

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	Office Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Tisch Environmental Inc.	TE-5025A 3393	Jiranatee Associates Co., Ltd.	COF-012-66	31 Aug 23	30 Aug 25	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	24P1252	11 Apr 24	10 Apr 25	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24P1367	22 Apr 24	21 Apr 25	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24H752	10 Apr 24	9 Apr 25	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1180540062	UAE Consultant Co.,Ltd.	17102024	17 Oct 24	16 Oct 25	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778110	UAE Consultant Co.,Ltd.	17102024	17 Oct 24	16 Oct 25	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1200636462	UAE Consultant Co.,Ltd.	04102024	4 Oct 24	3 Oct 25	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778108	UAE Consultant Co.,Ltd.	04112024	4 Oct 24	3 Oct 25	-
9	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NP1E15A0014	6 Jun 23	6 Jun 31	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778113	UAE Consultant Co.,Ltd.	04092024	4 Sep 24	3 Sep 25	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387061	UAE Consultant Co.,Ltd.	06092024	6 Sep 24	5 Sep 25	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387063	UAE Consultant Co.,Ltd.	19062024	19 Jun 24	18 Jun 25	-
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387065	UAE Consultant Co.,Ltd.	06092024	6 Sep 24	5 Sep 25	-

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No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
14	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NP1E15A0014	6 Jun 23	6 Jun 31	-
15	Wind Speed/Wind Direction	WS/WD	LSI Lastem	DNA202/E-LOG BQ1705627/17037708	Jiranatee Associates Co., Ltd.	CWS-027-67	7 Aug 24	6 Aug 25	-
16	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	05103-5 309017844	Thai Meteorological Department	173/24	11 Apr 24	10 Apr 25	-
17	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	05103-5 309019236	Thai Meteorological Department	174/24	11 Apr 24	10 Apr 25	-
18	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DB0041	Thai Meteorological Department	119/24	13 Mar 24	12 Mar 25	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Larson Davis	CAL150 6306	Innovative Instrument Co.,Ltd.	24-ACT-067	17 May 24	16 May 25	-
20	Sound Level Meter	$L_{Aeq} 24 \text{ hrs}$, L_{A90} , L_{Amax} , L_{Ain}	Larson Davis	LXT1 0007305	Electrical And Electronics Institute Foundation For Industrial Development	CP20240323EA	22 Aug 24	21 Aug 25	-
21	Sound Level Meter	$L_{Aeq} 24 \text{ hrs}$, L_{A90} , L_{Amax} , L_{Ain}	Larson Davis	LXT1 0007306	Electrical And Electronics Institute Foundation For Industrial Development	CP20240290EA	5 Aug 24	4 Aug 25	-

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.	E24-080074	26 Aug 24	25 Aug 25	-
2	Pre-Test Console	Total Suspended Particulate Hydrogen Sulphide	Apex Instruments, USA	XC-572-V 0807048	Envi Equipment Service Co., Ltd.	E24-070061	23 Jul 24	22 Jul 25	-
3	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 61658806/0419	Entech Industrial Sulation Co., Ltd.	G 670175	8 Mar 24	7 Mar 25	-
4	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 61658816/0419	Entech Industrial Sulation Co., Ltd.	G 670125	23 Feb 24	22 Feb 25	-

CERTIFICATE OF CALIBRATION

Certificate No.: COF-012-66

Page 3 of 3 Pages

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

: Topload Office
: TISCH
: TE-5025A
: 3393
: UAE-EFM-064/2590
: Used item
: United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phraekhanong,
Bangkok 10260

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

: 14 Aug 2023
: 31 Aug 2023
: 01 Sep 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 23.8 °C and 56.3 %RH.

