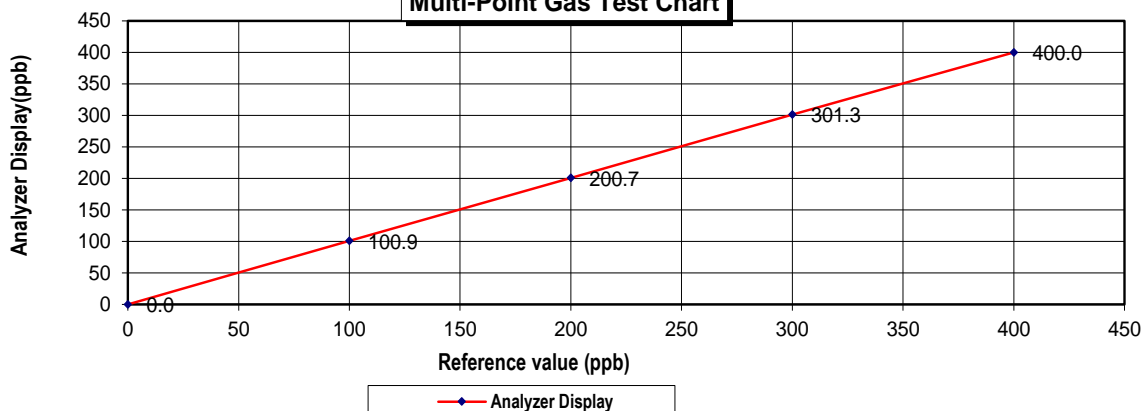
#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.9	0.90	0.89	0.89
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	301.3	1.30	0.43	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.33

Multi-Point Gas Test Chart



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26 / 9 / 2567

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26 / Sep / 2024



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)

LTD

Part Number: E05NI91E15A0014

Cylinder Number: EB0162121

Laboratory: 124 - Plumsteadville - PA

PGVP Number: A12023

Gas Code: CO,CO<sub>2</sub>,NO,NO<sub>x</sub>,SO<sub>2</sub>,BALN

Reference Number: 160-402772205-1

Cylinder Volume: 144.0 CF

Cylinder Pressure: 2016 PSIG

Valve Outlet: 660

Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

#### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	100.4 PPM	G1	+/- 0.9% NIST Traceable	06/27/2023, 07/06/2023
NITRIC OXIDE	100.0 PPM	100.2 PPM	G1	+/- 0.9% NIST Traceable	06/27/2023, 07/06/2023
SULFUR DIOXIDE	100.0 PPM	100.0 PPM	G1	+/- 1.4% NIST Traceable	06/27/2023, 07/06/2023
CARBON MONOXIDE	200.0 PPM	199.2 PPM	G1	+/- 0.3% NIST Traceable	06/26/2023
CARBON DIOXIDE	8.000 %	7.982 %	G1	+/- 1.2% NIST Traceable	06/27/2023
NITROGEN	Balance				

#### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	104202308	CC754364	98.36 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Jan 04, 2031
PRM	C2219101	APE1514048	100.19 PPM NITRIC OXIDE/NITROGEN	+/- 0.3%	Feb 28, 2025
GMIS	2023042525	CC754381	98.52 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Apr 25, 2031
PRM	12409	D913660	15.01 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Feb 17, 2023
GMIS	153400202002	EB0130037	9.693 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.6%	Sep 29, 2025
NTRM	160102-22	KAL003820	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Nov 01, 2027
CO	230601	CC745902	249.47 PPM CARBON MONOXIDE/NITROGEN	+/- 0.3%	Dec 09, 2028
NTRM	130606-02	CC411730	13.359 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 14, 2025

The SRM, NTRM, PRM, or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

#### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO <sub>2</sub>	FTIR	Jun 15, 2023
SIEMENS ULTRAMAT6E N1-C8-180	NDIR	Jun 14, 2023
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Jun 29, 2023
Nicolet iS50 FTIR AUP2010245 NO <sub>2</sub>	FTIR	Jun 15, 2023
Nicolet iS50 FTIR AUP2010245 SO <sub>2</sub>	FTIR	Jun 08, 2023

  
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### MULTI-POINT GAS TEST REPORT

**Test Date** : Sep 4, 2024

**Equipment** : Gas Analyzer (SO<sub>2</sub>)

**Model** : 43i

**Manufacturer** : Thermo SCIENTIFIC

**Serial Number** : 1182920014

#### Standard Gas Concentration

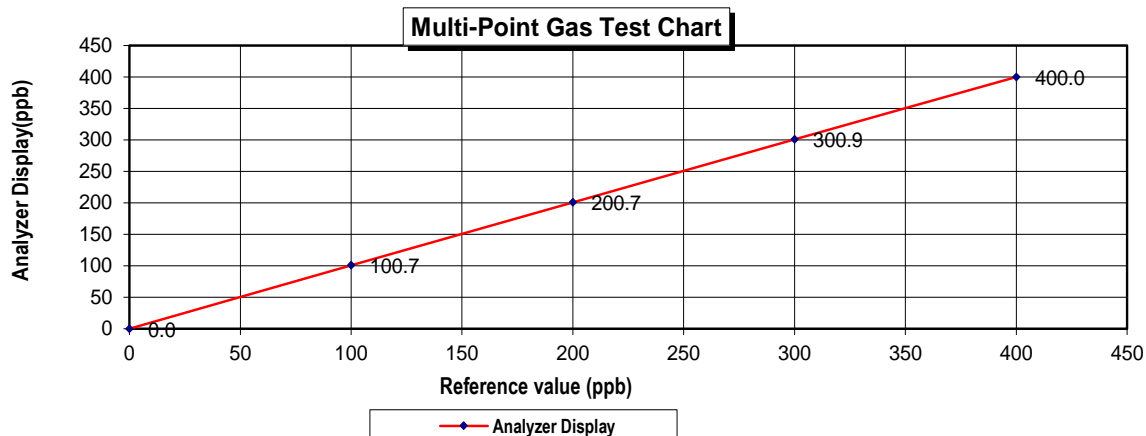
Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB01159156
Expiration Date :	Nov 06, 2026

#### Dilutor Detail

Manufacturer :	Thermo SCIENTIFIC
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70	0.70
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.27
:Acceptable Limit $\pm 5\%$						



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4 / 9 / 2567

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4 / Sep / 2024

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### MULTI-POINT GAS TEST REPORT

**Test Date** : Sep 6, 2024

**Equipment** : Gas Analyzer (SO<sub>2</sub>)

**Model** : 43i

**Manufacturer** : Thermo SCIENTIFIC

**Serial Number** : 1182920016

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB01159156
Expiration Date :	Nov 06, 2026

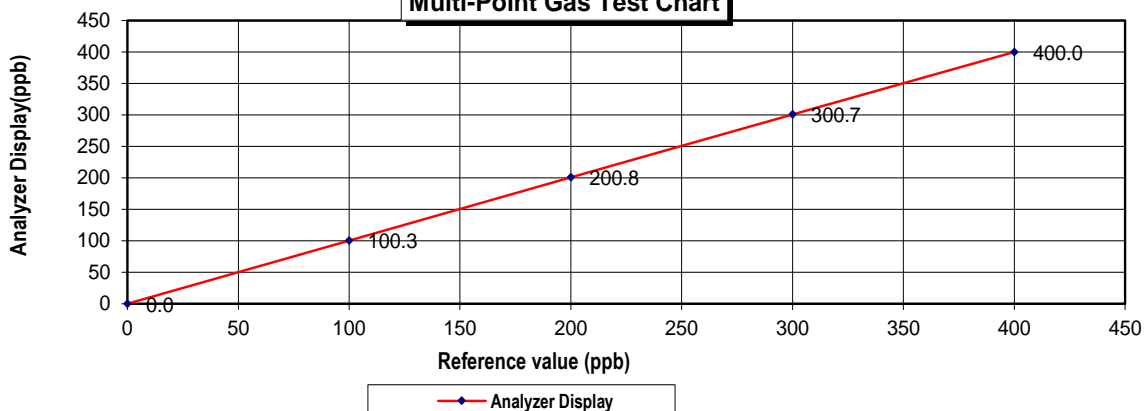
#### Dilutor Detail

Manufacturer :	Thermo SCIENTIFIC
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.3	0.30	0.30	0.30
Level 3	40.00%	200.0	200.8	0.80	0.40	0.40
Level 4	60.00%	300.0	300.7	0.70	0.23	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.19

