

ภาคผนวก ค
เอกสารสอบเทียบเครื่องมือ

List of Instruments Certification for Air & Noise 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 ₁₀)	Thermo Scientific	G25A 158M	Jiranaatee Associates Co., Ltd.	COF-001-66	14 Jul 23	13 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36 W/M -	Technology Promotion Association (Thailand-Japan)	24P1250	10 Apr 24	9 Apr 25	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1858	2 Jun 23	1 Jun 24	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1200	6 Jun 23	5 Jun 24	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Environmental Instrument	42C 42C-78933-390	UAE Consultant Co.,Ltd.	13112023	13 Nov 23	12 Nov 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920005	UAE Consultant Co.,Ltd.	13112023	13 Nov 23	12 Nov 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22177051	UAE Consultant Co.,Ltd.	21112023	21 Nov 23	20 Nov 24	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387035	UAE Consultant Co.,Ltd.	07112023	7 Nov 23	6 Nov 24	-
9	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04N99E15A01D3	21 Jun 21	21 Jun 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920015	UAE Consultant Co.,Ltd.	09112023	9 Nov 23	8 Nov 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	42i 1182920016	UAE Consultant Co.,Ltd.	03112023	3 Nov 23	2 Nov 24	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387065	UAE Consultant Co.,Ltd.	03112023	3 Nov 23	2 Nov 24	-
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387066	UAE Consultant Co.,Ltd.	03112023	3 Nov 23	2 Nov 24	-
14	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04N99E15A01D3	21 Jun 21	21 Jun 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
15	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2311DR0037	Thai Meteorological Department	123/24	13 Mar 24	12 Mar 25	-
16	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0008	Thai Meteorological Department	122/24	13 Mar 24	12 Mar 25	-
17	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0105	Thai Meteorological Department	120/24	13 Mar 24	12 Mar 25	-
18	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DR0041	Thai Meteorological Department	119/24	13 Mar 24	12 Mar 25	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV36 107224	Innovative Instrument Co.,Ltd.	23-ACT-117	4 Aug 23	3 Aug 24	-
20	Sound Level Meter	$L_{Aeq\ 24\ hrs}$ L_{Amax} L_{dn} L_{A90}	Larson Davis	LxT2 0005286	Innovative Instrument Co.,Ltd.	23-SLM-227	28 Jun 23	27 Jun 24	-
21	Sound Level Meter	$L_{Aeq\ 24\ hrs}$ L_{Amax} L_{dn} L_{A90}	Larson Davis	LxT2 0005289	Innovative Instrument Co.,Ltd.	23-SLM-224	28 Jun 23	27 Jun 24	-

List of Instruments Certification for Air & Noise 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 Hydrogen Sulphide	Apex Instruments, USA.	XC-572-V 0807047	Envi Equipment Service Co., Ltd.	E23-08072	17 Aug 23	16 Aug 24	-
2	Pre-Test Console	Total Suspended Particulate Hydrogen Sulphide	Apex Instruments, USA.	XC-572-V 1904011	Envi Equipment Service Co., Ltd.	E23-08066	5 Aug 23	4 Aug 24	-
3	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide	Testo	Testo 350 2376344	Entech Industrial Solution Co., Ltd.	G 660610	5 Oct 23	3 Oct 24	-
4	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide	Testo	Testo 350 60899617	Entech Industrial Solution Co., Ltd.	G 660614	6 Oct 23	4 Oct 24	-



The Result of Calibration

Certification No. 119/24

13 March, 2024

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Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mbar
1009.59	1009	0.59
1009.45	1009	0.45
1010.10	1010	0.10
1010.94	1011	-0.06
1011.48	1011	0.46
1011.64	1012	-0.16
1012.00	1012	0.00
1013.04	1013	0.04
1013.18	1013	0.18
1012.89	1013	-0.11
1013.20	1013	0.20
1013.44	1014	-0.56
1013.81	1014	-0.19
1014.19	1014	0.19
1015.06	1016	-0.04
1016.23	1016	0.23
1015.64	1016	-0.36
1015.23	1015	0.23
1012.87	1013	-0.13
1013.63	1014	-0.37

Average 0.04

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 119/24

13 March, 2024

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Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	Inches H ₂ O	Inches H ₂ O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.9	0.12
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 119/24

13 March, 2024

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Standard	Temperature Sensor Reading	
	Reading	Correction
Temp.	°C	°C
45.1	45	0.1
30.2	30	0.2
15.4	15	0.4

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 119/24

13 March, 2024

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Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
757.25	757	0.25
757.15	757	0.15
757.64	758	-0.36
758.27	758	0.27
758.66	758	0.66
758.94	759	-0.06
759.11	759	0.11
759.84	760	-0.16
759.95	760	-0.05
759.73	760	-0.27
759.96	760	-0.04
760.14	760	0.14
760.42	761	-0.58
760.70	761	-0.30
762.03	762	0.03
762.24	762	0.24
761.79	762	-0.21
761.48	761	0.48
759.71	760	-0.29
760.28	760	0.28

Average 0.02

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Rods 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 [T _{air}] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice mmHg	T	Standard Flow [Q _s] m ³ /min
1	0.700	753.503	23.71	23.16	48.213	1.565	1.248	0.853
2	1.001	753.442	23.75	23.36	52.965	3.186	1.781	0.930
3	1.115	753.274	23.95	23.57	35.125	4.360	2.034	1.059
4	1.175	753.263	23.94	23.73	26.925	8.729	2.169	1.127
5	1.412	753.351	24.03	23.75	25.751	6.920	2.623	1.358

Slope (m): 1.95114
Intercept (b): -0.02950
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _{air}] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice mmHg	γ	Standard Flow [Q _s] m ³ /min
1	0.700	753.503	23.71	23.16	48.213	1.565	0.783	0.656
2	1.001	753.442	23.75	23.36	52.965	3.186	1.130	0.934
3	1.115	753.274	23.95	23.57	35.125	4.160	1.281	1.064
4	1.175	753.263	23.94	23.73	26.925	4.729	1.366	1.133
5	1.412	753.351	24.03	23.75	25.751	6.920	1.652	1.365

Slope (w): 1.22204
Intercept (b): -0.01853
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

End of Certificate of Calibration



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CERTIFICATE OF CALIBRATION

Certificate No.: COF-001-68

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Tap Load Orifice
Gratuity GMW
G25A
1558M
UAE.DMA2.033/2554
Used Item
United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,
Bangkok 10260

Calibration procedure:
The Orifice gas flow device was calibrated against
Standard Rotary Displacement Meter (Rods
Meter) Model G65/16C/W2-04. The W6-C-004
was used as a calibration guideline.

Traceability:
This certificate provides a traceability of the
measurement to recognized the national
standards, and to realization of the international
system of units (SI) through the VSL (National
Metrology Institute of Netherlands) via Certificate
number: 02221301

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"

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

07 Jul 2023
14 Jul 2023
18 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1030 ± 10 hPa

CALIBRATION CONDITION:

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are 23.7 °C and 52.9%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:

Dr. Mr. Sarawit Thachalad
Mr. Miss Jitraporn Lertsomphol



Approved sign:



Calibration department manager

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



Cert.No.: 24P1250
Page: 2 of 2

Result of calibration:- Without adjustment
Function:- Pressure Measurement
Increasing Pressure

Range: 0 inH₂O to 36 inH₂O
Scale Interval: 0.1 inH₂O (The Second Estimate)

Applied Pressure	High-port side	UUC Indication Low-port side	ΔP	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	5.05	-4.95	10.00	0.00
12.00	6.05	-5.95	12.00	0.00
14.00	7.05	-6.95	14.00	0.00
16.00	8.10	-7.95	16.05	0.05
18.00	9.10	-8.95	18.05	0.05
20.00	10.10	-9.95	20.05	0.05
22.00	11.10	-10.95	22.05	0.05
24.00	12.10	-11.95	24.05	0.05
26.00	13.15	-12.95	26.10	0.10
28.00	14.15	-13.95	28.10	0.10
30.00	15.20	-14.95	30.15	0.15
32.00	16.20	-15.95	32.15	0.15
34.00	17.20	-16.95	34.15	0.15
35.50	18.00	-17.70	35.70	0.20

The uncertainty of measurement was ± 0.11 inH₂O
* ΔP = 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 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484

Certificate of Calibration

Certificate No.: 24P1250
Page: 1 of 2

Equipment: U Tube Manometer
Manufacturer: Dwyer
Model: 1221-36-W/M
Serial No.: -
ID No.: UAE.EFM.076/2566
Condition As-Received: Used Item

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.

Received Date: 03 April 2024
Calibration Date: 10 April 2024

Reference: 2404-0118WSC
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, Bangkok,
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 :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0176-23	12 Sep 2024

- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 4.0146293 inH₂O
- This instrument was used clean air as pressure media.
- This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.
- This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.
- The certificate is valid only to the item calibrated on date and place of calibration.
- 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 Khankaw
Issue Date: 17 April 2024

Approved Signatory :

[] Phalinee Prabpaipal
[] Sura Suwannasri
[✓] Attapol Panurach

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Cert.No.: 23P1858
Page: 2 of 2

Result of calibration:- Without adjustment

Range: 960 hPa to 1030 hPa

Function:- Absolute Pressure Measurement

Scale Interval: 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	958.83	970.47	981.83	991.32	1002.28	1011.84	1021.14	1032.30
UUC* Indication (hPa)	960.0	970.6	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	0.07	-0.47	-1.93	-1.32	-2.29	-1.84	-1.14	-2.30

Decreasing Pressure

Applied Pressure (hPa)	1032.30	1021.44	1011.67	1002.36	992.35	981.54	970.49	959.94
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-2.30	-1.44	-1.67	-2.36	-2.35	-1.94	-0.49	0.06

The uncertainty of measurement was ± 0.30 hPa

* 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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a 1165506



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23P1858
Page: 1 of 2

Equipment: Aneroid Barometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.ANV.124/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 02 June 2023

Reference: 2305-0919WSC

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

Ambient Temperature: (23 \pm 2) °C

Relative Humidity: (50 \pm 15) %

Atmospheric Pressure: 1007 mbar

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81 Soi Udomsak 41, Sukhumvit Road,
Bangchak, Phraekhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 5-1 : Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP142	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. This result of calibration instrument was in absolute pressure.				
5. This instrument was used clean air as pressure media.				
6. The certificate is valid only to the item calibrated on date and place of calibration.				
7. This Certification is traceable to the International System of Unit maintained through:-				
-National Institute of Metrology Thailand (NIMT)				

Calibrated by: Suksan Khanikaew
Issue Date: 08 June 2023

Approved Signatory: [Signature]

[Signature]
[Signature]
[Signature]

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a 0316958



Cert. No.: 23H1200
Page: 2 of 2

Result of Calibration:-

Before Adjustment

Function:

Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	48	7.9	1.6
25.0	60.0	63	3.0	1.7
25.0	80.0	76	-4.0	1.9

Result of Calibration:-

After Adjustment

Function:

Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	44	3.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	75	-5.0	1.9

Result of Calibration:-

Without Adjustment

Function:

Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (\pm °C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.5	-0.444	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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a 1165285



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23H1200
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.ANV.130/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023 to 06 June 2023

Reference: 2305-0919WSC

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

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 20) %

81 Soi Udomsak 41, Sukhumvit Road,
Bangchak, Phraekhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H402 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 :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23105	15 Mar 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:-				
-National Institute of Standards and Technology (NIST) , The United States of America				
-Technology Promotion Association (Thailand-Japan) , NSC-ONSC Accredited No. Calibration 0008				

Calibrated by: Somchai Dumvor
Issue Date: 07 June 2023

Approved Signatory: [Signature]

[Signature]
[Signature]
[Signature]

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a 0316274

MULTI-POINT GAS TEST REPORT

Test Date : Nov 13, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1182920005

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

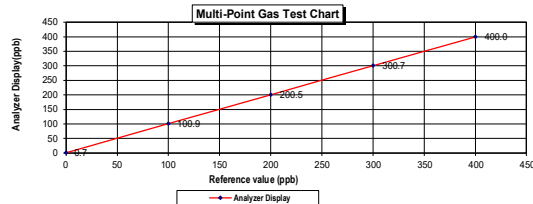
Dilutor Detail

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	0.7	0.70	0.70
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	200.5	0.50	0.25
Level 4	60.00%	300.0	300.7	0.70	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$



Calculate by

13 / Nov / 2023

Approve by

13 / Nov / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 13, 2023

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Environmental Instruments Serial Number : 42C-78933-390

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

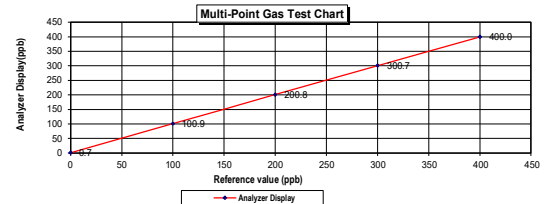
Dilutor Detail

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	0.7	0.70	0.70
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	200.8	0.80	0.40
Level 4	60.00%	300.0	300.7	0.70	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$



Calculate by

13 / Nov / 2023

Approve by

13 / Nov / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 7, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : CM22387035

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

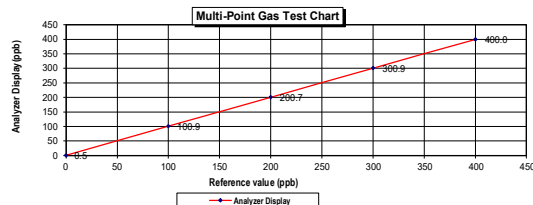
Dilutor Detail

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	0.5	0.50	0.50
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	200.7	0.70	0.35
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$



Calculate by

07 / Nov / 2023

Approve by

08 / Nov / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 21, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : CM22177051