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model GSC/MAC/2024. The WEL-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: 02233501

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)

MEASUREMENT RESULTS:

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

Table 1: The results of @ Standard calibration data

Plate	Flow rate m ³ /min	Pressure (Pa) mmHg	Temperature (T _a) °C	Temperature (T _m) °C	Δp_meter mmHg	Δp_Office inH ₂ O	F	Standard Flow [Q _s] m ³ /min
1	0.694	754.292	24.08	23.49	55.071	1.682	1.294	0.642
2	1.000	754.269	24.02	23.63	60.844	1.423	1.846	0.918
3	1.122	754.101	23.85	23.51	42.018	4.558	2.111	1.058
4	1.389	754.302	23.77	23.43	30.532	5.122	2.359	1.119
5	1.409	754.188	23.89	23.66	29.917	7.496	2.733	1.349

Slope (m): 2.03291
Intercept (b): -0.01401
Correlation coefficient (r): 0.99983
Uncertainty (k=2): 0.015 m³/min

Table 2: The results of @ actual calibration data

Plate	Flow rate m ³ /min	Pressure (Pa) mmHg	Temperature (T _a) °C	Temperature (T _m) °C	Δp_meter mmHg	Δp_Office inH ₂ O	F	Standard Flow [Q _s] m ³ /min
1	0.694	754.292	24.08	23.49	55.071	1.682	0.814	0.645
2	1.000	754.269	24.02	23.63	60.844	1.423	1.381	0.920
3	1.122	754.101	23.85	23.51	42.018	4.558	1.340	1.060
4	1.389	754.302	23.77	23.43	30.532	5.122	1.420	1.123
5	1.409	754.188	23.89	23.66	29.917	7.496	1.718	1.354

Slope (m): 1.27329
Intercept (b): -0.00881
Correlation coefficient (r): 0.99983
Uncertainty (k=2): 0.015 m³/min

End of Certificate of Calibration



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

Certificate of Calibration

Certificate No.: 24P1252
Page: 1 of 2

Equipment: U Tube Manometer
Manufacturer: Dwyer
Model: 1221-36-W/M
Serial No.: -
ID No.: UAE-EFM/078/2566

Condition As-Received: Used Item
Received Date: 03 April 2024
Calibration Date: 11 April 2024

Reference: 2404-0118WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1011 mbar

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.,
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,
Phraekhanong, 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 request 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 Khankaew
Issue Date: 17 April 2024

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

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Cert.No.: 24P1252
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	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	5.00	-5.00	10.00	0.00
12.00	6.00	-6.00	12.00	0.00
14.00	7.00	-7.05	14.05	0.05
16.00	8.00	-8.05	16.05	0.05
18.00	9.00	-9.05	18.05	0.05
20.00	10.00	-10.10	20.10	0.10
22.00	11.00	-11.10	22.10	0.10
24.00	12.00	-12.10	24.10	0.10
26.00	13.00	-13.10	26.10	0.10
28.00	14.00	-14.10	28.10	0.10
30.00	15.00	-15.10	30.10	0.10
32.00	16.00	-16.10	32.10	0.10
34.00	17.05	-17.10	34.15	0.15
35.80	18.00	-18.00	36.00	0.20

The uncertainty of measurement was ± 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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Certificate of Calibration

Certificate No. : 24P1367
Page : 1 of 2

Equipment : Aneroid Barometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE_ANV_152/2550

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 22 April 2024

Reference: 2404-0243WSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1007 mbar

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

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505046	MP-9094-23	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 Khankaew
Issue Date : 23 April 2024

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

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Cert.No.: 24P1367
Page: 2 of 2

Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range: 960 hPa to 1030 hPa
Scale Interval: 1 hPa (The Fifth Estimate)

Increasing Pressure								
Applied Pressure (hPa)	957.13	968.77	980.13	990.56	1001.26	1011.35	1022.10	1032.61
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	2.87	1.23	-0.13	-0.56	-1.26	-1.35	-2.10	-2.61

Decreasing Pressure								
Applied Pressure (hPa)	1032.61	1021.84	1010.88	1000.82	990.20	979.52	968.48	957.17
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-2.61	-1.84	-0.88	-0.82	-0.20	0.48	1.52	2.83