Multi-Point Gas Test Chart



Calculate by

*Ginchan. G*

6 / 9 2567

Approve by

*Patikom*

6 / Sep / 2024

### MULTI-POINT GAS TEST REPORT

**Test Date** : Sep 4, 2024

**Equipment** : Gas Analyzer (SO<sub>2</sub>)

**Model** : 43i

**Manufacturer** : Thermo SCIENTIFIC

**Serial Number** : 1182920017

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB01159156
Expiration Date :	Nov 06, 2026

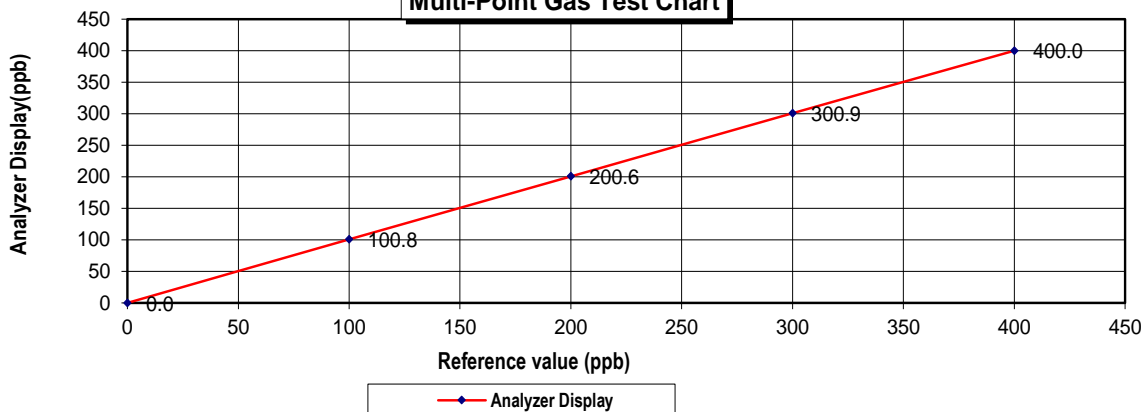
#### Dilutor Detail

Manufacturer :	Thermo SCIENTIFIC
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79	0.79
Level 3	40.00%	200.0	200.6	0.60	0.30	0.30
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb			Average Difference (%)			0.28

Multi-Point Gas Test Chart



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4 / Sep / 2024



### MULTI-POINT GAS TEST REPORT

**Test Date : Sep 4, 2024**

**Equipment :** Gas Analyzer (SO<sub>2</sub>)

**Model :** 43i

**Manufacturer :** Thermo SCIENTIFIC

**Serial Number :** 1180540065

#### Standard Gas Concentration

Sulphur Dioxide (SO <sub>2</sub> )	42.89
Nitric Oxide (NO)	46.77
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	965.9
Cylinder No. :	EB01159156
Expiration Date :	Nov 06, 2026

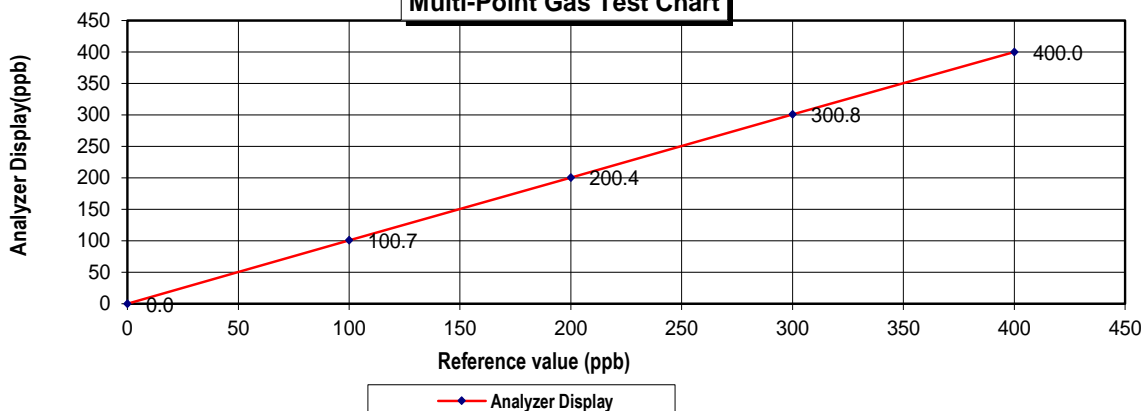
#### Dilutor Detail

Manufacturer :	Thermo SCIENTIFIC
Model :	146i
Serial Number :	1180540071

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70	0.70
Level 3	40.00%	200.0	200.4	0.40	0.20	0.20
Level 4	60.00%	300.0	300.8	0.80	0.27	0.27
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.23

**Multi-Point Gas Test Chart**



Calculate by

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.....4...../.....Sep...../.....2024.....

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)

LTD

Part Number: E05NI91E15A0014

Cylinder Number: EB0162121

Laboratory: 124 - Plumsteadville - PA

PGVP Number: A12023

Gas Code: CO,CO<sub>2</sub>,NO,NO<sub>2</sub>,SO<sub>2</sub>,BALN

Reference Number: 160-402772205-1

Cylinder Volume: 144.0 CF

Cylinder Pressure: 2016 PSIG

Valve Outlet: 660

Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

#### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	100.4 PPM	G1	+/- 0.9% NIST Traceable	06/27/2023, 07/06/2023
NITRIC OXIDE	100.0 PPM	100.2 PPM	G1	+/- 0.9% NIST Traceable	06/27/2023, 07/06/2023
SULFUR DIOXIDE	100.0 PPM	100.0 PPM	G1	+/- 1.4% NIST Traceable	06/27/2023, 07/06/2023
CARBON MONOXIDE	200.0 PPM	199.2 PPM	G1	+/- 0.3% NIST Traceable	06/26/2023
CARBON DIOXIDE	8.000 %	7.982 %	G1	+/- 1.2% NIST Traceable	06/27/2023
NITROGEN	Balance				

#### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	104202308	CC754364	98.36 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Jan 04, 2031
PRM	C2219101	APE1514048	100.19 PPM NITRIC OXIDE/NITROGEN	+/- 0.3%	Feb 28, 2025
GMIS	2023042525	CC754381	98.52 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Apr 25, 2031
PRM	12409	D913660	15.01 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Feb 17, 2023
GMIS	153400202002	EB0130037	9.693 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.6%	Sep 29, 2025
NTRM	160102-22	KAL003820	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Nov 01, 2027
CO	230601	CC745902	249.47 PPM CARBON MONOXIDE/NITROGEN	+/- 0.3%	Dec 09, 2028
NTRM	130606-02	CC411730	13.359 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 14, 2025

The SRM, NTRM, PRM, or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

#### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO <sub>2</sub>	FTIR	Jun 15, 2023
SIEMENS ULTRAMAT6E N1-C8-180	NDIR	Jun 14, 2023
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Jun 29, 2023
Nicolet iS50 FTIR AUP2010245 NO <sub>2</sub>	FTIR	Jun 15, 2023
Nicolet iS50 FTIR AUP2010245 SO <sub>2</sub>	FTIR	Jun 08, 2023

  
Approved for Release



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd  
63/14-15, 67/35-36  
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E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department.