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

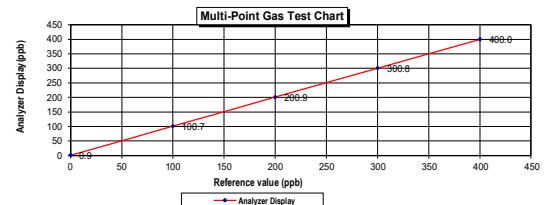
Dilutor Detail

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	0.9	0.90	0.90
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	200.9	0.90	0.45
Level 4	60.00%	300.0	300.8	0.80	0.27
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$



Calculate by

21 / Nov / 2023

Approve by

22 / Nov / 2023



MULTI-POINT GAS TEST REPORT

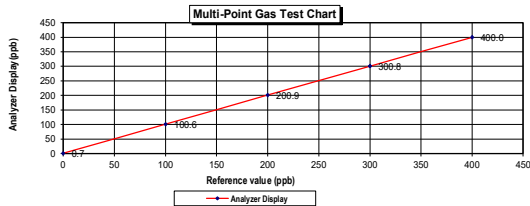
Test Date : Nov 9, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920015

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer : Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	Model : 146i
Methane (CH ₄)	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	984.8		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.7	0.70	0.70
Level 2 20.00%	100.0	100.6	0.60	0.60
Level 3 40.00%	200.0	200.9	0.90	0.45
Level 4 60.00%	300.0	300.8	0.80	0.27
Level 5 80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
:Acceptable Limit $\pm 5\%$		0.40		



Calculate by

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09 / 11 / 2023

09 / Nov / 2023



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 680
Gas Code: CO,NO,NOX,SO₂,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Test Method 18 for Assay and Certification of Gasometer Calibration Standards (May 2012) document EPA 800/9-12/931, using the assay procedures listed. Analytical Metrology 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 ppb, i.e. 0.2 measurements.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	$\pm 1.4\%$ NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.88 PPM	G1	$\pm 1.0\%$ NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 02, 2025
PRM	12388	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	$\pm 2.0\%$	Feb 20, 2020
GMS	40142383102	CC59581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	± 2.1	Feb 18, 2023
NTRM	16011043	CC473277	48.02 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Jun 17, 2022
NTRM	14060119	CC434277	580.9 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.8\%$	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO ₂	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO ₂	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES: PO #5221002607
GROSS WT: 28.40kg
NET WT: 4.73kg

The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

Approved for Release



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MULTI-POINT GAS TEST REPORT

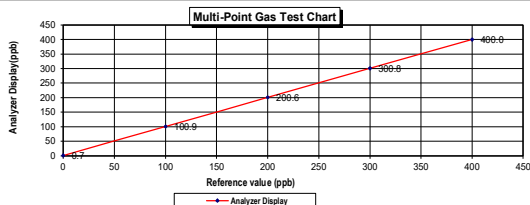
Test Date : Nov 3, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387065

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer : Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	Model : 146i
Methane (CH ₄)	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	984.8		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.7	0.70	0.70
Level 2 20.00%	100.0	100.9	0.90	0.89
Level 3 40.00%	200.0	200.6	0.60	0.30
Level 4 60.00%	300.0	300.8	0.80	0.27
Level 5 80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
:Acceptable Limit $\pm 5\%$		0.43		



Calculate by

Approve by

03 / Nov / 2023

03 / Nov / 2023



MULTI-POINT GAS TEST REPORT

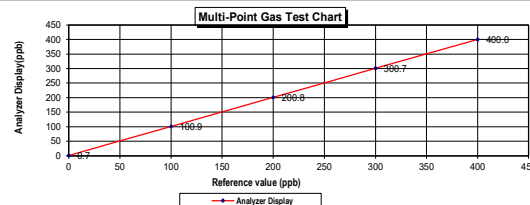
Test Date : Nov 3, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920016

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer : Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	Model : 146i
Methane (CH ₄)	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	984.8		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.7	0.70	0.70
Level 2 20.00%	100.0	100.9	0.90	0.89
Level 3 40.00%	200.0	200.8	0.80	0.40
Level 4 60.00%	300.0	300.7	0.70	0.23
Level 5 80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
:Acceptable Limit $\pm 5\%$		0.44		



Calculate by

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03 / Nov / 2023

03 / Nov / 2023

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N189E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Traceability Protocol for Analytical and Certification of Gascon Calibration Standards (May 2012) document EPA 800R-12/831, 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. 6.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.98 PPM	G1	+/- 1.4% NIST Traceable	08/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	08/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	08/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	C0708008	45.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12366	D859025	9.81 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2026
GMS	401423838102	C0505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	19011043	C0473277	46.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14050119	C0434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Tried Data Available Upon Request

NOTES: PO #5221002807
GROSS WT: 28.40kg
NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

Approved for Release



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MULTI-POINT GAS TEST REPORT

Test Date : Nov 3, 2023

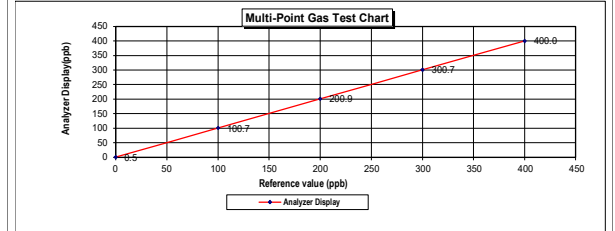
Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387066

Standard Gas Concentration	Value	Unit	Dilutor Detail	Value	Unit
Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer :	Thermo SCIENTIFIC	
Nitric Oxide (NO)	45.94	PPM	Model :	146i	
Methane (CH ₄)	-	PPM	Serial Number :	1180540071	
Carbon Monoxide (CO)	984.8				
Cylinder No. :	EB0143262				
Expiration Date :	Jun 24, 2024				

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.50	0.50	0.50
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	200.9	0.90	0.45
Level 4	60.00%	300.0	300.7	0.70	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb

: Acceptable Limit $\pm 5\%$ 

Calculate by

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...03.../...Nov.../...2023

Approve by

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...03.../...Nov.../...2023

Page 1 of 1

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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 123/24

13 March, 2024

Page : 2 of 5

Standard	HOOK GAGE NO. 1425	TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity
m/sec	mmHg	mmHg	m/sec
1.00	-	-	1.0
3.02	-	-	3.0
5.00	-	-	5.0
7.04	-	-	6.9
9.02	-	-	9.0
11.02	-	-	10.9
13.01	-	-	13.0
15.01	-	-	15.0
17.02	-	-	17.0
20.02	-	-	20.0

Wind Aloft Plotting Board.	
US DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watanaporn Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 13 March, 2024

Certification No. 123/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2311DR0037
Wind Sensor 2112DT0102

Customer : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1013.1 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer Theodor Friedrichs FD014 Serial No. 9310119 : HOOK GAGE NO. 1425

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848057 : Thermoschneider No. 918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220-No. V1220015

Calibrated by : Mr. Watcharaporn Subwat

Mechanical Engineer

Signed : Mr. Watcharaporn Subwat

(Authorized Signatory)

for the Chief

Sub-Standard Instrument

เอกสารไม่ควบคุม



The Result of Calibration

Certification No. 123/24

13 March, 2024

Page : 4 of 5

Standard Barometer Pressure	Tested Barometer Pressure	Correction mmHg
757.25	757	0.25
757.15	757	0.15
757.04	758	-0.36
758.27	758	0.27
758.86	759	-0.34
758.94	759	-0.06
759.11	759	0.11
759.64	760	-0.16
759.95	760	-0.06
759.73	760	-0.27
759.96	760	-0.04
760.14	760	0.14
760.42	760	0.42
760.70	761	-0.30
762.03	762	0.03
762.24	762	0.24
761.79	762	-0.21
761.48	761	0.48
759.71	760	-0.29
760.28	760	0.28

Average

0.02

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 123/24

13 March, 2024

Page : 3 of 5

Standard Barometer Pressure	Tested Barometer Pressure	Correction mbar
1009.59	1009	0.59
1009.45	1009	0.45
1010.10	1010	0.10
1010.94	1011	-0.06
1011.48	1011	0.48
1011.64	1012	-0.16
1012.06	1012	0.06
1013.04	1013	0.04
1013.18	1013	0.18
1012.89	1013	-0.11
1013.20	1013	0.20
1013.44	1014	-0.56
1013.81	1014	-0.19
1014.19	1014	0.19
1015.96	1016	-0.04
1016.23	1016	0.23
1015.64	1016	-0.36
1015.23	1015	0.23
1012.87	1013	-0.13
1013.63	1013	0.63

Average

0.09

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 13 March, 2024

Certification No. : 122/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver : 2205DR0008
Wind Sensor : 2205DT0008Customer : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1012.5 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Axiot Plotting Board

: Micromanometer Theodor Friedrichs FQ314 Serial No. 9310119 : HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731/241480 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02948057 : Thermoschneider No.918602

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB224 No. 11220015

: Digital Barometer Vaisala Type PTB330 No. K1280001

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

(Authorized Signatory)

for the Chief

Sub-Standard Instruments

เอกสารไม่ควบคุม



The Result of Calibration

Certification No. 123/24

13 March, 2024

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45	0.1
30.2	30	0.2
15.4	15	0.4

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



The Result of Calibration

Certification No. 122/24

13 March, 2024

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mbar
1009.59	1009	0.59
1009.45	1009	0.45
1010.10	1010	0.10
1010.94	1011	-0.06
1011.66	1012	-0.54
1011.84	1012	-0.16
1012.06	1012	0.06
1013.04	1013	0.04
1013.18	1013	0.18
1012.89	1013	-0.11
1013.20	1013	0.20
1013.44	1013	0.44
1013.81	1014	-0.19
1014.19	1014	0.19
1015.96	1016	-0.04
1016.23	1016	0.23
1015.64	1015	0.64
1015.23	1015	0.23
1012.87	1013	-0.13
1013.63	1013	0.63

Average

0.14

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 122/24

13 March, 2024

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	m/sec	inches H2O	inches H2O	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.9	0.12
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



The Result of Calibration

Certification No. 122/24

13 March, 2024

Page : 5 of 5

Standard	Temperature Sensor Reading	
	Reading	Correction
Temp. °C	°C	°C
45.1	45	0.1
30.2	30	0.2
15.4	15	0.4

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 122/24

13 March, 2024

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
757.25	757	0.25
757.15	757	0.15
757.64	758	-0.36
758.27	758	0.27
758.66	759	-0.34
758.94	759	-0.06
759.11	759	0.11
759.84	760	-0.16
759.95	760	-0.05
759.73	760	-0.27
759.99	760	-0.04
760.14	760	0.14
760.42	760	0.42
760.70	761	-0.30
762.03	762	0.03
762.24	762	0.24
761.79	762	-0.21
761.48	762	-0.52
758.71	760	-0.29
760.28	760	0.28

Average

0.03

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 120/24

13 March, 2024

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	mmHg	mmHg	mmHg	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.9	0.12
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharaporn Subwat
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 13 March, 2024

Certification No. 120/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2205DR0105

Wind Sensor 2205DT0105

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260,

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.4 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119 : HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848057 : Thermoachneider No. 918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PT29250 No. V1220015

Barometer Vaisala Type PT16550 No. A4380001

Calibrated by :

Mr. Watcharaporn Subwat

Mechanical Engineer

Signed :

Mr. Pitsak

Mechanical Engineer

(Authorized Signature)

for the Chief

Sub-Standard Instrument

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 120/24

13 March, 2024

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
757.25	757	0.25
757.15	757	0.15
757.04	758	-0.36
758.27	758	0.27
758.86	758	0.86
758.94	759	-0.06
759.11	759	0.11
759.84	760	-0.16
759.95	760	-0.05
759.73	760	-0.27
759.96	760	-0.04
760.14	760	0.14
760.42	760	0.42
760.70	761	-0.30
762.03	762	0.03
762.24	762	0.24
761.79	762	-0.21
761.48	762	-0.52
759.71	760	-0.29
760.28	760	0.28

Average

0.02

Calibrated by :

Mr. Watcharaporn Subwat
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 120/24

13 March, 2024

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mbar
1009.99	1009	0.99
1009.45	1009	0.45
1010.10	1010	0.10
1010.94	1011	-0.06
1011.46	1012	-0.54
1011.84	1012	-0.16
1012.06	1012	0.06
1013.04	1013	0.04
1013.18	1013	0.18
1012.99	1013	-0.11
1013.20	1013	0.20
1013.44	1014	-0.56
1013.81	1014	-0.19
1014.19	1014	0.19
1015.96	1016	-0.04
1016.23	1016	0.23
1015.64	1015	0.64
1015.23	1015	0.23
1012.87	1013	-0.13
1013.63	1014	-0.37

Average

0.04

Calibrated by :

Mr. Watcharaporn Subwat
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 13 March, 2024

Certification No. 119/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2111DR0041

Wind Sensor 2111DT0041

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.6 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Axiot Plotting Board

: Micromanometer Theodor Friedrichs PC014 Serial No. 9310119 : HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629566)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848067 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

Barometer Vaisala Type PTB330 No. K4320001

Calibrated by :

Sign

(Authorized Signatory)

Mr. Watcharigol

Mr.

for the Chief

Mechanical Engineer

Sub-Standard Instruments

เอกสารไม่ควบคุม



The Result of Calibration

13 March, 2024

Certification No. 120/24

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45	0.1
30.2	30	0.2
15.4	15	0.4

Calibrated by :

Mr. Watcharigol
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7139 MOO 11, SOI SUTINSARAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHU, SAMUT PRAKAN PROVINCE 10140 THAILAND
TEL : 0660-2116-7800-1 FAX: 0660-2116-7140

Page 2 of 2

Certificate No : 23-ACT-117

Request No : Req-2023-1546

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	94.03	0.03	-	-	0.13	0.25
114 dB / 1000 Hz	114.11	0.11	-	-	0.13	0.25

Frequency of Sound pressure level

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

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)		Measured (%)			
94 dB / 1000 Hz	0.26		-	-	0.40	2.5
114 dB / 1000 Hz	0.38		-	-	0.40	2.5

Note :

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibration pressure correction

- The calibration results exclude the microphone volume correction

End of Calibration

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7139 MOO 11, SOI SUTINSARAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHU, SAMUT PRAKAN PROVINCE 10140 THAILAND
TEL : 0660-2116-7800-1 FAX: 0660-2116-7140

Page 1 of 2

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260Certificate No : 23-ACT-117
Request No : Req-2023-1546

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 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013. ±10.0 hPa)

Received Date : 21 July 2023

Calibration Date : 4 August 2023

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	EEL	31 May 2024
THD Multimeter	2015	1047765	NIMT	31 January 2024

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. Nopphon Sangart
Service Calibration Engineer

Approved By :

Mr. Patch Mathavorn
Calibration Engineer Supervisor

Issue Date : 4 August 2023

Certificate No : 23-SLM-227
Request No : Req-2023-1416

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR	(± dB)	(± dB)
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)		
1000 Hz 114.0B	113.77	114.0	+0.23	113.8	+0.03		

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTER, Model SV 35A, SN. 73246

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting	(dB)	(± dB)
A	31.1	0.1

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting	(dB)	(± dB)
A	30.9	0.1
C	30.4	0.1
Z	34.7	0.1

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY	Acceptance Limit
FAST / 37-139	A	C	Z	(± dB)	(± dB)
STD Setting	(dB)	(dB)	(dB)	(± dB)	(± dB)
125 Hz	0.0	0.2	0.1	0.6	2.0
1000 Hz	0.0	0.0	0.0	0.6	1.0
4000 Hz	1.1	0.7	1.2	0.6	3.0
8000 Hz	2.8	1.0	2.9	3.2	5.0

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.