The uncertainty of measurement was ± 0.25 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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Certificate of Calibration

Certificate No. : 24H752
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE_ANV_004/2548

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 10 April 2024

Reference: 2404-0247WSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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

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

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

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison
with standard chilled mirror sensor for humidity measurement function and comparison with standard
temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Chilled Mirror Hygrometer	Dew Master	44730	21656	02 Aug 2024
2) Handheld Thermometer With Sensor	1521	A5A339	2311238	16 Oct 2024
2.The certificate is valid only to the item calibrated on date and place of calibration.				
3.This Certification is traceable to the International System of Unit maintained through:- -Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0 -Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008				

Calibrated by : Chakrit Waewwanjua
Issue Date : 18 April 2024

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

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Cert. No.: 24H752
Page: 2 of 2

Result of Calibration:- Without Adjustment

Function: Humidity Measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	41	0.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	78	-2.0	1.8

Result of Calibration:- Without Adjustment

Function: Temperature Measurement.

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
20.014	20.5	0.486	0.72
25.033	25.0	-0.033	0.72
30.010	30.0	-0.010	0.72
35.027	34.5	-0.527	0.72
40.013	39.5	-0.513	0.72

UUC* : Unit Under Calibration

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

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MULTI-POINT GAS TEST REPORT

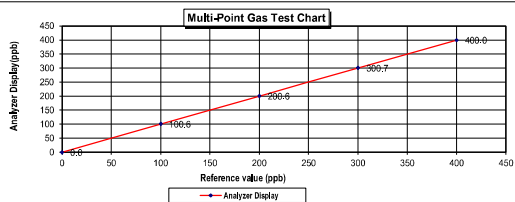
Test Date : Oct 17, 2024

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1180540062

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	EB0159156			
Expiration Date :	Nov 6, 2026			

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.60	0.60	0.60
Level 3	40.00%	200.0	0.60	0.30	0.30
Level 4	60.00%	300.0	0.70	0.23	0.23
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.23	
Acceptable Limit $\pm 5\%$					



MULTI-POINT GAS TEST REPORT

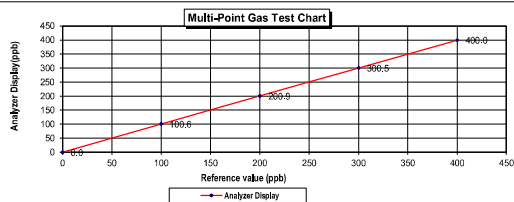
Test Date : Oct 17, 2024

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1201778110

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	EB0159156			
Expiration Date :	Nov 6, 2026			

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.60	0.60	0.60
Level 3	40.00%	200.0	0.90	0.45	0.45
Level 4	60.00%	300.0	0.50	0.17	0.17
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.24	
Acceptable Limit $\pm 5\%$					



MULTI-POINT GAS TEST REPORT

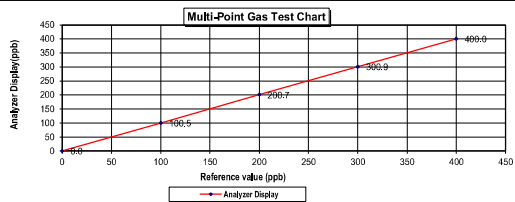
Test Date : Oct 4, 2024

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1200636462

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	EB0159156			
Expiration Date :	Nov 6, 2026			

Multi-point gas test data

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



MULTI-POINT GAS TEST REPORT

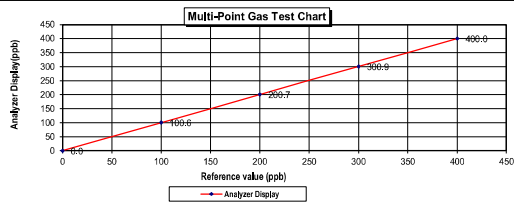
Test Date : Oct 4, 2024

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1201778108

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	EB0159156			
Expiration Date :	Nov 6, 2026			