Certificate Number

CWS-028-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : LSI Lastem  
**MODEL/TYPE** : Sensor: DNA202  
Data logger: E-LOG  
**SERIAL NUMBER** : Sensor: BQ1705626  
Data logger: 17037713  
**ID NUMBER** : -  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udumsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**RECEIVED DATE** : 02 Aug 2024  
**MEASUREMENT DATE** : 07 Aug 2024  
**ISSUE DATE** : 09 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH  
Atmospheric Pressure :  $1010 \pm 10$  hPa

**PLACE OF CALIBRATION** : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 195 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.217 [-]

**Preconditioning** : 24 hours at ambient conditions.

**Measurement Condition** : The average values during measurement are (24.5) °C, (43.0) %RH and (1009.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittrapon Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

- <sup>1</sup> Nozzle cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

เอกสารไม่ควบคุม

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



MEASUREMENT RESULTS<sup>5</sup>

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{std}$ <sup>6</sup> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{uuc}$ <sup>7</sup> (m/s)	Error (m/s)	$U$ ( $k=2$ ) (m/s)
1.101	24.08	24.75	0.91	-0.19	0.31
2.056	25.40	24.75	1.84	-0.22	0.31
3.148	24.10	24.75	2.91	-0.23	0.31
4.060	24.10	24.75	3.76	-0.30	0.31
5.10	23.80	24.75	4.91	-0.19	0.31
6.05	25.50	24.75	5.91	-0.13	0.31
6.99	23.90	24.75	6.83	-0.16	0.31
8.11	25.08	24.75	7.99	-0.12	0.31
9.12	24.10	24.75	9.06	-0.06	0.31
9.96	24.70	24.75	9.90	-0.06	0.31
11.05	24.20	24.75	11.05	0.00	0.31
12.01	24.52	24.75	11.97	-0.04	0.35
13.03	24.30	24.75	12.96	-0.07	0.31
13.99	24.44	24.75	13.96	-0.03	0.38
15.00	24.30	24.75	14.96	-0.04	0.37
16.01	24.30	24.75	16.02	0.01	0.34

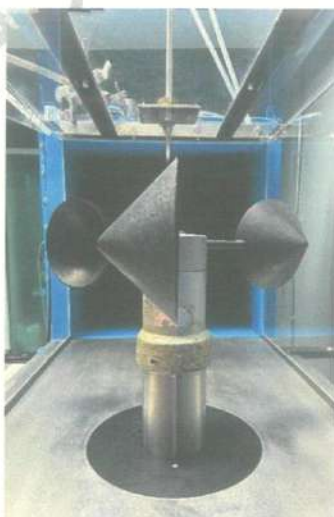
## Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Velocity of standard

<sup>7</sup> Velocity of Unit Under Calibration

## PHOTO OF CALIBRATION SET-UP



Calibration set-up of the Cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



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JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd  
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Web site: www.jiranatee.com

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

Wind direction measurement laboratory  
Calibration services department.



NSC – TISI – TIS 17025  
CALIBRATION 0367

Certificate Number

CWD-028-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : LSI Lastem  
**MODEL/TYPE** : Sensor: DNA212  
Data logger: E-LOG  
**SERIAL NUMBER** : Sensor: 19050292  
Data logger: 17037713  
**ID NUMBER** : -  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**RECEIVED DATE** : 02 Aug 2024  
**MEASUREMENT DATE** : 08 Aug 2024  
**ISSUE DATE** : 09 Aug 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH  
Atmospheric Pressure :  $1010 \pm 10$  hPa

**PLACE OF CALIBRATION** : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

**CALIBRATION CONDITION** : Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 52 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.058 [-]

**Preconditioning** : 24 hours at ambient conditions.

**Measurement Condition** : The average values during measurement are (24.3)°C, (45.1) %RH and (1005.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

- <sup>1</sup> Nozzle cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

MEASUREMENT RESULTS <sup>5</sup>

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	$D^{\circ}_{std}$	$D^{\circ}_{UUC}$	Error	$U (k=2)$
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.04	0.000	0	0	0.80
	45.000	46	1	0.80
	90.000	91	1	0.80
	135.000	136	1	0.80
	180.000	181	1	0.80
	225.000	226	1	0.80
	270.000	270	0	0.80
	315.000	315	0	0.80

## Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Direction of standard

<sup>7</sup> Direction of Unit Under Calibration

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



เอกสารไม่ควบคุม

## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING  
CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Prakanong, Bangkok 10260

Certificate No : 24-ACT-091  
Request No : Req-2024-1380

### Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1  
Manufacturer : SVANTEK Range : 94 , 114 dB / 1000 Hz  
Model : SV 36 Instrument Status : Used  
Serial Number : 107224  
ID : UAE.EFM.171/2564

### Calibration Environment and Details


Temperature : (  $23 \pm 2$  °C )  
Humidity : (  $50 \pm 20$  %RH )  
Barometric Pressure : (  $1013 \pm 10.0$  hPa )  
Received Date : 24 June 2024  
Calibration Date : 26 June 2024  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	12 June 2025
THD Multimeter	2015	1047765	NIMT	16 January 2025

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

### Note

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

Calibrated By :   
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 26 June 2024



Certificate No : 24-ACT-091

Request No : Req-2024-1380

**Sound pressure level**

**Calibration Results : Without Adjustment**

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty ( ± dB)	Acceptance limit Class 1 ( ± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	94.02	0.02	-	-	0.14	0.25	Pass
114 dB / 1000 Hz	114.05	0.05	-	-	0.13	0.25	Pass

**Frequency of Sound pressure level**

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)	Result
	Measured (Hz)	Deviated	Measured (Hz)	Deviated			
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70	Pass
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70	Pass

**Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)**

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)	Result
	Measured (%)	Measured (%)			
94 dB / 1000 Hz	0.24	-	0.40	2.5	Pass
114 dB / 1000 Hz	0.44	-	0.40	2.5	Pass

**Note :**

Function	Maximum-permitted Uncertainty of measurement
Sound pressure level	0.15 dB
Frequency	0.20%
Total distortion+noise	0.50%

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction



Certificate No : 24-ACT-091

Request No : Req-2024-1380

### Decision Rule for Statements of Conformity

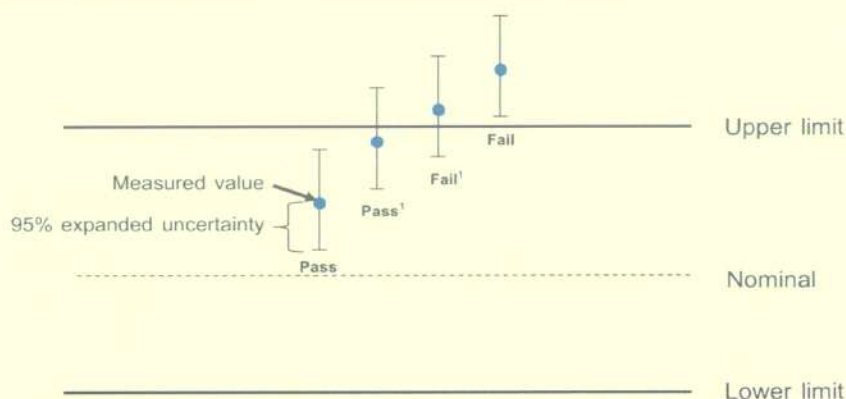
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration



**ELECTRICAL AND ELECTRONICS INSTITUTE  
FOUNDATION FOR INDUSTRIAL DEVELOPMENT**

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Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280

Tel: +66 2709 4860 Fax: +66 2324 0917



Certificate No.: CP20240287EA  
Operation No.: CP2024070250

## Certificate of Calibration

**Equipment:** Sound Level Meter

**Manufacturer:** Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

**Model/Type:** LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

**Serial No.:** 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)

**ID No.:** UAE.EFM.041/2566

**Customer:** United Analyst and Engineering Consultant Co.,Ltd.

**Address:** 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak  
Phrakhanong, Bangkok 10260

**Received Date:** 25 July 2024

**Calibrated Date:** 2 - 5 August 2024

**Issued Date:** 7 August 2024

**Calibrated by:** Ms. Juntaporn Kunhakom

Approved by: \_\_\_\_\_

( Mr. Sittichai Swaksuriyawong )  
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor ( $k$ ) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20240287EA

## Calibration Report

**Equipment:** Sound Level Meter  
**Manufacturer:** Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)  
**Model/Type:** LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)  
**Serial No.:** 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)  
**ID No.:** UAE.EFM.041/2566  
**Ambient Temperature:** ( 23 ± 2 ) °C  
**Relative Humidity:** ( 50 ± 15 ) %  
**Pressure:** (101.3 ± 1.5) kPa  
**Method of Calibration :-**  
 IEC 61672-3:2013.

### Condition of this result of calibration

1. Reference standards instrument :-

	<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1)	Standard microphone	4180	2787490	AA-1012-23	12 November 2024
2)	Arbitrary Function Generator	AFG2021	C010063	CK20240048EA	23 June 2025
3)	Programmable Attenuator	PA5	2755	EF-0040-23	1 October 2024
4)	6.5 Digit precision multimeter	8846A	9610014	CB20230200EA	15 November 2024
5)	Pressure humidity and Temperature Transmitter	PTU301	L3950483	CL1-P240023 CD20240142EA	24 March 2025 12 June 2025
6)	Pressure humidity and Temperature Transmitter	PTU301	L3950484	CL1-P240030 CD20240143EA	11 April 2025 12 June 2025
7)	Performance Audio Analyzer	U8903B	MY56510003	CB20240035EB CK20230072EA	13 February 2025 13 September 2024

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

3. This certification is traceable to the international system of unit maintained at :-

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

### Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
-	-	-	-

Certificate No.: CP20240287EA

## Calibration Report

Function : 2. Self-generated Noise

### 2.1 Microphone Installed

Measured value (dB)
30.5

### 2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	29.5
C-weighting	29.5
Z-weighting	35.5

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.4	0.3	0.4	±1.0
1000	0.1	0.1	0.1	±0.7
8000	-1.6	-1.6	-1.6	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	0.0	0.0	0.0	±1.0
125	0.0	0.0	-0.1	±1.0
250	0.0	0.0	-0.1	±1.0
500	0.0	0.0	-0.1	±1.0
1000	0.0	0.0	0.0	±0.7
2000	0.0	0.0	-0.1	±1.0
4000	0.0	0.0	-0.1	±1.0
8000	-0.1	-0.1	0.0	+1.5; -2.5
16000	0.0	0.0	-0.1	+2.5; -16.0



Certificate No.: CP20240287EA

### Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

#### 5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

#### 5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.1

Function : 7. Level Linearity on the reference level range

#### 7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
99.0	99.0	0.0	±0.8
104.0	104.0	0.0	±0.8
109.0	109.0	0.0	±0.8
114.0	114.0	0.0	±0.8
119.0	119.0	0.0	±0.8
124.0	124.0	0.0	±0.8
129.0	129.0	0.0	±0.8
134.0	134.0	0.0	±0.8
139.0	139.0	0.0	±0.8
140.0	140.0	0.0	±0.8

Certificate No.: CP20240287EA

### Calibration Report

#### 7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.1	0.1	±0.8
39.0	39.4	0.4	±0.8

#### Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	136.0	0.0	±0.5
	2	118.9	-0.1	+1.0 ; -1.5
	0.25	109.8	-0.2	+1.0 ; -3.0
Slow	200	129.5	-0.1	±0.5
	2	109.9	-0.1	+1.0 ; -3.0
	0.25	101.0	0.0	+1.0 ; -3.0
LAE	200	130.0	0.0	±0.5
	2	110.1	0.1	+1.0 ; -1.5
	0.25	101.0	0.0	+1.0 ; -3.0

#### Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	135.4	134.8	-0.6	±2.0
Positive half cycle	134.4	134.0	-0.4	±1.0
Negative half cycle	134.4	134.0	-0.4	±1.0

Certificate No.: CP20240287EA

### Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
144.3	144.2	-0.1	±1.5

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	139.0	139.0	0.0	±0.1

### Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

- Remarks:
1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
  2. The acceptance limit is for the deviated value.
  3. Acceptance limits was IEC61672-3:2013 Class 1.
  4. The coverage factor  $k = 2.00$

-- End of Report --

เอกสารไม่ควบคุม



**ELECTRICAL AND ELECTRONICS INSTITUTE  
FOUNDATION FOR INDUSTRIAL DEVELOPMENT**

975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37,

Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280

Tel: +66 2709 4860 Fax: +66 2324 0917



Certificate No.: CP20240289EA  
Operation No.: CP2024070252

## Certificate of Calibration

**Equipment:** Sound Level Meter

**Manufacturer:** Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

**Model/Type:** LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

**Serial No.:** 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)

**ID No.:** UAE.EFM.042/2566

**Customer:** United Analyst and Engineering Consultant Co.,Ltd.

**Address:** 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak  
Phrakhanong, Bangkok 10260

**Received Date:** 25 July 2024

**Calibrated Date:** 5 - 6 August 2024

**Issued Date:** 7 August 2024

**Calibrated by:** Ms. Juntaporn Kunhakom

Approved by: \_\_\_\_\_

( Mr. Sittichai Swaksuriyawong )  
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor ( $k$ ) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.



Certificate No.: CP20240289EA

### Calibration Report

**Equipment:** Sound Level Meter  
**Manufacturer:** Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)  
**Model/Type:** LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)  
**Serial No.:** 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)  
**ID No.:** UAE.EFM.042/2566  
**Ambient Temperature:** ( 23 ± 2 ) °C  
**Relative Humidity:** ( 50 ± 15 ) %  
**Pressure:** (101.3 ± 1.5) kPa  
**Method of Calibration :-**  
IEC 61672-3:2013.