เอกสารไม่ควบคุม

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD. Certificate No : 23-SLM-227
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok Request No : Req-2023-1416
10260

Unit Under Calibration Details

Measurement Item : Sound Level Meter Microphone Class : 2
Manufacturer : LARSON DAVIS Microphone Model : 375B02
Model : LxT2 Microphone S/N : B11740
Serial Number : 0005286 Preamplifier Model : P90MLxT2B
ID : UAEJFM1022562 Preamplifier S/N : 050087
Resolution : 0.1 dB Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 % RH ± 20 % RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 28 June 2023
Calibrated Date : 28 June 2023
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	6 October 2023	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	29 June 2023	TSI
Audio Generator	Syntek	Svan401	131	12 October 2023	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 : [Signature]
M. [Signature]
Calibration Officer

Approved By : [Signature]
S. [Signature]
Calibration Engineer Supervisor
Issue Date : 28 June 2023

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.

เอกสารไม่ควบคุม

Certificate No : 23-SLM-227
Request No : Req-2023-1416

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC	(± dB)	(± dB)
STD Setting	(dB)	(± dB)	(± dB)
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	REF	UUC	ERR	(± dB)	(± dB)
STD dB	(dB)	(dB)	(dB)	(± dB)	(± dB)
141.0B	141	141.0	0.0	0.8	0.8
143.0B	143	143.0	0.0	0.8	0.8
139.0B	139	139.0	0.0	1.1	1.1
134.0B	134	134.0	0.0	1.1	1.1
136.0B	136	136.0	0.0	1.1	1.1
124.0B	124	124.0	0.0	1.1	1.1
119.0B	119	119.0	0.0	1.1	1.1
114.0B	114	114.0	0.0	1.1	1.1
109.0B	109	109.0	0.0	1.1	1.1
104.0B	104	104.0	0.0	1.1	1.1
99.0B	99	98.9	-0.1	1.1	1.1
94.0B	94	94.0	0.0	1.1	1.1
89.0B	89	89.0	0.0	1.1	1.1
84.0B	84	84.0	0.0	1.1	1.1
79.0B	79	79.0	0.0	1.1	1.1
74.0B	74	74.0	0.0	1.1	1.1
69.0B	69	69.0	0.0	1.1	1.1
64.0B	64	64.0	0.0	1.1	1.1
59.0B	59	59.0	0.0	1.1	1.1
54.0B	54	54.0	0.0	1.1	1.1
49.0B	49	49.0	0.0	1.1	1.1
44.0B	44	44.2	0.2	1.1	1.1
43.0B	43	43.3	0.3	1.1	1.1
42.0B	42	42.3	0.3	1.1	1.1
41.0B	41	41.4	0.4	1.1	1.1

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.

เอกสารไม่ควบคุม

Certificate No : 23-SLM-227
Request No : Req-2023-1416

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY	Acceptance Limit
FAST / 37-139	A (dB)	C (dB)	Z (dB)	(± dB)	(± dB)
STD Setting	(dB)	(dB)	(dB)	(± dB)	(± dB)
63 Hz	-0.2	-0.1	0.0	0.2	2.0
125 Hz	-0.1	0.0	0.0	0.2	1.5
250 Hz	-0.1	0.0	0.0	0.2	1.5
500 Hz	-0.1	0.0	0.0	0.2	1.5
1000 Hz	0.0	0.0	0.0	0.2	1.0
2000 Hz	0.0	0.0	0.0	0.2	2.0
4000 Hz	0.0	0.0	0.0	0.2	3.0
8000 Hz	-0.1	-0.1	0.0	0.2	5
16000 Hz	-0.1	-0.1	-0.1	0.2	+5, -INF

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit
FAST / 37-139	REF	UUC	ERR	(± dB)	(± dB)
UUC Weighting	(dB)	(dB)	(dB)	(± dB)	(± dB)
A	114.00	114.0	0.0	0.2	0.2
C	114.00	114.0	0.0	0.2	0.2
Z	114.00	114.0	0.0	0.2	0.2

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit
37-139 / A	REF	UUC	ERR	(± dB)	(± dB)
UUC Time Respons	(dB)	(dB)	(dB)	(± dB)	(± dB)
Fast	114.00	114.0	0.0	0.2	0.1
Slow	114.00	114.0	0.0	0.2	0.1
Leq	114.00	114.0	0.0	0.2	0.1

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.

เอกสารไม่ควบคุม

Certificate No : 23-SLM-227
Request No : Req-2023-1416

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	145.2		
Negative one-half cycle	145.2		
Deviated	0.0	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate

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

Certificate No : 23-SLM-227
Request No : Req-2023-1416

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(± dB)
37-139	40.2	46.3	0.1	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A / 37-139	Toneburst	Ref	UUC	ERR	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)
Fast	200	115.0	115.0	0.0	1
	2	118.0	117.9	-0.1	+1.0, -2.5
	0.25	109.0	108.8	-0.2	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1
	2	109.0	108.9	-0.1	+1.0, -5.0
SEL	200	129.0	129.1	+0.1	1
	2	109.0	109.1	+0.1	+1.0, -2.5
	0.25	100.0	100.1	+0.1	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	137.4	136.8	-0.60	3.0
Positive half cycle	136.4	136.1	-0.30	2.0
Negative half cycle	136.4	136.1	-0.30	2.0

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.
เอกสารไม่ควบคุม

Certificate No : 23-SLM-224
Request No : Req-2023-1412

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	After Adjust	UNCERTAINTY	Acceptance
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114 dB	113.77	114.1	+0.33	113.8	+0.03
				(± dB)	(± dB)

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 73246

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	30.8	0.1

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	29.7	0.1
C	29.1	0.1
Z	33.7	0.1

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance
FAST / 37-139	A C Z		Limit
STD Setting	(dB) (dB) (dB)	(± dB)	(± dB)
125 Hz	0.0 0.2 0.0	0.6	2.0
1000 Hz	0.0 0.0 0.0	0.6	1.0
4000 Hz	1.1 1.1 1.3	0.6	3.0
8000 Hz	2.4 2.4 2.4	0.7	5.0

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.
เอกสารไม่ควบคุม

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address : R1 Soi Udomsak 41, Sakharavit Road, Bangtrak, Prakhong, Bangkok 10560
Certificate No : 23-SLM-224
Request No : Req-2023-1412

Unit Under Calibration Details

Measurement Item : Sound Level Meter
Manufacturer : LARSON DAVIS
Model : LxT2
Serial Number : 0093289
ID : UAE.EFM.105/2562
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 373B02
Microphone S/N : 011732
Preamplifier Model : P8MLx128
Preamplifier S/N : 056076
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 30 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 26 June 2023
Calibrated Date : 28 June 2023
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	8 October 2023	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA006234	29 June 2023	TISI
Audio Generator	Swamk	Swan401	131	12 October 2023	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. N. [Redacted]
Calibration Officer

Approved By :

Mr. Pait Mathavorn
Calibration Engineer Supervisor
Issue Date : 28 June 2023

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.
เอกสารไม่ควบคุม

Certificate No : 23-SLM-224
Request No : Req-2023-1412

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(\pm dB)	(\pm dB)
Initial	134.0		
Final	134.0		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 37-139	REF	UUC	ERR	Limit
STD dB	(dB)	(dB)	(dB)	(\pm dB)
142.00	142	142.0	0.0	0.3
139.00	139	139.0	0.0	1.1
134.00	134	134.0	0.0	1.1
128.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	98.9	-0.1	1.1
94.00	94	93.9	-0.1	1.1
89.00	89	88.9	-0.1	1.1
84.00	84	83.9	-0.1	1.1
79.00	79	78.9	-0.1	1.1
74.00	74	73.9	-0.1	1.1
69.00	69	68.9	-0.1	1.1
64.00	64	63.9	-0.1	1.1
59.00	59	58.9	-0.1	1.1
54.00	54	53.9	-0.1	1.1
49.00	49	48.9	-0.1	1.1
44.00	44	44.1	0.1	1.1
39.00	39	39.4	0.4	1.1

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.

เอกสารไม่ควบคุม

Certificate No : 23-SLM-224
Request No : Req-2023-1412

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve		Limit
STD Setting	A (dB) C (dB) Z (dB)	(\pm dB)	(\pm dB)
63 Hz	-0.1 0.0 0.0		2.0
125 Hz	-0.1 0.1 0.0		1.5
250 Hz	0.0 0.0 0.0		1.5
500 Hz	0.0 0.1 0.0		1.5
1000 Hz	0.0 0.0 0.0	0.2	1.0
2000 Hz	0.1 0.1 0.0		2.0
4000 Hz	0.0 0.1 0.1		3.0
8000 Hz	0.0 0.0 0.1		5
10000 Hz	0.0 0.0 -0.1		+5, -10%

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	Limit
UUC Weighting	(dB)	(dB)	(dB)	(\pm dB)
A	114.00	114.0	0.0	0.2
C	114.00	114.0	0.0	0.2
Z	114.00	114.0	0.0	0.2

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
37-139 / A	REF	UUC	ERR	Limit
UUC Time Response	(dB)	(dB)	(dB)	(\pm dB)
Fast	114.00	114.0	0.0	0.1
Slow	114.00	114.0	0.0	0.1
Log	114.00	114.0	0.0	0.1

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.

เอกสารไม่ควบคุม

Certificate No : 23-SLM-224
Request No : Req-2023-1412

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(\pm dB)	(\pm dB)
Positive one-half cycle	143.9		
Negative one-half cycle	144.0		
Deviated	-0.1	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(\pm dB)	(\pm dB)
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate

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

เอกสารไม่ควบคุม

Certificate No : 23-SLM-224
Request No : Req-2023-1412

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(\pm dB)
37-139	44.9	44.9	0.1	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A / 37-139	Toneburst	Ref	UUC	ERR	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(\pm dB)
Fast	200	135.0	134.9	-0.1	1
	2	118.0	117.8	-0.2	+1.0, -2.5
	0.25	109.0	108.6	-0.4	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1
	2	109.0	108.8	-0.2	+1.0, -2.0
	200	129.0	129.0	0.0	1
SEL	2	109.0	109.0	0.0	+1.0, -2.5
	0.25	100.0	99.8	-0.2	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(\pm dB)
Complete cycle	137.4	136.7	-0.70	3.0
Positive half cycle	136.4	136.2	-0.20	2.0
Negative half cycle	136.4	136.2	-0.20	2.0

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.

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	17/08/2023	09:35 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	SER23-08029			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	756.74			K ₁	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
Elapsed									
(Q)	(P ₀)	(V _{in})	(V _{out})	(t _{in})	(t _{out})	(V _{wi})	(V _{wf})	(t _{in})	(t _{out})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.58	13.0	791.0910	791.2310	29	29	163.88294	163.01908	28	28
12.67	13.0	791.2310	791.3710	29	29	163.01908	163.15584	28	28
8.62	26.0	791.3820	791.5220	28	28	163.16666	163.30406	28	28
8.63	26.0	791.5220	791.6620	28	28	163.30406	163.44110	28	28
14.05	40.0	791.6690	791.9490	28	28	163.44794	163.72240	27	27
14.03	40.0	791.9490	792.2290	28	28	163.72240	163.99618	27	27
10.30	70.0	792.2430	792.5230	29	29	164.00884	164.28298	26	26
10.27	70.0	792.5230	792.8030	29	29	164.28298	164.55634	26	26
9.03	90.0	792.8150	793.0950	29	29	164.56056	164.83294	26	26
9.02	90.0	793.0950	793.3750	29	29	164.83294	165.10484	26	26



เอกสารไม่ควบคุม

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udumuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : XC-572-V
Serial Number : 0807047
ID/Control No. :
Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH
Cal. Date : 17/08/2023
Issue Date : 17/08/2023

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 (SI).