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.60	0.60	0.60
Level 3	40.00%	200.0	0.70	0.35	0.35
Level 4	60.00%	300.0	0.90	0.30	0.30
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.25	
Acceptable Limit $\pm 5\%$					



CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)

LTD
Part Number: E05N91E15A0014 Reference Number: 160-402772205-1
Cylinder Number: E80162121 Cylinder Volume: 144.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2016 PSIG
PGVP Number: A12023 Valve Outlet: 660
Gas Code: CO,CO2,NO,NOX,SO2,BALN Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" (May 2012) document EPA-800R-12831, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analyte impurity as stated above with a confidence level of 99%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a molar/molar basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. Do not use this cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	100.0 PPM	100.4 PPM	G1	+/- 0.9% NIST Traceable
NITRIC OXIDE	100.0 PPM	100.2 PPM	G1	+/- 0.9% NIST Traceable
SULFUR DIOXIDE	100.0 PPM	100.0 PPM	G1	+/- 1.4% NIST Traceable
CARBON MONOXIDE	200.0 PPM	199.2 PPM	G1	+/- 0.3% NIST Traceable
CARBON DIOXIDE	8.000 %	7.992 %	G1	+/- 1.2% NIST Traceable
NITROGEN	Balance			

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
GMS	10402308	CC754364	98.38 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%
PRM	C2219101	APF1514048	100.18 PPM NITRIC OXIDE/NITROGEN	+/- 0.3%
GMS	2023042525	CC754381	98.52 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%
PRM	12408	DB13860	15.01 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%
GMS	1534030302	E80130337	9.993 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.6%
NTRM	160102-22	KAL003020	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%
CO	239601	CC745602	248.47 PPM CARBON MONOXIDE/NITROGEN	+/- 0.3%
NTRM	138906-02	CC411730	13.359 % CARBON DIOXIDE/NITROGEN	+/- 0.6%

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicodet i550 FTIR ALP2010245 CO2	FTIR	Jun 15, 2023
SIEMENS ULTRAMAT6E N1-C8-180	NDIR	Jun 14, 2023
Nicodet i550 FTIR ALP2010245 NO	FTIR	Jun 29, 2023
Nicodet i550 FTIR ALP2010245 NO2	FTIR	Jun 15, 2023
Nicodet i550 FTIR ALP2010245 SO2	FTIR	Jun 08, 2023

Approved for Release

Page 1 of 1

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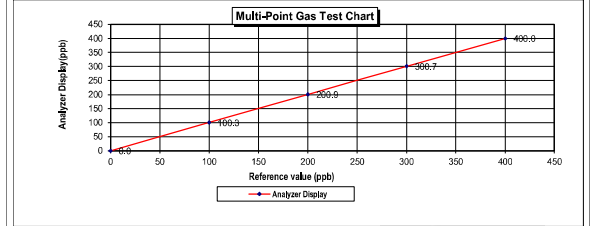
MULTI-POINT GAS TEST REPORT

Test Date : Sep 4, 2024

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1201778113

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	E80159156			
Expiration Date :	Nov 06, 2026			

Multi-point gas test data					
	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.3	0.30	0.30
Level 3	40.00%	200.0	200.9	0.45	0.45
Level 4	60.00%	300.0	300.7	0.23	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb				
:Acceptable Limit \pm 5%			Average Difference (%)		0.20



4 / 9 / 2567

4 / Sep / 2024

Page 1 of 1

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MULTI-POINT GAS TEST REPORT

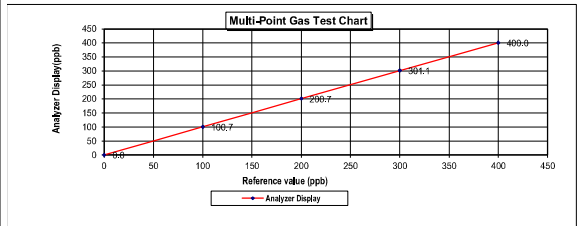
Test Date : Sep 6, 2024

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387061

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	E80159156			
Expiration Date :	Nov 06, 2026			