#### Condition of this result of calibration

1. Reference standards instrument :-

	<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1)	Standard microphone	4180	2787490	AA-1012-23	12 November 2024
2)	Arbitrary Function Generator	AFG2021	C010063	CK20240048EA	23 June 2025
3)	Programmable Attenuator	PA5	2755	EF-0040-23	1 October 2024
4)	6.5 Digit precision multimeter	8846A	9610014	CB20230200EA	15 November 2024
5)	Pressure humidity and Temperature Transmitter	PTU301	L3950483	CL1-P240023 CD20240142EA	24 March 2025 12 June 2025
6)	Pressure humidity and Temperature Transmitter	PTU301	L3950484	CL1-P240030 CD20240143EA	11 April 2025 12 June 2025
7)	Performance Audio Analyzer	U8903B	MY56510003	CB20240035EB CK20230072EA	13 February 2025 13 September 2024

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

3. This certification is traceable to the international system of unit maintained at :-

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

#### Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
-	-	-	-

Certificate No.: CP20240289EA

## Calibration Report

Function : 2. Self-generated Noise

### 2.1 Microphone Installed

Measured value (dB)
30.3

### 2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	30.1
C-weighting	30.0
Z-weighting	35.7

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.3	0.2	0.3	±1.0
1000	0.2	0.2	0.2	±0.7
8000	-0.2	-0.1	-0.1	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	-0.1	0.1	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±0.7
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	-0.1	0.0	0.0	+1.5; -2.5
16000	0.0	0.0	-0.1	+2.5; -16.0

Certificate No.: CP20240289EA

### Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

#### 5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

#### 5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.1

Function : 7. Level Linearity on the reference level range

#### 7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
99.0	99.0	0.0	±0.8
104.0	104.0	0.0	±0.8
109.0	109.0	0.0	±0.8
114.0	114.0	0.0	±0.8
119.0	119.0	0.0	±0.8
124.0	124.0	0.0	±0.8
129.0	129.0	0.0	±0.8
134.0	134.0	0.0	±0.8
139.0	139.0	0.0	±0.8
140.0	140.0	0.0	±0.8
141.0	141.0	0.0	±0.8

Certificate No.: CP20240289EA

### Calibration Report

#### 7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.1	0.1	±0.8
39.0	39.4	0.4	±0.8

#### Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	135.9	-0.1	±0.5
	2	118.8	-0.2	+1.0 ; -1.5
	0.25	109.8	-0.2	+1.0 ; -3.0
Slow	200	129.5	-0.1	±0.5
	2	109.9	-0.1	+1.0 ; -3.0
	0.25	100.9	-0.1	+1.0 ; -3.0
LAE	200	130.0	0.0	±0.5
	2	110.0	0.0	+1.0 ; -1.5
	0.25	100.9	-0.1	+1.0 ; -3.0

#### Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	135.4	134.8	-0.6	±2.0
Positive half cycle	134.4	134.0	-0.4	±1.0
Negative half cycle	134.4	134.0	-0.4	±1.0



Certificate No.: CP20240289EA

### Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
144.3	144.2	-0.1	±1.5

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	139.0	139.0	0.0	±0.1

### Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks:

1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
2. The acceptance limit is for the deviated value.
3. Acceptance limits was IEC61672-3:2013 Class 1.
4. The coverage factor  $k = 2.00$

-- End of Report --

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



## Certificate of Calibration

Cert.No.: 24CH1422

Page.: 1 of 3

**Equipment :** pH Meter  
**Manufacturer :** EcoSense  
**Model :** pH100A  
**Serial No. :** 24H005160JEN  
**ID No. :** UAE.EFM.042/2567(EFM.pH.05/67)  
**Condition As-Received:** Used Item  
**Received Date :** 13 November 2024  
**Calibration Date :** 14-15 November 2024  
**Reference :** 2411-0421WSC-5  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
  
**Ambient Temperature :** (25 ± 2.5) °C  
**Relative Humidity :** (50 ± 15) %  
**Calibration Procedure :** In - house method :  
- CP-CH5 by direct measurement with DC voltage  
standard and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with temperature standard  
  
**Calibrated by :** Warakorn Lerngagtrakul  
  
**Approved by :** \_\_\_\_\_  
Approved Signatory  
  
( ) Unnopphol Harachai  
( ) Ponpan Paipim  
(✓) Saithip Meangmai  
  
**Issue Date :** 20 November 2024

**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.

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Cert.No.: 24CH1422

Page.: 2 of 3

**Condition of this calibration result**

1. Reference Standard Instrument

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1)Document Process Calibrator	54030049	130RC116	24E2759	25 Aug 2025
2)Ref. Standard Thermometer	4982054	110RC044	24I757	14 Jul 2025

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,  
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00  
: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	1034203	27 Sep 2026
pH 6.999	Hach Lenge GmbH	C03145	28 Feb 2026
pH 10.010	CPA chem	1034205	27 Sep 2025

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

**Calibration Results**

**Function : mV Measurement**

**Performing standard curve by Document Process Calibrator at pH (4,7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 24H005160JEN	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

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Cert.No.: 24CH1422

Page.: 3 of 3

### Calibration Results

#### Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7)(7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: 240904SIA605377	4.008	4.01	173	0.0071	2.00
	6.999	7.00	0	0.0092	2.00
	6.999	7.00	0	0.0085	2.00
	10.010	10.01	-173	0.0085	2.00

#### Function : Temperature Measurement

##### (\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : -

- Serial No. : 240904SIA605377

Dimension of probe

- Length : 110 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor $k$
15.0	15.002	15.1	0.098	0.13	2.00
30.0	30.002	30.0	-0.002	0.13	2.00
45.0	45.003	44.8	-0.203	0.13	2.00

**Remark** - UUC\* = Unit Under Calibration

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

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## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok  
10260

Certificate No : 24-AFM-156

Request No : Req-2024-1575

### Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : TSI Accuracy : 2% of Reading  
Model : 4146 Sensor Model : -  
Serial Number : 41462327002 Sensor Serial Number : -  
ID : UAE.EFM.125/2566 Instrument Status : Used  
Location of Calibration : LAB 4 AIR VELOCITY METER

### Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 15 July 2024  
Calibration Date : 19 August 2024  
Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceble	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	2 August 2025
Temperature meter	GT 11	08000057	Qreborn	1 March 2025
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

### Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

### Note :

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

Calibration By : me  
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By : ป. 57  
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 27 August 2024

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Certificate No : 24-AFM-156

Request No : Req-2024-1575

**Result of Calibration : Without Adjustment**

Temperature (°C)	Pressure (kPa)	STD (l/min)	UUC (l/min)	Error (l/min)	Uncertainty (l/min)	MPE (l/min)	Result
21.50	100.55	0.020	0.021	0.001	0.0013	0.005	N/A
21.30	100.53	0.050	0.052	0.002	0.0033	0.005	N/A
21.40	100.56	0.099	0.101	0.002	0.0028	0.005	N/A
21.30	100.58	0.200	0.204	0.004	0.0056	0.005	N/A
21.50	100.54	0.500	0.505	0.005	0.007	0.010	N/A
21.60	100.52	1.000	1.019	0.019	0.014	0.020	N/A
21.40	100.58	1.698	1.731	0.033	0.024	0.034	N/A
21.70	100.63	1.999	2.037	0.038	0.029	0.040	N/A
21.60	100.64	2.998	3.057	0.059	0.043	0.060	N/A
22.00	100.80	4.002	4.079	0.077	0.056	0.080	N/A
22.30	100.96	5.001	5.094	0.093	0.072	0.100	N/A

**Note**                      STD : Standard                      UUC : Unit Under Calibration  
 - UUC Reference Condition : 21.1 °C, 101.3 kPa, Air  
 - Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where    Q = Flow Rate                      P = Absolute Pressure                      T = Absolute Temperature  
           Meas = Measurement Condition                      ref = Standard Condition

\* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available, Customer does not require a statement of conformity.

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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.