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



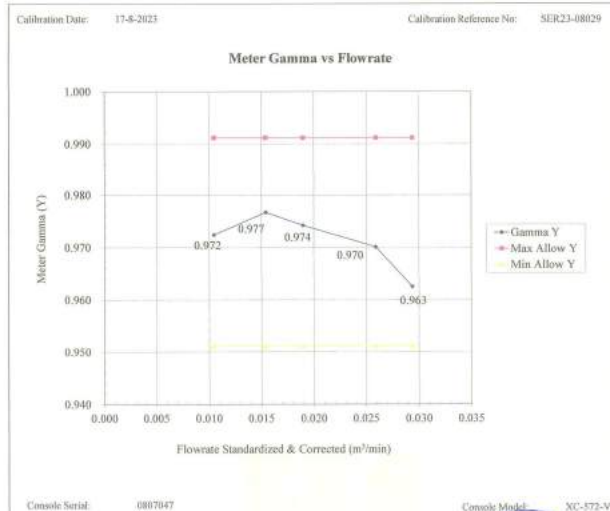
Calibrated by : Mr. Sanya Sangnil

Approved by : [Signature]

Technical Manager

เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	17/08/2023	09:35 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	SER23-08029			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	756.74			K ₁	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



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	17/08/2023	09:35 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	SER23-08029			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	756.74			K ₁	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data									
Standardized Data					Results				
					Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate			
(V _{std})	(Q _{std})	(V _{wi})	(Q _{wi})	(V)	(ΔV)	(Q _{std})	(ΔH ₀)	(ΔH ₀)	Variation
m³	m³/min	m³	m³/min			m³/min	mm H ₂ O		
0.136	0.011	0.132	0.010	0.970	-0.001	0.010	51.902	3.446	
0.136	0.011	0.132	0.010	0.975	0.003	0.010	52.116	3.660	
0.136	0.016	0.133	0.015	0.978	0.007	0.015	47.907	-0.549	
0.136	0.016	0.133	0.015	0.975	0.004	0.015	48.345	-0.111	
0.273	0.019	0.267	0.019	0.975	0.004	0.019	49.080	0.624	
0.273	0.019	0.266	0.019	0.973	0.002	0.019	49.207	0.751	
0.275	0.027	0.267	0.026	0.971	0.000	0.026	46.382	-2.075	
0.275	0.027	0.266	0.026	0.969	-0.002	0.026	46.345	-2.111	
0.276	0.031	0.266	0.029	0.963	-0.008	0.029	46.642	-1.814	
0.276	0.031	0.265	0.029	0.962	-0.010	0.029	46.635	-1.821	
				0.971	Y Average			48.456	ΔH ₀ 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 ±0.02.
For ΔH₀, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm).



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	0807047
DGM Model Number	SK25EX
DGM Serial Number	00003580
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 19777

Calibration Conditions			
Date	Time	17/08/2023	02:45 PM
Calibration Reference No.	SER23-08029		
Reference Thermometer	DIGICON		
Serial Number	183169105		

Results											
Console Thermocouple Simulator											
Meter Box Channel Temperature Reading (°C)											
Channel and test point	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-17.0	24.0	37.0	95.0	149.0	259.0	372.0	483.0	595.0	817.0	1040.0
Aux	-17.0	24.0	37.0	95.0	149.0						
Probe	-17.0	24.0	37.0	95.0	149.0						
Filter	-17.0	24.0	37.0	95.0	149.0						
ExH	-17.0	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

Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	Time	17/08/2023	09:35 AM
Console Serial Number	0807047	Calibration Reference No.	SER23-08029		
DGM Model Number	SK25EX	Barometric Pressure	756.74 mmHg		
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		
		Std Temp	293	K	
		Std Press	760	mm Hg	
		K _i	0.386		
		Console Leak Check	PASS		



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	05/08/2023	09:50 AM
Console Serial Number	1904011	Calibration Reference No.	SER23-08027		
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg		
DGM Serial Number	00004114	Calibration Meter Gamma	0.999		
		Std Temp	293	K	
		Std Press	760	mm Hg	
		K _i	0.386		
		Console Leak Check	PASS		

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
Elapsed (Q)	(P _o)	(V _{in})	(V _{out})	(t _{in})	(t _{out})	(V _{in})	(V _{out})	(t _{in})	(t _{out})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.35	13.0	1342.996	1343.136	29	29	155.32046	155.46168	27	27
12.42	13.0	1343.136	1343.276	29	29	155.46168	155.60264	27	27
8.80	26.0	1343.282	1343.422	29	29	155.60872	155.75014	27	27
8.80	26.0	1343.422	1343.562	30	30	155.75014	155.89098	26	26
13.95	40.0	1343.569	1343.849	30	30	155.89796	156.17902	26	26
13.95	40.0	1343.849	1344.129	31	31	156.17902	156.45838	26	26
10.50	70.0	1344.138	1344.418	31	31	156.46734	156.74556	26	26
10.47	70.0	1344.418	1344.698	32	32	156.74556	157.02264	26	26
9.12	90.0	1344.711	1344.991	32	32	157.03528	157.31088	26	26
9.12	90.0	1344.991	1345.271	32	32	157.31088	157.58638	25	25



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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-es.com

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : XC-572-V
Serial Number : 1904011
ID./Control No. : -
Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH
Cal. Date : 05/08/2023
Issue Date : 05/08/2023

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 (SI).

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

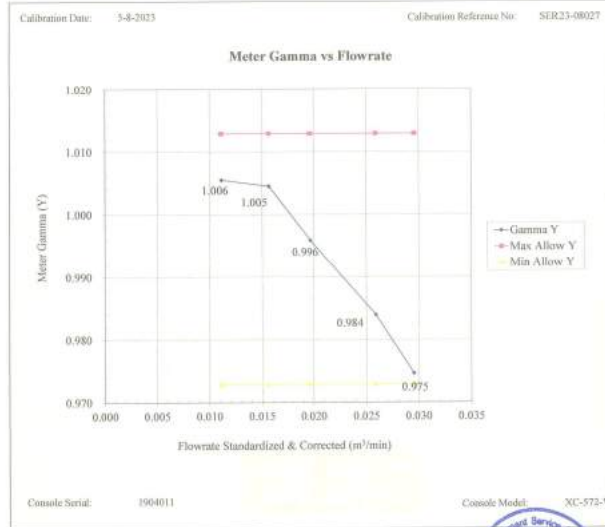


Calibrated by : Mr. Sanya Sangnil

Approved by : (Mr. Mana Fuchit) Technical Manager

เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K1	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



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	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K1	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data							
Standardized Data				Results			
				Dry Gas Meter			
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	
(V _{ref}) m³	(Q _{ref}) m³/min	(V _{std}) m³	(Q _{std}) m³/min	Value (Y)	Variation (ΔY)	Std & Corr (Q _{corrected}) m³/min	Variation (ΔH _g)
0.137	0.011	0.138	0.011	1.006	0.014	0.011	46.171
0.137	0.011	0.137	0.011	1.005	0.012	0.011	46.843
0.137	0.016	0.138	0.016	1.007	0.014	0.016	46.870
0.137	0.016	0.138	0.016	1.002	0.010	0.016	47.999
0.275	0.020	0.275	0.020	0.999	0.006	0.020	45.847
0.275	0.020	0.273	0.020	0.993	0.000	0.020	46.407
0.276	0.026	0.272	0.026	0.986	-0.007	0.026	46.656
0.276	0.026	0.271	0.026	0.982	-0.011	0.026	46.743
0.276	0.030	0.269	0.030	0.975	-0.018	0.030	46.263
0.277	0.030	0.270	0.030	0.974	-0.018	0.030	46.142
				0.993	Y Average	46.504	
						ΔH _g 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 +0.02.
For ΔH_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	05/08/2023	12:10 PM
Console Serial Number	1904011	Calibration Reference No.		SER23-08027	
DGM Model Number	SK25EX	Reference Thermometer		DIGICON	
DGM Serial Number	00004114	Serial Number		183169105	
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 17215				

Results										
Console Thermocouple Simulator										
Meter Box Channel Temperature Reading (°C)										
Channel and test point	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0
Stack	-17.0	25.0	37.0	93.0	149.0	258.0	370.0	481.0	592.0	814.0
Aux	-16.0	25.0	37.0	93.0	149.0					
Probe	-17.0	24.0	37.0	93.0	149.0					
Filter	-16.0	24.0	37.0	93.0	149.0					
Oven	-16.0	24.0	37.0	93.0	149.0					
Exit	-16.0	24.0	37.0							

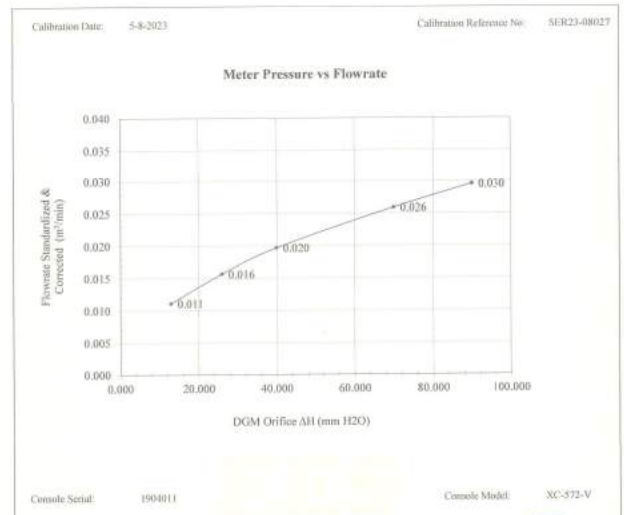
Tolerance Range

Stack	± 1.50%	Absolute		Meter	± 3.0 °C
Probe	± 3.0 °C			Exit	± 2.0 °C
Filter	± 3.0 °C				



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K1	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



เอกสารไม่ควบคุม

Certificate No.: G 660610

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 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 ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.5 °C Humidity : 66.7 %RH Pressure : 1007.5 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1019.4 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.53	0.032	0.15
O ₂ (%Vol)	10.04	10.09	0.05	0.20
O ₂ (%Vol)	21.02	21.11	0.09	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1003	1000	-3	12
NO ₂ (ppm)	30.34	28.2	-2.14	8.0
NO ₂ (ppm)	80.96	79.4	-1.56	8.0
NO ₂ (ppm)	201.9	200.8	-1.1	12
NO (ppm)	30.01	28	-2.01	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	325	2.5	12
SO ₂ (ppm)	50.36	51	0.64	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	600.8	600	-0.8	13

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

End of Report

FM-CL-09-C Rev.8

Page 2 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID : 0106536035591 www.entech.co.th

เอกสารไม่ควบคุม

Certificate No: G 660610

Date of issue : 05-Oct-23

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 02398589/208
Instrument serial no. : 02376344/208
ID no. or control no. : UAE.EHA2.113/2555
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 UDOMSUK41, SUKHUMVIT ROAD, BANGCHAK PRAKONG BANGKOK 10260

Total pages of certificate : 2 Pages
Receiving no. : U-233244
Receiving date : 28-Sep-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,80.96,201.9 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 Measurement were carried out the stabilized laboratory

Temperature : 23 ±5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, 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 measurement 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 reproduced 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 traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 04-Oct-23

Mr. Kwanchai Khamduang
Calibration Technician

Mrs. Nongluck Wongpattee
Technical Manager

FM-CL-09-C Rev.8

Page 1 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID : 0106536035591 www.entech.co.th

เอกสารไม่ควบคุม

Certificate No.: G 660614

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 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 ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.1 °C Humidity : 66.7 %RH Pressure : 1009.4 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1019.4 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.48	-0.018	0.15
O ₂ (%Vol)	10.04	10.07	0.03	0.20
O ₂ (%Vol)	21.02	21.10	0.08	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	304	2	6.0
CO (ppm)	1003	1008	5	12
NO ₂ (ppm)	30.34	28.2	-2.14	8.0
NO ₂ (ppm)	80.96	80.5	-0.46	8.0
NO ₂ (ppm)	201.9	204.7	2.8	12
NO (ppm)	30.01	29	-1.01	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	322	-0.5	12
SO ₂ (ppm)	50.36	50	-0.36	6.0
SO ₂ (ppm)	100.8	103	2.2	6.0
SO ₂ (ppm)	600.8	606	5.2	13

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

End of Report

FM-CL-09-C Rev.8

Page 2 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID : 0106536035591 www.entech.co.th

เอกสารไม่ควบคุม

Certificate No: G 660614

Date of issue : 06-Oct-23

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03099402/701
Instrument serial no. : 60899617/701
ID no. or control no. : UAE.EFM. 007/2560
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 Udomsak 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260

Total pages of certificate : 2 Pages
Receiving no. : U-233244
Receiving date : 28-Sep-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,80.96,201.9 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 Measurement were carried out the stabilized laboratory

Temperature : 23 ±5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, 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 measurement 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 reproduced 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 traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 05-Oct-23

Mr. Kwanchai Khamduang
Calibration Technician

Mrs. Nongluck Wongpattee
Technical Manager

FM-CL-09-C Rev.8

Page 1 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Niamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID : 0106536035591 www.entech.co.th

เอกสารไม่ควบคุม

รายงานผลการปฏิบัติงานตามการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบมลภาวะทางสิ่งแวดล้อม
โครงการปรับปรุงคุณภาพน้ำดื่ม บริษัท บางจาก ศรีราชา จำกัด (มหาชน)
ประจำปี พ.ศ. 2567

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองทั้งหมด (TSP) ฝุ่นละอองขนาดเล็กกว่า 10 ไมครอน (PM-10)	Mettler-Toledo	MS203S/01 B007010311	National Food Institute, Ministry of Industry, Thailand	2402284-001-01	2 Apr 24	1 Apr 25	-
2	Analytical Balance (Readability 0.1 mg)		Mettler-Toledo	MS204TS/00 C252434235	National Food Institute, Ministry of Industry, Thailand	2402420-003-01	19 Apr 24	18 Apr 25	-

รายงานผลการปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม
โครงการปรับปรุงคุณภาพน้ำนั้น บริษัท บางจาก คอร์ปอเรชั่น จำกัด (มหาชน)
ประจำปี พ.ศ. 2567

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพน้ำ									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 123115210	National Food Institute, Ministry of Industry, Thailand	2401718-001-01	11 Mar 24	10 Mar 25	-
2	pH Meter		Mettler-Toledo	Seven Easy S20 / 1230525212	DKSH (Thailand) Ltd.	C072401.67	9 Apr 24	8 Apr 25	-
3	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (SS) ของแข็งทั้งหมด (TS)	Mettler-Toledo	XSR20SDU / C09071872	National Food Institute, Ministry of Industry, Thailand	2402283-001-01	2 Apr 24	1 Apr 25	-
4	Analytical Balance (Readability 0.01 mg)	ของแข็งละลายน้ำทั้งหมด (TDS)	Mettler-Toledo	XSR20SDU / C210685394	National Food Institute, Ministry of Industry, Thailand	2402283-002-01	2 Apr 24	1 Apr 25	-
5	Hot Air Oven		Memmert	UF55 / B2120411	Technology Promotion Association (Thailand-Japan)	24TM589	1 Apr 24	31 Mar 25	-
6	Analytical Balance (Readability 0.1 mg)	น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	XSR204 / C117655043	Technology Promotion Association (Thailand-Japan)	24MM293	11 May 24	10 May 25	-
7	BOD Incubator	บีโอดี (BOD)	Aico	UC4-1320 / (UAE:WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	24TM303	10 Feb 24	8 Feb 25	-
8	BOD Incubator		Aico	UR-1320 / (UAE:WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	24TM587	1 Apr 24	31 Mar 25	-
9	COD Reactor (Heating Block)	ซีโอดี (COD)	Hanna	H839800-02 / H0185001	Hanna Instruments (Thailand) Ltd.	HIT-2412-0389	18 Mar 24	17 Mar 25	-
10	COD Reactor (Heating Block)		Hanna	H839800-02 / 1147807	Hanna Instruments (Thailand) Ltd.	HIT-2417-0568	23 Apr 24	22 Apr 25	-
11	UV-VIS Spectrophotometer	ไฮโดรไลต์ (CN), ฟีนอล (Phenol), ซีโอดี (COD) ฟีนอล (Phenol)	Agilent Technologies	Cary60 G6860A / MV15410009	DOE Services Co.,Ltd.	SP24-018	7 May 24	6 May 25	-
12	UV-VIS Spectrophotometer		Hitachi	U-1900 / 2021-064	DOE Services Co.,Ltd.	SP24-008	16 Jan 24	14 Jan 25	-
13	Atomic Absorption Spectrophotometer (AAS)	ปรอท (Hg)-น้ำทิ้ง	Agilent Technologies	System ID: G8432A A4240FS / MV13160001	Thailand Institute of Scientific and Technological Research (TISTR)	MIT-ACL No. 387/67	2 Feb 24	31 Jan 25	-
14	Cold Vapor Atomic Fluorescence Spectrometer (CVAFS)	ปรอท (Hg)-น้ำทะเล	Analytik Jena	mercur DUO plus / KI70A0153	Analytik Jena Fairfast Thailand Ltd.	Maintenance Protocol	12 Feb 24	10 Feb 25	-

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

Calibration Report

Certificate No.:	2401178-001-01				
Equipment:	pH Meter	Resolution:	0.01 pH ± 1 mV		
	Manufacturer: METTLER TOLEDO	Model:	SevenEasy pH		
	Serial No.: 123155210	Type:	Bench-top		
	ID No.: UAE-WAT 0102553				
Date of Calibration:	11 March 2024				
Location:	Chemical Calibration Laboratory, National Food Institute				
Environment Condition:	Ambient Temperature: (23.4 ± 1.5) °C	Relative Humidity:	(51 ± 3) %		
Condition of Equipment:	Good Condition				
Condition of This Results of Calibration					
1. Calibration Method	W-CO-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.	Expiry Date	
2.1 pH Voltage Calibrator	2190903	Fluke	21F5003A	12 June 2024	
2.2 Digital Thermometer	2190907	Fluke	CC 66207-01	30 October 2024	
2.3 Thermo-Hygro Meter	NFLBTH 014793	Isto	CC 662053-01	3 April 2024	
Certified Reference Material	Lot No.	Manufacturer	Ref.N	Expiry Date	
2.4 pH buffer 4.008 (Primary pH buffer Solution)	688842	CPAchem	PH416.L5	13 April 2025	
2.5 pH buffer 6.865 (Primary pH buffer Solution)	688843	CPAchem	PH417.L5	13 April 2025	
2.6 pH buffer 10.01 (Primary pH buffer Solution)	688844	CPAchem	PH420.L5	13 April 2024	
2.7 pH buffer 7.00 (Standard pH buffer Solution)	200109	HACH LANGE GmbH	S119004	18 October 2022	
3. This certification is traceable to The International System of Unit (SI Unit)					
3.1 Instruments No.2,1	through	NISC-TISI-TS 17025 Laboratory Accredited of Calibration No.0008			
3.2 Instruments No.2,2 and 2,3	through	NISC-TISI-TS 17025 Laboratory Accredited of Calibration No.0081			
3.3 Certified Reference Material No.2,4 to 2,6	traceable to	Primary measurement method- Homed cell using calibrated thermometer, thermometer, 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 No. PTB-BPCA.84393504029 and Certificate No. PTB-PH05-5550062022 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany)			
4. This result 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

2008 Bangkok, 39 Bangkok, Bangkok 10110, Thailand
2008 So 35, Anu Annu Road, Bang Yai, Bangkok 10110, Thailand
Tel: +66(0) 2422 8588 Fax: +66(0) 2422 8545

Calibration Certificate

Certificate No.:	2401718-001-01
Client name:	UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address:	3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhnong, Bangkok 10260

Equipment:	pH Meter
Manufacturer:	METTLER TOLEDO
Model:	SevenEasy pH
Serial No.:	1231155210
ID No.:	UAE.WAT.010/2553
Order No.:	2401718
Operation No.:	2401718-001
Date of Receipt:	27 February 2024
Date of Calibration:	11 March 2024

Calibrated by	Mr.Manas Somsak Specialist	Approved by	 (Mr.Pheraphat Tuanjit) Manager, Division of Calibration Laboratory Responsible for the Technical Management Tool
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Date of Issue: 12 March 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.

E-CIS-009 Revision: 01 Date: 20-04-65

2000 แขวงถนนสิรินธร 36 แขวงถนนสิรินธร แขวงบางกอกใหญ่ เขตบางกอกใหญ่ กรุงเทพมหานคร **เอกสารไม่ควบคุม**
2000 So 35, Anu Anien Road, Bang 11 Khan Subdist, Bang Phie District, Bangkok 10700, Thailand
Tel: +6621 2424 8888 Fax: +6621 2424 8885

Calibration Report

Certificate No.:	2401718-001-01
Equipment:	Digital Thermometer with RTD (pH Meter)
Resolution:	0.1 °C
Model:	SevenEasy pH
Serial No.:	1231155210
ID No.:	LAE-INT 0102953
Manufacturer:	METTLER TOLEDO
Date of Calibration:	11 March 2024

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition:

Ambient Temperature	23 °C ± 1 °C
Relative Humidity	51 % ± 2 %

Condition of this results of Calibration:

- Calibration Method :
 - In house method: W-T6-025 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 the laboratory is the International Temperature scale of 1990 (ITS-90).
- Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 087786	08-Jun-24	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : Low Temperature Bath (DSOGL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

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

F-CS-012 Revision: 01 Date: 20-04-2015

[illegible]

Calibration Report

Certificate No.:	240118-001-01	Resolution: 0.01 pH	1 mV
Equipment:	pH-Meter	Model:	SevenEasy pH
	Manufacturer: METTLER TOLEDO	Model:	SevenEasy pH
	Serial No.: 1231155210	Type:	Bench top
	ID No.: UAE.WAT.010/2553		
Date of Calibration:		Page 3 of 3	
11 March 2024			

Calibration Results:					
1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)					
(offset value before adjust: -0.4 mV)					
Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.121	414	0.00	0.58	2.00
2	295.914	296	2.00	0.58	2.00
4	177.484	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.061	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.461	-177	10.00	0.58	2.00
12	-295.911	-296	12.00	0.58	2.00
14	-414.118	-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.:	3005701	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	4.01	189	-	0.0071	2.00
7.001	7.00	13	99.9	0.0066	2.00
10.010	10.01	-160	97.2	0.0085	2.00
6.865	6.87	21	-	0.0074	2.00

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

2008 นานาเอ็นเอชเอ็นจี 30 นานาเอ็นเอชเอ็นจี นานาเอ็นเอชเอ็นจี นานาเอ็นเอชเอ็นจี นานาเอ็นเอชเอ็นจี **เอกสารไม่ควบคุม**
2008 So 30: Anu Anon Road Bang 30 Anon Subdome, Bang Phra District Bangkok 10700 Thailand
Tel : +6621 232 8888 Fax : +6621 232 8885

Reference standard equipment:

Equipment	Certificate no	Cal. date	Next Cal. date
Digital Thermometer with Probe	QR23-1073	2 May 23	2 May 24

Calibration Results:

Without Adjustment

Sensor Type: RTD

Channel: -

Diameter (mm) 4

Length (mm): 135

Immersion (mm): 110

Calibrate Point (°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Uncertainty (± °C)
15.0	15.010	15.1	-0.090	0.076
25.0	25.006	25.1	-0.094	0.076
35.0	35.004	35.0	0.004	0.076

The End of Certificate

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 สุขุมวิท ถนน, กรุงเทพฯ, กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260
Phone: +66 2032 7100 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - in Asia and Beyond.

เอกสารไม่ควบคุม
CAL-FM-C15-14: 06 Dec 2022

Certificate of Calibration

Equipment: Digital Thermometer with Probe
Model: SevenEasy pH
Serial No.: 1230525212
Manufacturer: METTLER TOLEDO
ID No.: UAE.WAS.003/2553

Certificate No.: C15240373
Issued Date: 09 April 2024
Job No.: WO-00024208
Page: 1 of 2
Condition: In Condition

Customer: United Analyst and Engineering Consultant Company Limited
3 Sol Udomsuk 41 Sukhumvit Road,
Bangchak, Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature: 22 °C ± 3 °C
Humidity: 50 %RH ± 20 %RH
Voltage: 220 VAC ± 10 %

Calibration Place: Thermo-Hygro Laboratory, DKSH Technology Limited,
2533 Sukhumvit Road, Bangchak,
Prachanong, Bangkok 10260 Thailand

Calibration By: Mr. Nateekarn Mitjit

Calibration Date: 09 April 2024

The Method used: In house method, CAL-WI-19, by comparison with standard thermometer

Traceability: This certificate is traceable to the International System of Unit maintained by Quality Reborn Co.,Ltd. (QR) Certificate No. QR23-1073

(Mr. Nateekarn Mitjit)

Person in charge

(Mr. Pramote Ramrong)

Authorized signatory

This certificate is issued in the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 สุขุมวิท ถนน, กรุงเทพฯ, กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260
Phone: +66 2032 7100 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - in Asia and Beyond.

เอกสารไม่ควบคุม
CAL-FM-C15-14: 06 Dec 2022

ศูนย์บริการและพัฒนาอุตสาหกรรม
ศูนย์บริการและพัฒนาอุตสาหกรรม
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center



Calibration Certificate

Certificate No.: 2402283-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Sol Udomsuk 41, Sukhumvit Road,
Bangchak, Prachanong, 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.: 2402283

Operation No.: 2402283-001

Date of Receipt: 2 April 2024

Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong
Scientist

Approved by

(Mr. Pramote Ramrong)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 9 April 2024

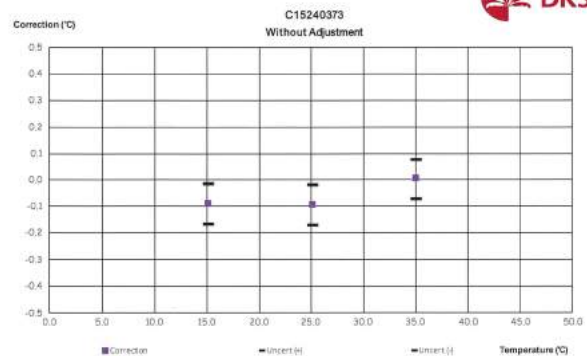
The uncertainties are for a confidence probability of approximately 95%

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

2008 สุขุมวิท ถนน, กรุงเทพฯ, กรุงเทพมหานคร 10260
2008 Sol 36, Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260
Tel: +66(0) 2032 8550 Fax: +66(0) 2032 8545

เอกสารไม่ควบคุม



Delivering Growth - in Asia and Beyond.

เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2402283-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 3 of 4

Calibration Results: (Continued)

Calibration Range: 0 - 80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 80 g ; Resolution: 0.00001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (+g)	Coverage Factor k
Unload	0.00000	0.00000	0.00000	0.0000088	2.00
0.001	0.001003	0.00101	-0.00001	0.0000091	2.00
0.005	0.005003	0.00499	0.00001	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	0.50001	0.00001	0.000014	2.00
1	1.000003	1.00002	-0.00002	0.000016	2.00
2	2.000003	2.00001	0.00001	0.000017	2.00
5	5.000017	5.00002	0.00000	0.000020	2.00
10	10.000009	10.00000	0.00001	0.000026	2.00
20	20.000021	20.00002	0.00001	0.000037	2.00
30	30.000046	30.00003	0.00001	0.000052	2.00
50	50.000028	50.00004	-0.00001	0.000068	2.00
80	80.000068	80.00005	0.00002	0.00011	2.00

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

Calibration Report

Certificate No.: 2402283-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 2 of 4

Environment Condition: Ambient Temperature: 24.5 ± 0.5 °C Relative Humidity: 47.5 ± 2.5 %

Place of Calibration: Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NTE 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	8505567572	TCS	M33040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NF3.BTH 016/23	Quality Reborn	Q824-0343	9 February 2025

3. This certificate 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:

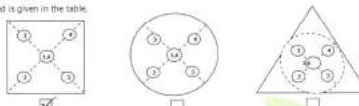
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
40	0.0000052
80	0.0000063
100	0.000048
200	0.000053

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)
100.0002	100.0001	100.0002	99.9999	100.0001	100.0001	0.0003

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

Calibration Certificate

Certificate No.: 2402283-002-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 SOI UDOMSUK 41, SUKHWIT 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.: 2402283

Operation No.: 2402283-002

Date of Receipt: 2 April 2024

Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong **Approved by** (Mr.Phe)

Scientist

Manager, Division of Calibration Laboratory

Date of Issue: 9 April 2024

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.: 2402283-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 4 of 4

Calibration Results: (Continued)

Calibration Range: 81 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 81 - 200 g ; Resolution: 0.0001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (+g)	Coverage Factor k
80	80.00010	80.00000	0.00010	0.000015	2.00
100	100.00006	100.00000	0.00006	0.000015	2.00
110	110.000007	110.00001	0.00000	0.000017	2.00
120	120.000009	120.00000	0.00001	0.000018	2.00
130	130.000010	130.00000	0.00001	0.000019	2.00
140	140.000014	140.00000	0.00001	0.000020	2.00
150	150.000009	150.00001	0.00000	0.000020	2.00
160	160.000010	160.00001	0.00000	0.000022	2.00
170	170.000012	170.00001	0.00000	0.000023	2.00
200	200.000016	200.00000	0.00002	0.000028	2.00

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

----- End -----

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

Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 3 of 4

Calibration Results: (Continued)

Calibration Range: 0 - 80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 80 g; Resolution: 0.00001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Unloaded	0.00000	0.00000	0.00000	0.0000085	2.00
0.001	0.001003	0.00101	-0.00001	0.0000089	2.00
0.005	0.005003	0.00500	0.00000	0.0000092	2.00
0.01	0.010003	0.01000	0.00000	0.0000089	2.00
0.05	0.049996	0.05000	0.00000	0.0000096	2.00
0.1	0.100011	0.10000	0.00001	0.000011	2.00
0.5	0.500016	0.50001	0.00001	0.000014	2.00
1	1.000003	1.00002	-0.00002	0.000016	2.00
2	2.000023	2.00001	0.00001	0.000017	2.00
5	5.000017	5.00002	-0.00000	0.000020	2.00
10	10.000009	10.00000	0.00001	0.000026	2.00
20	20.000031	20.00000	0.00003	0.000037	2.00
30	30.000040	30.00001	0.00003	0.000050	2.00
50	50.000028	50.00002	0.00001	0.000048	2.00
80	80.000058	80.00002	0.00005	0.00011	2.00

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

2008 บำรุงราษฎร์ 36 บำรุงราษฎร์ แขวงบางนา เขตบางนา กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amorn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

nfi.com

Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 2 of 4

Environment Condition: Ambient Temperature: 24.5 ± 0.5 °C Relative Humidity: 47.5 ± 2.5 %

Place of Calibration: Laboratory, 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	850567572	TCS	M23040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-HI	NFI.8TH.015/23	Quality Reborn	QR24-0343	9 February 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:

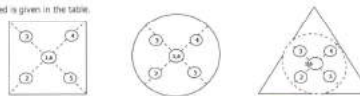
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
40	0.000042
80	0.000052
100	0.000048
200	0.000048

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)
100.0000	100.0001	99.9999	99.9999	100.0001	100.0000	0.0001

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

2008 บำรุงราษฎร์ 36 บำรุงราษฎร์ แขวงบางนา เขตบางนา กรุงเทพมหานคร เอกสารไม่ควบคุม
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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTAKARIN ROAD SOI 36, SUANLIANG, SUANLIANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2719-9484



Cert. No.: 24TM589
Page: 1 of 3

Certificate of Calibration

Equipment: Hot Air Oven
Manufacturer: Memmert
Model: UF 55
Serial No.: B212.0411
ID No.: UAE.WAO.005/2566
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: 01 April 2024
Calibration Date: 01 - 02 April 2024
Ambient Temperature: (26 ± 10) °C
Relative Humidity: (50 ± 30) %
Calibrated by: Krisda Maloe
Approved by: [Signature]
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date: 5 April 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.

เอกสารไม่ควบคุม
A 0065065

Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.0001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 220 g

Date of Calibration: 2 April 2024

Page 4 of 4

Calibration Results: (Continued)

Calibration Range: 81 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 81 - 200 g; Resolution: 0.0001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
90	90.00010	90.00001	0.00009	0.000015	2.00
100	100.00006	100.00001	0.00005	0.000015	2.00
110	110.00007	110.00001	0.00006	0.000016	2.00
120	120.00009	120.00000	0.00009	0.000017	2.00
130	130.00010	130.00000	0.00010	0.000019	2.00
140	140.00014	140.00000	0.00014	0.000020	2.00
150	150.00009	150.00001	0.00008	0.000020	2.00
160	160.00010	160.00001	0.00009	0.000022	2.00
170	170.00012	170.00001	0.00011	0.000023	2.00
200	200.00016	200.00002	0.00014	0.000028	2.00

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

***** End *****

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

2008 บำรุงราษฎร์ 36 บำรุงราษฎร์ แขวงบางนา เขตบางนา กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amorn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

nfi.com



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0004OC-3
Result of Calibration :-
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM589
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor
104.0	104.0	104.0	0.032	0.47	0.84	2
120.0	120.0	120.0	0.12	0.72	1.3	2
180.0	180.0	180.0	0.13	1.2	1.5	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.464	103.847	104.226	104.232	104.106	103.691	104.275	104.127	104.013	0.42
120.0	120.486	120.089	120.635	120.596	119.531	119.644	120.364	120.144	120.158	1.1
180.0	180.574	179.769	180.285	180.870	179.594	179.790	180.287	179.961	179.802	1.1

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 %.

-000-

เอกสารไม่ควบคุม
a 1209738



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0004OC-3

Cert. No.: 24TM589
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) and Thermocouple Type T.

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	MY57013711	23LM115	TPA	11 Jul 2024

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

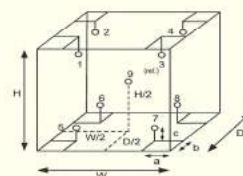
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
Dimension of Chamber :
D = 0.50 m
W = 0.80 m
H = 0.75 m
Capacity = 0.30 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	26
REL Humid. (%)	47	48
AC Supply (Volt)	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	(120 to 180) °C	(104) °C
1	21-18TC-01	22-18RTD-2/1
2	21-18TC-02	18RTD-2/2
3	21-18TC-03	18RTD-2/3
4	21-18TC-04	18RTD-2/4
5	21-18TC-05	18RTD-2/5
6	21-18TC-06	18RTD-2/6
7	21-18TC-07	18RTD-2/7
8	21-18TC-08	18RTD-2/8
9 (ref.)	21-18TC-09	18RTD-2/9

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a 1209739



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-2

Cert.No.: 24MM293
Page: 2 of 3

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:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
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 :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor
100	100.0000	0.0000	0.27	2.03
200	200.0001	-0.0001	0.31	2

After Adjustment :

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

Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00007
200	0.00007

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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.: 24MM293
Page.: 1 of 3

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : XSR204
Serial No. : C117635043
ID No. : UAE.WAS.012/2564
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 :
() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 15 May 2024

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 24TM303
Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URC4S013201
ID No. : UAE.WAO.015/2561
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 : 10 February 2024
Calibration Date : 10 February 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :

() Pornthippa Tameyakul
(x) Unnophol Harachai
() Suwit Imjai

Issue Date : 19 February 2024

The Uncertainties are for a confidence probability of approximately 95%

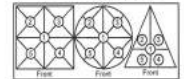
This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0160C-2
Result of calibration

Cert.No.: 24MM293
Page: 3 of 3



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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
+0.0002	-0.0001	0.0000	+0.0002	0.0000	0.0003

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.0000	0.0000	0.15	2.13
1	1.0000	0.0000	0.15	2.13
5	5.0000	0.0000	0.15	2.13
10	10.0000	0.0000	0.15	2.11
20	20.0000	-0.0000	0.19	2.03
50	50.0001	-0.0001	0.19	2.06
60	60.0001	-0.0001	0.19	2.04
80	80.0001	-0.0001	0.27	2
100	100.0002	-0.0002	0.27	2.03
120	120.0001	-0.0001	0.29	2
200	200.0001	-0.0001	0.31	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 %.

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เอกสารไม่ควบคุม



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2402-0234OC-1

Cert. No.: 24TM303
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	MY59003411	23LM208	TPA	27 Dec 2024

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

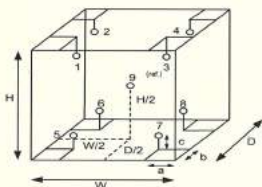
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



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 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	31
REL.Humid. (%)	70	65
AC Supply (Volt)	233	234

Position :	Ref. Std. ID No.:
1	20RTD-2/1
2	20RTD-2/2
3	20RTD-2/3
4	20RTD-2/4
5	20RTD-2/5
6	20RTD-2/6
7	20RTD-2/7
8	20RTD-2/8
9 (ref.)	20RTD-2/9

เอกสารไม่ควบคุม



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2402-0234OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 24TM303
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.1	19.9	0.37	0.72	1.4	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.873	19.803	20.322	19.690	19.615	19.585	19.612	19.558	19.645	0.58

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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เอกสารไม่ควบคุม



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2404-0004OC-1

Cert. No.: 24TM587
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	MY57013711	23LM115	TPA	11 Jul 2024

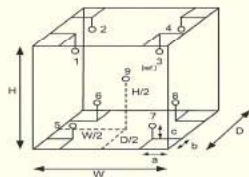
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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)	27	26
REL.Humid. (%)	48	49
AC Supply (Volt)	221	220

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	23-18RTD-06
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

Probe Installation Details :

a = 10 cm	D = 0.62 m
b = 10 cm	W = 1.2 m
c = 10 cm	H = 1.2 m
	Capacity = 0.80 m ³

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a 1209743



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3009-29 FAX. 0-2719-9484



Certificate of Calibration

Cert. No.: 24TM587
Page : 1 of 3

Equipment : BOD Incubator

Manufacturer : ARCO

Model : UR-1320

Serial No. :

ID No. : UAE.WAO.018/2551

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 : 01 April 2024

Calibration Date : 01 April 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Krinda Malee

Approved by :

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

Issue Date : 5 April 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 & Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม
A 0065063



Hanna Instruments (Thailand) Ltd.

410/67-68 Soi Ratchadapisek 24, Ratchadapisek Rd., Samsen-mok,
Huaykwang, Bangkok 10310 Tel: 0-2541-4199 Fax: 0-2541-4198



Certificate No. : HIT-2412-0389

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater

Meter Model : HI839800-02

Tube Heater : 25 Vial Capacity

Temperature Range : (-10 to 160)°C

Manufacturer : Hanna Instruments

Condition As-Received : Used Product

Ambient Temperature : (25 ± 2)°C

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

3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,
Phrakhanong, Bangkok 10260

Received date : 18 March 2024

Calibrate date : 18 March 2024

Issue date : 20 March 2024

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.

Serial No. : HI018500I

Resolution : 0.1°C

Temperature of Reaction : 150°C

Made in : Romania

Reference : RE240478

Relative Humidity : (50 ± 15)%RH

Calibrated by : ☒ Mr. Pichit Pethong
☐ Mr. Channarong Soinak

Approved by :
Mr. Anan Suwanchaisakul
Authorized Signatory



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



Equipment : BOD Incubator

Condition As-Received : Used Item

Reference : 2404-0004OC-1

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Cert. No.: 24TM587

Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.45	0.55	1.3	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.954	20.183	20.235	19.707	19.706	19.739	19.785	19.821	19.828	0.66

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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a 1209742


Certificate No. : HIT-2417-0568

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02 Serial No. : 1147807
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 : RE240681
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 : 22 April 2024
Calibrate date : 23 April 2024
Issue date : 25 April 2024
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 Suwanakulchai
Authorized Signatory



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).