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	200.7	0.35	0.35
Level 4	60.00%	300.0	301.1	0.37	0.37
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb				
:Acceptable Limit \pm 5%			Average Difference (%)		0.28



6 / 9 / 2567

6 / Sep / 2024

Page 1 of 1

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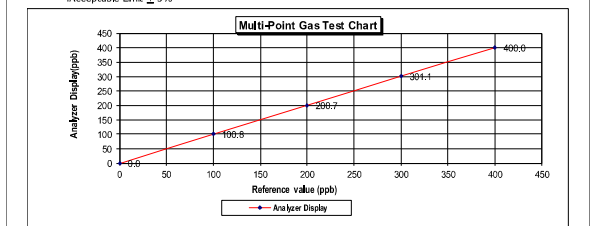
MULTI-POINT GAS TEST REPORT

Test Date : June 19, 2024

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387063

Standard Gas Concentration			Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	46.77	PPM	Model :	146i
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	965.9			
Cylinder No. :	E80159156			
Expiration Date :	Nov 06, 2026			

Multi-point gas test data					
	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79
Level 3	40.00%	200.0	200.7	0.35	0.35
Level 4	60.00%	300.0	301.1	0.37	0.37
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb				
:Acceptable Limit \pm 5%			Average Difference (%)		0.30



19 / 06 / 2567

19 / June / 2024

Page 1 of 1

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MULTI-POINT GAS TEST REPORT

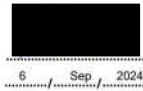
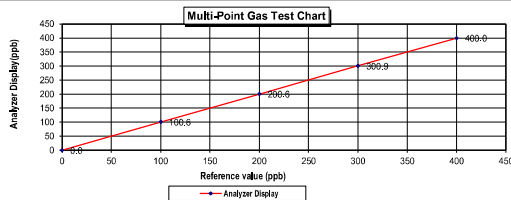
Test Date : Sep 6, 2026

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CH22387065

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	42.89	PPM	Manufacturer : Thermo SCIENTIFIC
Nitric Oxide (NO)	46.77	PPM	Model : 146i
Methane (CH ₄)	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	965.9		
Cylinder No. :	EB01159156		
Expiration Date :	Nov 05, 2026		

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	100.6	0.60	0.60
Level 3 40.00%	200.0	200.6	0.30	0.30
Level 4 60.00%	300.0	300.9	0.30	0.30
Level 5 80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb	Average Difference (%)	0.24	
Acceptable Limit $\pm 5\%$				



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CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND) LTD.

Part Number: EDSN191E15AD014 Reference Number: 160-40277205-1
Cylinder Number: EB01152121 Cylinder Volume: 144.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2016 PSIG
PGVP Number: A12023 Valve Outlet: 650
Gas Code: CO, CO₂, NO, NO₂, SO₂, BALN Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with EPA Traceability Protocol for Alloy and Certification of Gaseous Calibration Standards (May 2017) document EPA 800R-12031, 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 the calibration medium. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do not use this cylinder below 100 psig, i.e. 0.7 megapascal.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO _x	100.0 PPM	100.4 PPM	G1	$\pm 0.9\%$ NIST Traceable	06/27/2023, 07/06/2023
NITRIC OXIDE	100.0 PPM	100.2 PPM	G1	$\pm 0.9\%$ NIST Traceable	06/27/2023, 07/06/2023
SULFUR DIOXIDE	100.0 PPM	100.0 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/27/2023, 07/06/2023
CARBON MONOXIDE	200.0 PPM	199.2 PPM	G1	$\pm 0.3\%$ NIST Traceable	06/27/2023
CARBON DIOXIDE	8,000 %	7,992 %	G1	$\pm 1.2\%$ NIST Traceable	06/27/2023
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
GMIS	104203208	CT754364	98.36 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Jan 04, 2031
PRM	C2219101	AP61514048	100.19 PPM NITRIC OXIDE/NITROGEN	$\pm 0.3\%$	Feb 28, 2025
GMIS	2023042525	CT754361	98.52 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Apr 25, 2031
PRM	12409	0913660	15.01 PPM NITROGEN DIOXIDE/AIR	$\pm 1.5\%$	Feb 17, 2023
GMIS	15340202002	EB0303037	9.593 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 1.5\%$	Sep 29, 2025
NTRM	160102-22	KAL003820	97.69 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Nov 01, 2027
CO	23061	CT745602	249.47 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.3\%$	Dec 05, 2028
NTRM	130806-02	CCA11730	13.356 % CARBON DIOXIDE/NITROGEN	$\pm 0.6\%$	May 14, 2025