Certificate No : 24-AFM-156

Request No : Req-2024-1575

### Decision Rule for Statements of Conformity

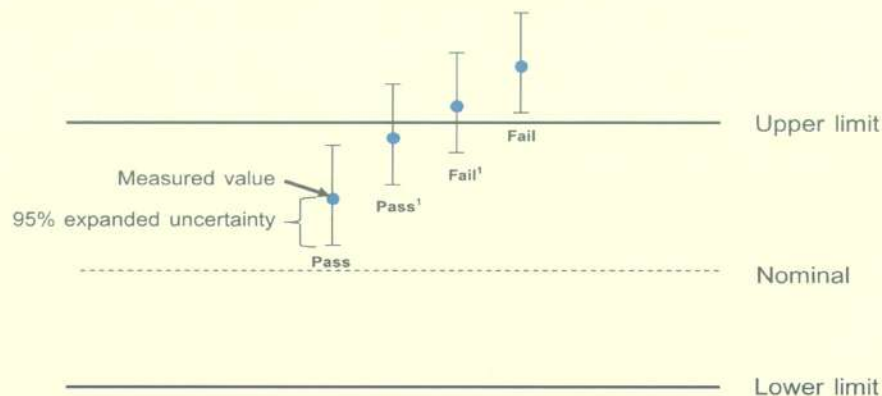
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

**เอกสารไม่ควบคุม**





## Certificate of Calibration

Certificate No. : 24P1370

Page : 1 of 2

**Equipment :** Aneroid Barometer  
**Manufacturer:** Barigo  
**Model :** 111MS  
**Serial No.:** -  
**ID No.:** UAE.EMA2.065/2552

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Corporate Services 3: Equipment Calibration and Testing Services.

**Condition As-Received:** Used Item

**Received Date:** 05 April 2024

**Calibration Date:** 22 April 2024

**Reference:** 2404-0243WSC

**Submitted by:** United Analyst and Engineering Consultant Co.,Ltd.

**Ambient Temperature:** ( 23 ± 2 ) °C

**Relative Humidity:** ( 50 ± 15 ) %

**Atmospheric Pressure:** 1007 mbar

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**Procedure used:** The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

### 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 Barometer	DPI142	1422505046	MP-0094-23	03 May 2024

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

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

8.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

**Calibrated by :** Suksan Khankaew  
**Issue Date :** 23 April 2024

**Approved Signatory :** \_\_\_\_\_  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
[✓] Attapol Panurach

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Cert.No.: 24P1370

Page: 2 of 2

**Result of calibration:- Without adjustment**

**Range :** 720 mmHg to 770 mmHg

**Function:- Absolute Pressure Measurement**

**Scale Interval :** 1 mmHg ( The Fifth Estimate )

**Increasing Pressure**

Applied Pressure (mmHg)	715.75	726.88	738.53	749.84	761.99	774.19
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0
Error (mmHg)	4.25	3.12	1.47	0.16	-1.99	-4.19

**Decreasing Pressure**

Applied Pressure (mmHg)	774.19	761.85	749.40	738.00	726.53	715.75
UUC* Indication (mmHg)	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-4.19	-1.85	0.60	2.00	3.47	4.25

The uncertainty of measurement was  $\pm 0.24$  mmHg

\* UUC = Unit Under Calibration

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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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. : 24H1486

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer  
Manufacturer: Digicon  
Model : TH-02A  
Serial No.: 435031147  
ID No.: UAE.EFM.005/2567  
Condition As-Received: New Item  
Received Date: 10 July 2024  
Calibration Date: 15 July 2024  
to 17 July 2024  
Reference: 2407-0393WSC  
Ambient Temperature: ( 25 ± 3 ) °C  
Relative Humidity: ( 50 ± 20 ) %

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

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

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) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	21819	25 Sep 2024
2) Handheld Thermometer With Sensor	1523	5717096	2311321	08 Nov 2024

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 through:-

-Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Surasit Phansudnoi  
Issue Date : 17 July 2024

Approved Signatory :

Viporn

[ ] Chakrit Waewwanjua

[✓] Viporn Tantiyawutti

[ ] Unnopphol Harachai

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Cert. No.: 24H1486

Page.: 2 of 2

**Result of Calibration:-** Without Adjustment

**Function:** Humidity Measurement.

<u>Reference</u> <u>Temperature</u> (°C)	<u>Standard</u> <u>Humidity</u> (%R.H.)	<u>UUC*</u> <u>Reading</u> (%R.H.)	<u>Error</u> (%R.H.)	<u>Uncertainty</u> <u>of Measurement</u> (±%R.H.)
25.0	40.1	39	-1.1	1.4
25.0	50.1	48	-2.1	1.6
25.0	60.0	58	-2.0	1.6
25.0	70.2	69	-1.2	1.6

**Result of Calibration:-** Without Adjustment

**Function:** Temperature Measurement.

<u>Standard</u> <u>Temperature</u> (°C)	<u>UUC*</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> <u>of Measurement</u> (±°C)
20.014	20.3	0.286	0.42
24.984	25.2	0.216	0.42
30.050	30.2	0.150	0.42
40.027	40.1	0.073	0.42

**UUC\*** : Unit Under Calibration

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

-o0o-

เอกสารไม่ควบคุม





Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok  
10260

Certificate No : 24-TPM-313  
Request No : Req-2024-1485  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : TSI QUEST  
Model : QT-34  
Serial Number : TEX040015  
Resolution : 0.1 °C  
ID Number : UAE.EFM.119/2566  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 3 July 2024  
Calibrated Date : 9 July 2024  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM  
Which was calibrated on 1 March 2024, Calibration Certificate No. : QR24-0478

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By :

Mr. Noppadon Luangart  
Technical Manager

Issue Date :

10 July 2024

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Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 24-TPM-313

Request No : Req-2024-1485

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	20.032	20.0	0.0	0.13
	25.032	25.0	0.0	0.13
	30.031	30.1	- 0.1	0.13
	35.037	35.1	- 0.1	0.13
	40.040	40.2	- 0.2	0.13
	45.038	45.1	- 0.1	0.13
	50.042	50.2	- 0.2	0.13
	60.045	60.3	- 0.3	0.13
DRY	20.033	20.0	0.0	0.13
	25.030	25.0	0.0	0.13
	30.033	30.1	- 0.1	0.13
	35.034	35.1	- 0.1	0.13
	40.039	40.2	- 0.2	0.13
	45.038	45.1	- 0.1	0.13
	50.042	50.2	- 0.2	0.13
	60.046	60.3	- 0.3	0.13
GLOBE	20.033	19.9	+ 0.1	0.13
	25.030	25.1	- 0.1	0.13
	30.033	30.0	0.0	0.13
	35.035	35.0	0.0	0.13
	40.038	40.1	- 0.1	0.13
	45.041	45.1	- 0.1	0.13
	50.040	50.1	- 0.1	0.13
	60.045	60.1	- 0.1	0.13

End of Certificate

Calibrated By :

Mr. Sittichok Jirapukdeesakul

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Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok  
10260

Certificate No : 24-TPM-315

Request No : Req-2024-1482

Page : 1/2

Unit Under Calibration Details

Calibration Parameter	: Temperature	Range Calibration	: 20 °C to 60 °C
Instrument Name	: Thermal Environment Monitor	Type of Sensor	: RTD
Manufacturer	: TSI QUEST	Sensor Diameter (mm)	: 4.5
Model	: QT-34	Calibration Position (mm)	: 67.5
Serial Number	: TEX040016	Instrument Status	: Used
Resolution	: 0.1 °C		
ID Number	: UAE.EFM.120/2566		

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 3 July 2024  
Calibrated Date : 9 July 2024  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM  
Which was calibrated on 1 March 2024, Calibration Certificate No. : QR24-0478

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By :

Mr. Noppadon Luangart

Technical Manager

Issue Date :

10 July 2024

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## Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 24-TPM-315