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Certificate No. : HIT-2412-0389

Page : 2 of 2

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	WK2307-164-1	WK Electric Co., Ltd.
Digital Thermo-Hygrometer	HT-771SD	AL07155	24H41	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	150.0	0.50

Unit : °C

(1A)	(2A)	(3A)	(4A)	(5A)
150.308	150.221	150.101	150.121	149.738
(1B)	(2B)	(3B)	(4B)	(5B)
150.011	149.395	150.792	149.934	150.178
(1C)	(2C)	(3C)	(4C)	(5C)
150.071	150.052	150.477	150.400	150.451
(1D)	(2D)	(3D)	(4D)	(5D)
149.225	149.601	149.411	150.014	149.708
(1E)	(2E)	(3E)	(4E)	(5E)
150.096	149.107	150.024	150.002	149.342

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

CERTIFICATE OF CALIBRATION

Certificate No. : SP24-018 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 : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : UAE.WAT.020/2558

Received Date : 7 May 2024

Calibration Date : 7 May 2024

Issue Date : 9 May 2024

Condition Instrument : Good

Calibrated by : 

Technical Manager

Approved by : (Ms. Chonnam Sungsangern)
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

Certificate No. : HIT-2417-0568

Page : 2 of 2

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	WK2307-164-1	WK Electric Co., Ltd.
Digital Thermo-Hygrometer	HT-771SD	AL07155	24H41	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	149.8	0.49

Unit : °C

(1A)	(2A)	(3A)	(4A)	(5A)
148.901	149.249	149.950	150.042	149.186
(1B)	(2B)	(3B)	(4B)	(5B)
149.724	149.578	149.852	150.100	150.117
(1C)	(2C)	(3C)	(4C)	(5C)
149.863	149.799	150.233	149.847	149.977
(1D)	(2D)	(3D)	(4D)	(5D)
149.550	149.666	149.958	149.744	149.819
(1E)	(2E)	(3E)	(4E)	(5E)
150.044	149.869	149.361	149.973	149.654

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 **

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REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5780	0.5747	0.0033	0.0031	2.00
	1.0484	1.0438	0.0046	0.0029	2.00
	2.1876	2.1832	0.0044	0.0080	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5595	0.5581	0.0014	0.0034	2.00
	1.0239	1.0231	0.0008	0.0035	2.00
	2.1230	2.1219	0.0011	0.0080	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5230	0.5184	0.0046	0.0030	2.00
	0.9633	0.9614	0.0019	0.0029	2.00
	1.9753	1.9731	0.0022	0.0070	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5181	0.5150	0.0031	0.0031	2.00
	1.0002	0.9964	0.0038	0.0033	2.00
	1.9973	1.9914	0.0059	0.0088	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5517	0.5485	0.0032	0.0030	2.00
	1.0803	1.0772	0.0031	0.0030	2.00
	2.0373	2.0293	0.0080	0.0080	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5591	0.5565	0.0026	0.0031	2.00
	1.0518	1.0482	0.0036	0.0030	2.00
	1.9274	1.9202	0.0072	0.0079	2.00

เอกสารไม่ควบคุม



REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 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 : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

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REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.9	0.16	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.1	0.49	0.18	2.00
445.94	445.6	0.34	0.18	2.00
453.66	453.3	0.36	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.0	0.59	0.18	2.00
637.98	638.7	-0.72	0.18	2.00
431.38	430.8	0.58	0.18	2.00
472.50	472.4	0.10	0.18	2.00
513.47	513.7	-0.23	0.18	2.00
528.88	529.1	-0.22	0.18	2.00
573.17	573.5	-0.33	0.18	2.00
585.35	585.2	0.15	0.20	2.00
684.40	685.1	-0.70	0.18	2.00
740.72	741.4	-0.68	0.20	2.00
748.55	749.1	-0.55	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.3	-0.02	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%

- * Indicates non TISI accredited

- End of Certificate -

เอกสารไม่ควบคุม



REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7469	0.7435	0.0034	0.0057	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8674	0.8639	0.0035	0.0060	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2919	0.2907	0.0012	0.0051	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6430	0.6402	0.0028	0.0055	2.00

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REPORT OF CALIBRATION

Certificate No. : SP24-008

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 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 : 4.0 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.

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FM-708-02 R01 1/11/2021

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CERTIFICATE OF CALIBRATION

Certificate No. : SP24-008

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-1900

Serial No. : 2021-064

ID No. : UAE.WAS.006/2552

Received Date : 16 January 2024

Calibration Date : 16 January 2024

Issue Date : 19 January 2024

Condition Instrument : Good

Calibrated by :

(Mr.Tanawat Rittsach)

Technical Manager

Approved by :

(Ms. Chonthicha Sangern)

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 accuracy is recognized national standards and to the work of measurement realized as 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.

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REPORT OF CALIBRATION

Certificate No. : SP24-008

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Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7469	0.748	-0.0011	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.865	0.0024	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.293	-0.0011	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.641	0.0020	0.0055	2.00

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FM-708-02 R01 1/11/2021

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REPORT OF CALIBRATION

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Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.575	0.0030	0.0031	2.00
	1.0484	1.046	0.0024	0.0029	2.00
	2.1876	2.186	0.0016	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.558	0.0015	0.0034	2.00
	1.0239	1.024	-0.0001	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	0.520	0.0030	0.0030	2.00
	0.9633	0.961	0.0023	0.0029	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	0.516	0.0021	0.0031	2.00
	1.0002	0.999	0.0012	0.0033	2.00
	1.9973	1.994	0.0033	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.550	0.0017	0.0030	2.00
	1.0803	1.080	0.0003	0.0030	2.00
	2.0373	2.032	0.0052	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.558	0.0011	0.0031	2.00
	1.0518	1.051	0.0008	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

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FM-708-02 R01 1/11/2021



Request No. 25-67 / 0275

MTC. ACL.No. 358 / 67

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"

Model AA240FS, Serial No. MY13160001

2. Working standard solution "Inorganic Ventures"

Multi Analyte Custom Grade Solution, Lot No. S2-MEB675610

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udumsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer (WI-500-02-30)

2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

CALIBRATION RANGE: 0.02, 0.10, 0.30, 0.50, 0.70 mg/L at 228.8 nm Cd, 0.10, 0.20, 0.30, 0.50, 0.70 mg/L at 357.9 nm Cr,
0.05, 0.10, 0.30, 0.50, 0.70 mg/L at 324.7 nm Cu, 0.10, 0.30, 0.50, 0.70, 1.00 mg/L at 248.3 nm Fe,
0.20, 0.50, 0.70, 1.00, 1.50 mg/L at 217.0 nm Pb, 0.05, 0.10, 0.30, 0.50, 0.70 mg/L at 279.5 nm Mn,
0.10, 0.30, 0.50, 0.70, 1.00 mg/L at 232.0 nm Ni, 0.05, 0.10, 0.30, 0.50, 0.70 mg/L at 213.9 nm Zn

CALIBRATION DATE : 2 February 2024

REFERENCE MATERIAL : Traceable to NIST "Agilent Technologies", "CARLO ERBA"

Cadmium Lot No. 0006589926, Chromium Lot No. 0112384886, Copper Batch No. T117098A, Iron Batch No. T126087A,
Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 25 ± 5 °C Relative humidity 50 ± 20 %

The Atomic Absorption Spectrophotometer has been calibrated against Reference Material traceable to National Institute of Standards and Technology (NIST) by The Analytical Chemistry Laboratory. The results are attached herewith.

Calibrated by [Redacted]
(Mr. Atitpat Ratana)Approved by [Redacted]
(Miss Sirinida Uayawong)

Director of Analytical Chemistry Laboratory

Ref. 2015267020100454001

Issued Date : 11 March 2024

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REPORT OF CALIBRATION

Certificate No. : SP24-008

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Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.54	241.1	0.44	0.18	2.00
279.40	278.9	0.50	0.18	2.00
288.70	288.0	0.70	0.18	2.00
334.22	333.8	0.42	0.18	2.00
361.26	360.8	0.46	0.18	2.00
418.48	418.2	0.28	0.18	2.00
446.70	446.0	0.70	0.18	2.00
453.20	453.1	0.10	0.18	2.00
460.06	459.6	0.46	0.18	2.00
536.90	536.4	0.50	0.18	2.00
637.94	637.6	0.34	0.18	2.00
440.74	440.1	0.64	0.18	2.00
472.22	472.0	0.22	0.18	2.00
513.70	513.5	0.20	0.18	2.00
528.72	528.2	0.52	0.18	2.00
574.60	574.3	0.30	0.18	2.00
585.48	585.0	0.48	0.20	2.00
684.63	684.2	0.43	0.18	2.00
740.27	740.0	0.27	0.20	2.00
748.28	747.8	0.48	0.18	2.00
807.16	806.8	0.36	0.18	2.00
879.70	879.2	0.50	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%

- * Indicates non-ISO notation

- End of Certificate -

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FM-704-02 R01 1/11/2021



Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

2. Precision

Element	Conc. (mg/L)	Absorbance	Ave. Abs.	SD	NRSD
Cd	0.02	0.0078 0.0076 0.0069 0.0075 0.0071 0.0070 0.0076 0.0074 0.0077 0.0067 0.007 0.0064 5.15			
	0.50	0.1008 0.1007 0.0999 0.0997 0.1000 0.0996 0.1008 0.1007 0.1005 0.0999 0.100 0.0005 0.46			
	0.70	0.2301 0.2306 0.2277 0.2305 0.2310 0.2295 0.2290 0.2293 0.2305 0.2296 0.230 0.0010 0.42			
	0.10	0.0094 0.0093 0.0093 0.0098 0.0094 0.0095 0.0090 0.0090 0.0094 0.0090 0.009 0.0003 2.75			
Cr	0.30	0.0241 0.0236 0.0221 0.0238 0.0231 0.0226 0.0231 0.0223 0.0230 0.0231 0.023 0.0006 2.75			
	0.70	0.0500 0.0500 0.0500 0.0524 0.0499 0.0511 0.0509 0.0512 0.0515 0.0504 0.051 0.0008 1.63			
	0.05	0.0061 0.0062 0.0064 0.0061 0.0069 0.0061 0.0062 0.0064 0.0061 0.006 0.0003 5.00			
	0.30	0.0419 0.0411 0.0402 0.0407 0.0405 0.0404 0.0399 0.0400 0.0399 0.0400 0.040 0.0006 1.58			
Cu	0.70	0.0960 0.0960 0.0960 0.0959 0.0947 0.0955 0.0952 0.0952 0.0951 0.0955 0.096 0.0005 0.48			
	0.10	0.0096 0.0101 0.0103 0.0100 0.0099 0.0096 0.0106 0.0099 0.0105 0.0102 0.010 0.0003 3.38			
	0.50	0.0424 0.0415 0.0428 0.0427 0.0421 0.0426 0.0413 0.0430 0.0421 0.0419 0.042 0.0006 1.33			
	1.00	0.0830 0.0839 0.0847 0.0834 0.0832 0.0820 0.0839 0.0838 0.0837 0.0845 0.084 0.0008 0.92			
Fe	0.20	0.0078 0.0074 0.0078 0.0078 0.0076 0.0078 0.0077 0.0078 0.0078 0.0077 0.008 0.0001 1.71			
	0.70	0.0278 0.0273 0.0271 0.0267 0.0270 0.0264 0.0274 0.0273 0.0269 0.0269 0.027 0.0004 1.45			
	1.50	0.0531 0.0548 0.0552 0.0555 0.0547 0.0546 0.0544 0.0544 0.0549 0.0547 0.055 0.0004 0.64			
	0.05	0.0116 0.0107 0.0110 0.0103 0.0108 0.0108 0.0112 0.0107 0.0109 0.0108 0.011 0.0003 3.15			
Mn	0.30	0.0630 0.0649 0.0649 0.0651 0.0646 0.0646 0.0649 0.0646 0.0640 0.0648 0.065 0.0003 0.48			
	0.70	0.1463 0.1465 0.1459 0.1471 0.1475 0.1474 0.1487 0.1473 0.1462 0.1468 0.147 0.0008 0.56			
	0.10	0.0095 0.0100 0.0096 0.0103 0.0102 0.0096 0.0100 0.0095 0.0097 0.0096 0.010 0.0003 3.04			
	0.50	0.0943 0.0933 0.0938 0.0944 0.0930 0.0937 0.0944 0.0937 0.0938 0.0934 0.094 0.0005 1.09			
Ni	1.00	0.0812 0.0820 0.0834 0.0829 0.0818 0.0829 0.0831 0.0835 0.0816 0.0819 0.082 0.0008 0.99			
	0.05	0.0374 0.0377 0.0373 0.0377 0.0374 0.0377 0.0373 0.0371 0.0371 0.0374 0.037 0.0002 0.61			
	0.30	0.1985 0.1993 0.1975 0.1992 0.1979 0.1988 0.1993 0.1985 0.1978 0.2004 0.199 0.0009 0.52			
	0.70	0.4027 0.4031 0.4019 0.4021 0.4023 0.3981 0.4042 0.4025 0.3993 0.3997 0.402 0.0019 0.42			

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

CALIBRATION DATA

1. Noise Level

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
Absorbance	0.0006	0.0004	-0.0003	0.0001	-0.0011	-0.0005	0.0008	0.0004
	0.001	0.0017	-0.0009	0.0008	0.0001	0.0002	-0.0003	0.0007
	0.0006	0.0017	-0.0020	0.0005	0.0005	0.0004	0.0013	0.0014
	0.0001	0.0018	-0.0007	0.0005	-0.0004	-0.0005	-0.0001	0.0010
	-0.0001	0.0019	-0.0014	0.0003	0.0010	0.0000	0.0002	-0.0001
	0.0011	0.0014	-0.0017	0.0009	-0.0008	0.0004	0.0006	0.0010
	-0.0002	0.0015	-0.0015	0.0003	0.0002	-0.0008	0.0009	0.0013
	0.0006	0.0012	-0.0001	0.0006	0.0008	0.0001	-0.0002	0.0013
	0.0008	0.0009	-0.0003	0.0003	0.0005	0.0002	0.0001	0.0007
	0.0012	0.0011	-0.0012	0.0008	0.0003	0.0004	0.0004	0.0013
	0.0003	0.0015	-0.0019	0.0001	-0.0002	0.0000	-0.0003	0.0003
	0.0005	0.0017	-0.0019	-0.0007	0.0000	-0.0007	0.0005	0.0005
	-0.0006	0.0016	0.0000	0.0006	-0.0001	0.0013	0.0006	0.0010
	0.0003	0.0011	-0.0002	0.0001	-0.0007	0.0009	0.0009	0.0002
	0.0003	0.0012	-0.0011	0.0007	-0.0003	-0.0003	0.0010	0.0009
	0.0004	0.0018	-0.0016	-0.0004	-0.0006	0.0008	0.0007	0.0007
Average Absorbance	-0.0001	0.0018	-0.0018	0.0013	-0.0006	-0.0001	0.0014	0.0006
	0.0003	0.0017	-0.0001	0.0001	-0.0012	-0.0004	0.0001	0.0002
	0.0010	0.0018	-0.0007	0.0003	-0.0005	-0.0002	0.001	0.0003
	0.0004	0.0019	-0.0008	-0.0001	-0.0004	0.0003	0.0002	0.0008