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iSD FTR ALP2010245 CO ₂	FTIR	Jun 15, 2023
SIEMENS ULTRAMAT6E N1-C8-190	NDIR	Jun 14, 2023
Nicolet iSD FTR ALP2010245 NO ₂	FTIR	Jun 19, 2023
Nicolet iSD FTR ALP2010245 NO _x	FTIR	Jun 15, 2023
Nicolet iSD FTR ALP2010245 SO ₂	FTIR	Jun 06, 2023

Approved for Release

Jirante Associate Co., Ltd.
43/24 15, 67/51 B,
Petchaburi 7/51, Rd. Nonthaburi, Bangkok
Bangkok 10610(Thailand)
Tel: +66(0)29983211
Mobile: +66(0)9998403
E-mail: jae@jiranteecol.com
Web site: www.jiranteecol.com

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

Air speed measurement laboratory
Calibration services department

Certificate Number

CWS-027-47

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	Cup anemometer
MANUFACTURER	LSI Latham
MODEL/TYPE	Series: DINA202 Data logger: L-10G
SERIAL NUMBER	Serial: R21705627 Data logger: L7017708
ID NUMBER	-
CONDITION AS RECEIVED	Used item
CUSTOMER	United Analyst and Engineering Consultant Co., Ltd. 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
RECEIVED DATE	02 Aug 2024
MEASUREMENT DATE	07 Aug 2024
ISSUE DATE	09 Aug 2024
ENVIRONMENTAL CONDITIONS:	
Ambient condition in the laboratory are as follow:	
Temperature	(23.0 \pm 3.0) °C
Relative Humidity	(55.0 \pm 15.0) %RH
Atmospheric Pressure	(1010.10 \pm 10) hPa
PLACE OF CALIBRATION	Ethel-type wind tunnel of Jirante Associate Co., Ltd.
CALIBRATION CONDITIONS	Wind tunnel cross-section area ¹ 300 cm ² Wind direction (up/down) ² 195 cm ² Diameter of mounting pipe ³ mm Blockage ratio of test object ⁴ 0.217 [-]
Preconditioning	24 hours at ambient conditions
Measurement Condition	(The average values during measurement are (23.8) °C, (43.5) %RH and (1009.2) hPa.

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transmitter ng601-0455-02 and pilot tube with precision differential pressure meter model: DP462500 in an air flow with reference of 1984-type, wind tunnel unit: R07-001, cross test section area: the M-CI-002 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2017 was used as calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards and to resolution of the international system of units (SI) through the NMPT (National Metrology Institute of Thailand) via Certificate Number: MN-0007-24 and MN-0005-23.