Request No : Req-2024-1482

Page : 2/2

## Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	20.032	19.9	+ 0.1	0.13
	25.032	25.0	0.0	0.13
	30.031	30.1	- 0.1	0.13
	35.037	35.0	0.0	0.13
	40.040	40.0	0.0	0.13
	45.038	45.1	- 0.1	0.13
	50.042	50.1	- 0.1	0.13
	60.045	60.0	0.0	0.13
DRY	20.033	20.0	0.0	0.13
	25.030	25.1	- 0.1	0.13
	30.033	30.1	- 0.1	0.13
	35.034	35.1	- 0.1	0.13
	40.039	40.2	- 0.2	0.13
	45.038	45.2	- 0.2	0.13
	50.042	50.2	- 0.2	0.13
	60.046	60.2	- 0.2	0.13
GLOBE	20.033	19.9	+ 0.1	0.13
	25.030	25.0	0.0	0.13
	30.033	30.1	- 0.1	0.13
	35.035	35.1	- 0.1	0.13
	40.038	40.2	- 0.2	0.13
	45.041	45.3	- 0.3	0.13
	50.040	50.2	- 0.2	0.13
	60.045	60.3	- 0.3	0.13

End of Certificate

Calibrated By :



Mr. Sittichok Jirapukdeesakul

เอกสารไม่ควบคุม



## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING  
CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Prakanong, Bangkok 10260

Certificate No : 24-ACT-120

Request No : Req-2024-1896

### Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 2  
Manufacturer : LARSON DAVIS Range : 94 , 114 dB / 1000 Hz  
Model : CAL150 Instrument Status : Used  
Serial Number : 6307  
ID : UAE.EFM.049/2563

### Calibration Environment and Details


Temperature : (  $23 \pm 2$  °C )  
Humidity : (  $50 \pm 20$  %RH )  
Barometric Pressure : (  $1013 \pm 10.0$  hPa )  
Received Date : 26 August 2024  
Calibration Date : 10 September 2024  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	12 June 2025
THD Multimeter	2015	1047765	NIMT	16 January 2025

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

### Note

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

Calibrated By :   
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 10 September 2024



Certificate No : 24-ACT-120

Request No : Req-2024-1896

**Sound pressure level**

**Calibration Results : Without Adjustment**

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty ( ± dB)	Acceptance limit Class 2 ( ± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	93.96	-0.04	-	-	0.13	0.40	Pass
114 dB / 1000 Hz	114.04	0.04	-	-	0.13	0.40	Pass

**Frequency of Sound pressure level**

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 2 ( ± %)	Result
	Measured (Hz)	Deviated	Measured (Hz)	Deviated			
94 dB / 1000 Hz	999.14	0.09	-	-	0.01	1.7	Pass
114 dB / 1000 Hz	999.11	0.09	-	-	0.01	1.7	Pass

**Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)**

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty ( ± %)	Acceptance limit Class 2 ( ± %)	Result
	Measured (%)	Measured (%)			
94 dB / 1000 Hz	0.12	-	0.40	3.0	Pass
114 dB / 1000 Hz	0.23	-	0.40	3.0	Pass

**Note :**

Function	Maximum-permitted Uncertainty of measurement
Sound pressure level	0.35 dB
Frequency	0.20%
Total distortion+noise	1.00%

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

Certificate No : 24-ACT-120

Request No : Req-2024-1896

### Decision Rule for Statements of Conformity

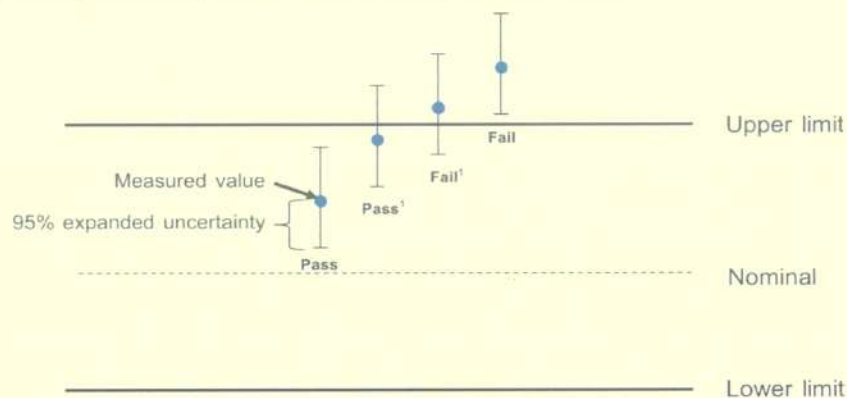
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration

## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok  
10260

Certificate No : 24-SLM-205  
Request No : Req-2024-1371

### Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : RION  
Model : NL-42  
Serial Number : 00558037  
ID : UAE.EFM.036/2558  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : UC-52  
Microphone S/N : 200032  
Preamplifier Model : NH-24  
Preamplifier S/N : 47892  
Instrument Status : Used

### Calibration Environment and Details


Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$   
Humidity :  $50\% \text{RH} \pm 20\% \text{RH}$   
Barometric Pressure :  $1013 \text{ hPa} \pm 10 \text{ hPa}$   
Received Date : 20 June 2024  
Calibrated Date : 25 June 2024  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic


### Reference Standard

Instrument	Brand	Model	SN.	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	20 August 2024	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	26 July 2024	TSI
Audio Generator	SvanteK	Svan401	131	8 October 2024	WK Electric

### Note

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

Calibrated By :   
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 25 June 2024

**เอกสารไม่ควบคุม**

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

Certificate No : 24-SLM-205

Request No : Req-2024-1371

### 1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY	Acceptance	Result
FAST / A / 30-130	Level	UUC	ERR	UUC	ERR	( ± dB)	Limit	
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)		( ± dB)	
1000 Hz 114 dB	114.22	114.0	-0.22	114.2	-0.02	0.20	0.30	Pass

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35, SN. 44783

### 2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	( ± dB)
A	15.5	0.10

### 3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	( ± dB)
A	12.3	0.10
C	16.4	0.10
Z	19.7	0.10

### 4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Respose curve			UNCERTAINTY	Acceptance	Result
FAST / 30-130	A	C	Z	( ± dB)	Limit	
STD Setting	(dB)	(dB)	(dB)		( ± dB)	
125 Hz	0.0	0.1	0.1	0.60	1.5	Pass
1000 Hz	0.0	0.0	0.0	0.60	1.0	Pass
4000 Hz	1.7	1.7	1.7	0.60	3.0	Pass
8000 Hz	-1.3	-1.1	-1.3	0.70	5.0	Pass

**เอกสารไม่ควบคุม**

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



Certificate No : 24-SLM-205

Request No : Req-2024-1371

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency			UNCERTAINTY	Acceptance	Result
FAST / 30-130	Weighting Responce curve				Limit	
STD Setting	A (dB)	C (dB)	Z (dB)	( ± dB)	( ± dB)	
63 Hz	-0.2	-0.1	0.0	0.20	2.0	Pass
125 Hz	-0.1	0.0	0.0		1.5	Pass
250 Hz	-0.1	0.0	0.0		1.5	Pass
500 Hz	0.0	0.0	0.0		1.5	Pass
1000 Hz	0.0	0.0	0.0		1.0	Pass
2000 Hz	0.0	0.0	0.0		2.0	Pass
4000 Hz	0.0	0.0	0.0		3.0	Pass
8000 Hz	0.1	0.1	0.0		5.0	Pass
16000 Hz	-1.3	-1.4	0.0		+5, -INF.	Pass

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / 30-130	REF	UUC	ERR			
UUC Weighting	(dB)	(dB)	(dB)	0.20	0.20	Pass
A	114.00	114.0	0.0			
C	114.00	114.0	0.0			
Z	114.00	114.0	0.0			

UUC Setting	STD	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
30-130 / A	REF	UUC	ERR			
UUC Time Respone	(dB)	(dB)	(dB)	0.20	0.10	Pass1
Fast	114.00	114.0	0.0			
Slow	114.00	114.0	0.0			
Leq	114.00	114.0	0.0			