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

3.4 Reading on wavelength- Iron (Fe) at 248.3 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Fe	0.100	0.104	0.005	4.60	± 0.014
	0.500	0.482	-0.018	3.55	± 0.016
	1.006	0.968	-0.038	3.75	± 0.029

3.5 Reading on wavelength- Lead (Pb) at 217.0 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Pb	0.201	0.202	0.001	0.54	± 0.014
	0.706	0.719	0.012	1.73	± 0.030
	1.513	1.459	-0.054	3.57	± 0.061

3.6 Reading on wavelength- Manganese (Mn) at 279.5 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Mn	0.0505	0.050	0.000	0.83	± 0.005
	0.3031	0.306	0.003	1.12	± 0.007
	0.7023	0.698	-0.004	0.62	± 0.005

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

3. Trueness

3.1 Reading on wavelength- Cadmium (Cd) at 228.8 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cd	0.020	0.020	0.000	1.10	± 0.005
	0.301	0.301	0.000	0.11	± 0.005
	0.707	0.693	-0.013	1.85	± 0.008

3.2 Reading on wavelength- Chromium (Cr) at 357.9 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cr	0.1007	0.104	0.004	3.49	± 0.009
	0.3035	0.297	-0.006	2.11	± 0.012
	0.7071	0.685	-0.023	3.19	± 0.023

3.3 Reading on wavelength- Copper (Cu) at 324.7 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cu	0.051	0.047	-0.004	7.58	± 0.003
	0.303	0.296	-0.007	2.19	± 0.009
	0.704	0.698	-0.005	0.71	± 0.005

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FMBL/MTC.002 Rev.4

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analytikjena
An Endress+Hauser Company

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur DUO /
mercur DUO plus

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Request No. 25-67 / 0275

5 / 5

MTC. ACL. No. 358 / 67

3.7 Reading on wavelength- Nickel (Ni) at 232.0 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Ni	0.101	0.098	-0.003	2.90	± 0.013
	0.508	0.502	-0.006	1.16	± 0.018
	1.012	0.962	-0.051	5.02	± 0.032

3.8 Reading on wavelength- Zinc (Zn) at 213.9 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Zn	0.050	0.045	-0.005	9.39	± 0.013
	0.303	0.324	0.021	7.04	± 0.013
	0.707	0.675	-0.032	4.52	± 0.019

Remark : The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 (k = 2)
which gives a level of confidence of approximately 95%

Calibrated by _____
(Mr. Atipat Ratana)

Approved by _____
(Miss Suladda Deawtong)
Director of Analytical Chemistry Laboratory
Issued Date : 11 March 2024

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE
End of Certificate

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Fax. (66) 0 2579 8592
E-mail : sunalee@tistr.or.th

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Maintenance works basic unit

tightness visual check inside the Mercur ☒
visual check if gold-traps are broken ☒
visual check if spectrometer is contaminated ☒
visual check of the fluorescence cell ☒
visual check of the absorption cell, incl. window ☒
reactor cleaning ☒
check pump-hose, if necessary change it ☒
check swivel drive (SEV) ☒
check drying-hose, output gas-liquid-separator ☒
test Bubble-Sensor ☒
check gas flows ☒
check volume flows, reagents ☒
recording stray light values ☒
measurement with 30 ng/l ☒

Maintenance works Autosampler

Serial No.: N/A

lubricate the dosing-winding (Teflon-grease-spray) ☐
clean the dosing cylinder, if necessary exchange it ☐
lubricate the winding system of the height drive with some drops of oil ☐
check the toothed belt ☐
check the position of the mechanical stopper (height: 13mm) ☐
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s) ☐
check the pump rate of washing cup ☐
check the electrical hose connections for good contact ☐
check the connectors of the magnetic valves ☐
check the dosing hose for buckling, if necessary exchange it ☐

Serial-No.: K170A0153 Customer-No.: C04-006
Date: 12 February 2024 Carried out by: Mr. Srichai Fak-On

Maintenance with following Operational Qualification (OQ) ☐
(requires a separate OQ protocol)

Company	บริษัท ยูโนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริงคอนซัลแตนท์ จำกัด
User	คุณกรวิทย์
Department	ห้องปฏิบัติการ (Mercur Analysis)
Street	3 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง
Zip Code, City	กรุงเทพมหานคร 10260
Country	ประเทศไทย
Phone	
Fax	
E-mail	

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max conc.: 10 µg/L PMT-voltage:451.....V		
Blank-solution without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int 0.0005 Int 0.0027 RSD 1.81 %
Conditions.: max conc.: 1.7 µg/L PMT-voltage:444.....V		
Blank-solution without enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int 0.0043 Int 0.0171 RSD 1.81 %
Fok.-factor (Int ₂ / Int ₁)	> 3.5	6.33
Analytical parameters Absorption cell		
Blank-solution without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext 0.0004 Ext 0.0025 RSD 3.17 %
Comments		
# Sensitivity check (Without enrichment / FBR / 100 ng/L)		
Int. Blank = 0.0008		
Int. 100 ng/L = 0.0097		
RSD % = 0.96		

Signature Technician

Place, Date (DD/MM/YYYY)

Signature Customer

Place, Date (DD/MM/YYYY)

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor	o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
Valve 1	10 Nl/h or 0.166 NL/min	0.166 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.833 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.083 NL/min
Valve 4	10 Nl/h or 0.166 NL/min	0.166 NL/min
Check liquidflow		
Acid	2.5 ml/min ± 1 ml	2.5 ml/min
Red.-agent	2.5 ml/min ± 1 ml	2.5 ml/min
Sample	10 ml/min ± 2 ml	10 ml/min
Adventitious light - values		
(V)	from file	
100	0	0
200	0	0
300	0	0
350	0	0
400	1	1
450	3	3
500	8	8
550	18	17
575	26	25
600	36	35

Mercur

Report file: C:\WinAAS\TMP\2024\Result\WO\Pro_006
 Program version: 4.7.9.0 Printed on: 12/02/2024 14:32
 Recording started on 12/02/2024 14:21 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters

Hg

Method Without Enrichment / FBR / 30 µg/L_PM_12-02-2024
 Created on 12/02/2024 Time 11:09
 Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		

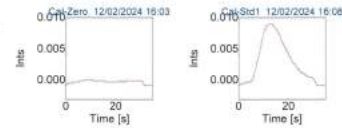
Working mode	w/o enrich.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	12 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	10 NL/h

Mercur

เอกสารไม่ควบคุม

Peak plots

Hg



Mercur

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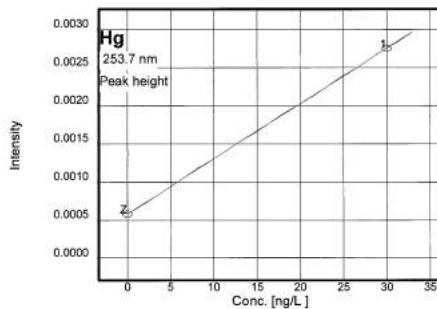
Calibration function 1 12/02/2024 14:31 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.000588 k2=0.000072

Recal. factor: ---

Slope	0.00007 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000586				PkH	14:23
		0.000564					14:24
		0.000612					14:25
0ng/L		0.000587		0.000024310	4.137		14:25
Cal-Std1		0.002810				PkH	14:28
		0.002740					14:29
		0.002713					14:30
30.00ng/L		0.002754		0.000049960	1.814		14:30
Calibration	Calibration function: 01						14:31

Mercur

เอกสารไม่ควบคุม

QC parameters

QC type	Conc. check	QC check samp. 2
QC check samp. 1	---	Conc.
Error limit	---	Error limit
Rep. measurement	off	Reaction
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.
QC std.1 limit	± 20.00%	QC std.2 limit
QC std. act.	flag + continue	
Expect. blank abs.	0.0100± 0.0100	Reaction
QC precision	off	QC Recal.factor
		off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	Zero
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles
Confid. level	95.4 %	Blind cycles
Grubbs stat.	off	

Calibration standards

Hg

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.000587 A: 0.01383	0.000024 0.000359	4.137 2.597
2	Cal-Std1	(--)	##	30.000	H: 0.002754 A: 0.04276	0.000049 0.000186	1.814 0.437

Mercur

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Mercur

Report file: C:\WinAAS\TMP\2024\Result\WO\Pro_007
 Program version: 4.7.9.0 Printed on: 12/02/2024 14:55
 Recording started on 12/02/2024 14:41 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters**Hg**

Method With Enrichment / FBR / 30 µg/L_PM_12-02-2024
 Created on 12/02/2024 Time 11:37
 Program ---

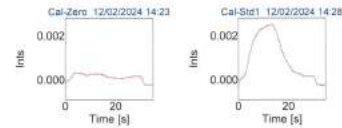
Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	20 s
PMT	444 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		

Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	20 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	10 s	Gas wash time3	10 NL/h
Heat time coll.1	20 s	Cool. time coll.1	25 s

Mercur

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Peak plots**Hg**

Mercur

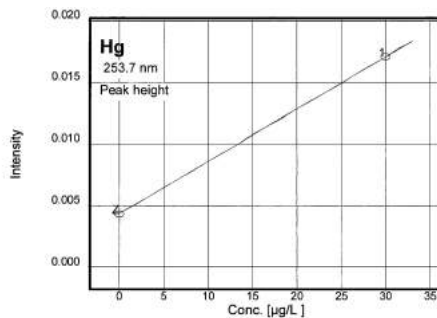
เอกสารไม่ควบคุม

Calibration function 1 12/02/2024 14:55 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.004358 k2=0.000425 Recal. factor: ---

Slope	0.00042 Ints/(µg/L)	R2-adjusted	1.0000
sc0	1.00000 µg/L		
Lower limit	0 µg/L	Upper limit	33.0 µg/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.004343				PkH	14.44
		0.004378					14.46
		0.004352					14.47
	0 µg/L	0.004358		0.000018180	0.417		14.47
Cal-Std1		0.01726				PkH	14.51
		0.01695					14.52
		0.01708					14.54
	30.00 µg/L	0.01710		0.0001520	0.889		14.54
Calibration	Calibration function: 01						14.55

Mercur

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QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 µg/L)	QC std.2 no.	1(30.000 µg/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100 ± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	µg/L
No. standards	1	Conversion fac.	1000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	Zero
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards**Hg**

No	Name	State	Pos	Conc./ µg/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.004358 A: 0.01559	0.000018 0.000277	0.417 1.673
2	Cal-Std1	(--)	##	30.000	H: 0.01710 A: 0.06278	0.000152 0.000516	0.889 0.982

Mercur

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Mercur

Report file: C:\WinAAS\TMP\2024\Result\WO\Pro_008
 Program version: 4.7.9.0 Printed on: 12/02/2024 15:22
 Recording started on 12/02/2024 15:10 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters

Hg

Method Without enrichment / FBR 100 ng/L PM_12-02-2024
 Created on 12/02/2024 Time 11:54
 Program ---

Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	238 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	off	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Purge time1	40 s		

QC parameters

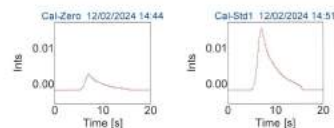
QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep. measurement	off	QC std.2 no.	1(100.00 ng/L)
QC std.1 no.	1(100.00 ng/L)	QC std.2 limit	± 0.00%
QC std.1 limit	± 50.00%		
QC std. act.	flag + continue	Reaction	flag + continue
Expect. blank abs.	0.0100± 0.0100	Reaction	off
QC precision	off	QC Recal.factor	Off

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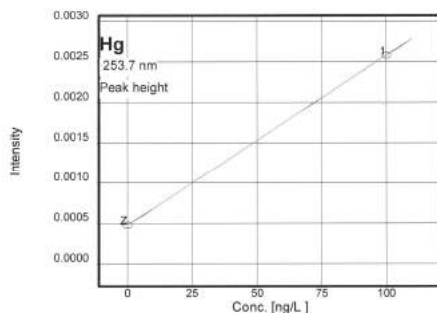
Peak plots

Hg



Mercur

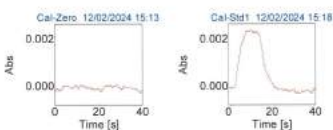
เอกสารไม่ควบคุม

**Measurements and events (sorted by time)**

Hg Without enrichment / FBR 100 ng/L PM_12-02-2024 12/02/2024 15:10							
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000328				PkH	15:13
		0.000248					15:14
		0.000858					15:15
0ng/L		0.000478		0.00033131	69.26		15:15
		0.002638					15:18
		0.002615					15:19
		0.002487					15:21
100.ng/L		0.002580		0.000081841	3.171		15:21
							15:22
Calibration	Calibration function: 01						15:22

Peak plots

Hg



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Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	μg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards

Hg

No	Name	State	Pos	Conc./ng/L	Abs	SD	RSD/%
1	Cal-Zero	(--)	##	0.00	H: 0.000478 A: 0.005393	0.000331 0.002260	69.26 41.90
2	Cal-Std1	(--)	##	100.00	H: 0.002580 A: 0.034199	0.000081 0.002697	3.171 7.887

Calibration function 1 12/02/2024 15:22 Calibration (Peak height)

Abs=k1+k2*conc

k1=0.000478 k2=0.000021

Recal. factor: ---

Slope	0.00002 Abs/(ng/L)	R2-adjusted	1.0000
sd0	1.00000 ng/L	Charact. conc.	207.402 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

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