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

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
[Signature]
[Signature]



Approved signature

Mr. Pongsak Boonlertchai
Calibration Department Manager

Remarks:
¹ Nullify cross section area of the wind tunnel
² Prescribed cross section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio: $\frac{A_{obj}}{A_{tunnel}}$

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MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pilot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 15 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

U_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	U_{ref} (m/s)	Error (m/s)	U (m/s)
1.059	23.58	24.05	0.9	-0.1	0.11
2.061	24.24	24.05	1.8	-0.3	0.31
3.124	24.02	24.05	2.9	-0.2	0.31
4.086	24.04	24.05	3.8	-0.3	0.31
5.09	23.68	24.05	4.9	-0.2	0.31
6.88	23.84	24.05	5.9	-0.7	0.31
6.99	23.52	24.05	6.8	-0.2	0.31
8.16	24.48	24.05	8.0	-0.9	0.31
9.12	23.50	24.05	9.1	-0.1	0.31
9.98	24.03	24.05	9.9	-0.1	0.31
11.04	23.46	24.05	11.1	0.0	0.31
12.05	23.46	24.05	12.1	0.1	0.31
13.96	23.50	24.05	13.0	-0.1	0.31
15.05	23.52	24.05	14.9	0.1	0.31
16.09	23.50	24.05	16.0	0.0	0.34

Remarks:

¹ Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place

² Velocity of Standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration setup of the Cup anemometer calibration in the wind tunnel of Jirante Associate Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Please be aware that the photo of the set-up is not true to scale due to imaging geometry.



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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 : 11 April, 2024

Certification No. : 174/24

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Sensor : YOUNG

Basic Datalogger : NRG

Type : Sensor : 05103-5 Basic Datalogger : LR20

Serial No. : Sensor : 79424 Basic Datalogger : 300019236

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 : 1013.3 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pilot Tube Theodor Friedrichs Type 0800.0000 series 9023

N.I.S.T. Test Reference Number 731/241460

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pisood Promsat



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 174/24

11 April, 2024

Page : 2 of 2

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Pressure	Velocity	Correction
Ultrasonic Anemometer	m/sec	inches	inches	m/sec	m/sec
1.00	-	-	-	0.90	0.10
3.02	-	-	-	3.00	0.02
5.00	-	-	-	4.98	0.02
7.04	-	-	-	7.02	0.02
9.02	-	-	-	8.94	0.08
11.01	-	-	-	10.98	0.03
13.01	-	-	-	12.96	0.05
15.01	-	-	-	15.00	0.01
17.02	-	-	-	17.04	-0.02
20.02	-	-	-	20.10	-0.08

Wind Aloft Plotting Board.	
US DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90.0	91
180.0	182
270.0	271

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer



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. : 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 Consultants 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 :

: 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. 6389/94

: Isetto, Isetto 645 Serial No. 02848057 : Thermoschneider No. 918602

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type P15330 No. P4320001

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pisood Promsat

(Authorized Signatory)

for the Chief

Sub-Standard Instrument

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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. 119/24

13 March, 2024

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	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.	
US DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 119/24

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
1011.46	1011	0.46
1011.84	1012	-0.16
1012.06	1012	0.06
1013.04	1013	0.04
1013.16	1013	0.16
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	1016	0.23
1012.87	1013	-0.13
1013.63	1014	-0.37

Average

0.04

Calibrated by :

Mr. Watchapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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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. 119/24

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
757.84	758	-0.06
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
761.45	761	0.48
759.71	760	-0.29
760.28	760	0.28

Average

0.02

Calibrated by :

Mr. Watchapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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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. 119/24

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. Watchapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
710/400 13, 101 BUNDESKHON 13 LAMON BANGKOK
AMPHOR BANG PHU (SANGKAT) PHAN PHUONG 1, 1040 THAILAND
TEL : 0800 21 09 000 0 FAX : 0800 21 09 740



Certificate of Calibration

Customer

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

Certificate No : 24-ACT-067
Request No : Req-2024-1024

Unit Under Calibration Details

Measurement item : Acoustic Calibrator
Manufacturer : LARSON DAVIS
Model : CAL150
Serial Number : 6306
ID : UAE.EFM.048.2563

Class : 2
Range : 94, 114 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

Temperature : (23 ± 0.2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ± 10.0 hPa)
Received Date : 8 May 2024
Calibration Date : 17 May 2024