เอกสารไม่ควบคุม

Certificate No : 24-SLM-205

Request No : Req-2024-1371

## 7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY  ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / A / 30-130	UUC			
STD Setting	(dB)			
Initial	114.0			
Final	114.0			
Deviated	0.0	0.10	0.30	Pass

## 8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY  ( ± dB)	Acceptance	Result
FAST / A / 30-130	REF	UUC	ERR		Limit	
STD dB	(dB)	(dB)	(dB)		( ± dB)	
138.00	138	137.9	-0.1	0.30	1.1	Pass
134.00	134	134.0	0.0		1.1	Pass
129.00	129	128.9	-0.1		1.1	Pass
124.00	124	124.0	0.0		1.1	Pass
119.00	119	119.0	0.0		1.1	Pass
114.00	114	114.0	0.0		1.1	Pass
109.00	109	109.0	0.0		1.1	Pass
104.00	104	104.0	0.0		1.1	Pass
99.00	99	99.0	0.0		1.1	Pass
94.00	94	94.0	0.0		1.1	Pass
89.00	89	89.0	0.0		1.1	Pass
84.00	84	84.0	0.0		1.1	Pass
79.00	79	79.0	0.0		1.1	Pass
74.00	74	74.0	0.0		1.1	Pass
69.00	69	69.0	0.0		1.1	Pass
64.00	64	64.0	0.0		1.1	Pass
59.00	59	59.0	0.0		1.1	Pass
54.00	54	54.0	0.0		1.1	Pass
49.00	49	49.0	0.0		1.1	Pass
44.00	44	44.0	0.0		1.1	Pass
39.00	39	39.0	0.0		1.1	Pass
34.00	34	34.0	0.0		1.1	Pass
29.00	29	29.0	0.0		1.1	Pass
24.00	24	24.0	0.0		1.1	Pass

**เอกสารไม่ควบคุม**

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

Certificate No : 24-SLM-205

Request No : Req-2024-1371

### 9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance	Result
FAST / A	REF	UUC	ERR	( ± dB)	Limit	
UUC Range	(dB)	(dB)	(dB)		( ± dB)	
30-130	29.60	29.8	0.2	0.30	1.1	Pass
	114	114.0	0.0		1.1	Pass

### 10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance	Result
A / 30-130	Toneburst	Ref	UUC	ERR	( ± dB)	Limit	
UUC Time Response	(ms)	(dB)	(dB)	(dB)		( ± dB)	
Fast	200	126.0	126.0	0.0	0.20	1.0	Pass
	2	109.0	109.0	0.0		+1.0, -2.5	Pass
	0.25	100.0	99.9	-0.1		+1.5, -5.0	Pass
Slow	200	119.6	119.6	0.0		1.0	Pass
	2	100.0	100.0	0.0		+1.0, -5.0	Pass
SEL	200	120.0	120.0	0.0		1.0	Pass
	2	100.0	100.0	0.0		+1.0, -2.5	Pass
	0.25	91.0	90.9	-0.1		+1.5, -5.0	Pass

### 11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance	Result
FAST / C / 55-141	REF	UUC	ERR	( ± dB)	Limit	
STD Setting	(dB)	(dB)	(dB)		( ± dB)	
Complete cycle	136.4	136.4	0.00	0.20	3.0	Pass
Positive half cycle	135.4	135.2	-0.20		2.0	Pass
Negative half cycle	135.4	135.2	-0.20		2.0	Pass

**เอกสารไม่ควบคุม**

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



Certificate No : 24-SLM-205

Request No : Req-2024-1371

## 12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance	Result
FAST / A / 30-130	UUC		Limit	
STD Setting	(dB)	( ± dB)	( ± dB)	
Positive one-half cycle	139.5			
Negative one-half cycle	139.3			
Deviated	0.2	0.20	1.5	Pass

## 13. High Level Stability

2.1 High Level Stability				
UUC Setting	Measured	UNCERTAINTY	Acceptance	Result
FAST / A / 30-130	UUC		Limit	
STD Setting	(dB)	( ± dB)	( ± dB)	
Initial	129.0			
Final	129.0			
Deviated	0.0	0.10	0.30	Pass

### Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

- Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

**เอกสารไม่ควบคุม**

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



Certificate No : 24-SLM-205

Request No : Req-2024-1371

#### Decision Rule for Statements of Conformity

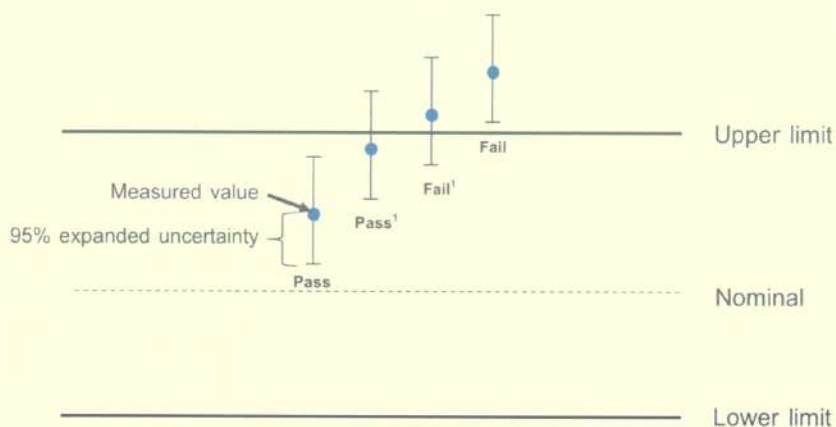
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

เอกสารไม่ควบคุม

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

Cert. No. : ACL24160

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00409023 / 185669 / 90468  
**ID No.:** UAE.EFM.011/2564

**Condition As Found :** GOOD

**Customer :** UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)  
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,  
BANGCHAK SUB-DISTRICT,  
PHRAKHANONG DISTRICT, BANGKOK 10260  
THAILAND.

**Location :** -  
**Ambient Temperature :** ( 23.0  $\pm$  3 ) °C  
**Pressure :** ( 101.3  $\pm$  3 ) kPa  
**Relative Humidity :** ( 50.0  $\pm$  20 ) %

**Received Date :** 10 MAY 2024  
**Calibration Date :** 04 - 05 JUNE 2024  
**Date of Issue :** 06 JUNE 2024

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

  
( Thanakul Petchurai )

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

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# SITHIPORN ASSOCIATES CO., LTD.

## CALIBRATION LABORATORY

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Cert. No. : ACL24160  
Job No. : VC67AC0071  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

### Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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G. Ketcha-

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### Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	-	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

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### Result of calibration :

#### 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.94)	93.9	0.0	±0.3

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value ( dB )
15.6

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value ( dB )
A - weight	14.2
C - weight	20.5
Flat	26.0

#### 3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	-0.1	-0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.0	2.1	±5.0

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#### 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

#### 5. Frequency and time weightings at 1 kHz

##### 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.0	94.0	0.0	± 0.2
C - weight	94.0	94.0	0.0	± 0.2
Flat	94.0	94.0	0.0	± 0.2

##### 5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	94.0	94.0	0.0	± 0.1
Slow	94.0	94.0	0.0	± 0.1
Leq	94.0	94.0	0.0	± 0.1

#### 6. Long - term stability

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.0	94.0	0.0	

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### 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 1.1

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### 8. Level linearity including the level range control

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Auto	94.0	94.0	0.0	±1.1

### 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

### 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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## 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.6	89.5	-0.1	±1.5

## 12. High level stability

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor  $k = 2$   
or any value following calculation, providing a level of confidence of approximately 95 %

————— End of Calibration Certificate —————

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