Location of Calibration : LAB 1 Acoustic

Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	31 May 2024
THD Multimeter	2015	1047765	NIMT	16 January 2025

Traceability

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

Note

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

Calibrated By :

Mr. Noppadol Laingart
Service Calibration Engineer

Approved By :

Mr. Pooi Mathavorn
Calibration Engineer Supervisor

Issue Date : 17 May 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing body.
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Certificate No : 24-ACT-067
Request No : Req-2024-1024

Sound pressure level						
Calibration Results : Without Adjustment						
Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 2 (± dB)
	Measured	Deviated value	Measured	Deviated value		
94 dB / 1000 Hz	94.09	0.09	-	-	0.13	0.40
114 dB / 1000 Hz	114.10	0.10	-	-	0.13	0.40

Frequency of Sound pressure level						
Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 2 (± %)
	Measured (Hz)	Deviated value	Measured (Hz)	Deviated value		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)				
Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (± %)	Acceptance limit Class 2 (± %)
	Measured (%)	Measured (%)		
94 dB / 1000 Hz	0.05	-	0.40	3.0
114 dB / 1000 Hz	0.21	-	0.40	3.0

Note :

Function	Maximum-permitted Uncertainty of measurement
Sound pressure level	0.35 dB
Frequency	0.20%
Total distortion+noise	1.00%

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibration pressure correction
- The calibration results exclude the microphone volume correction

End of Calibration

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the
FIM-708-ACT-02 Rev 01 Issue date: 01/20

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ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT
975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37,
Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280
Tel: +66 2709 4860 Fax: +66 2324 0917



Certificate No.: CP20240323EA
Operation No.: CP2024080294

Certificate of Calibration

Equipment: Sound Level Meter

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

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

Serial No.: 0007305 (Meter), 345234 (Microphone), 077640 (Preamplifier)

ID No.: UAE.EFM.038/2566

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

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

Received Date: 9 August 2024

Calibrated Date: 22 - 27 August 2024

Issued Date: 28 August 2024

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.
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Page 1 of 6

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F-CAL-004 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20240323EA

Calibration Report

Equipment: Sound Level Meter

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

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

Serial No.: 0007305 (Meter), 345234 (Microphone), 077640 (Preamplifier)

ID No.: UAE.EFM.038/2566

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration
1. Reference standards instrument :-

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

2. This result of calibration was found accurate as shown on date and place of calibration only.
3. This certification is traceable to the international system of unit maintained at :-
Reference standards instrument for Acoustic function
- National Institute of Metrology (Thailand)
Reference standards instrument for Electrical function
- National Institute of Metrology (Thailand)
- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

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

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ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20240323EA

Calibration Report

Function : 2. Self-generated Noise
2.1 Microphone Installed

Measured value (dB)
30.1

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	29.9
C-weighting	30.0
Z-weighting	35.5

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)
Meter free-field acoustic response at a level of 84 dB.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.2	0.1	0.1	+1.0
1000	-0.1	-0.1	-0.1	+0.7
8000	0.6	0.5	0.6	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings
Weighting network response with relative to 1 kHz.

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

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Certificate No.: CP20240323EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

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

5.2 Time weighting at 1 kHz

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

Function : 6. Long-Term Stability

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

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

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

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

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Page 4 of 6

F-CAL-005 Ed.1

Certificate No.: CP20240323EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

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

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	136.0	0.0	±0.5
	2	118.9	-0.1	+1.0 ; -1.5
	0.25	109.7	-0.3	+1.0 ; -3.0
Slow	200	129.5	-0.1	±0.5
	2	109.9	-0.1	+1.0 ; -3.0
	0.25	100.9	-0.1	+1.0 ; -3.0

Function : 9. Peak C sound level

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

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Page 5 of 6

F-CAL-005 Ed.1

Certificate No.: CP20240323EA

Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
143.7	143.7	0.0	±1.5

Function : 11. High-Level Stability

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

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

Uncertainty of measurement

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

Remarks:

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

-- End of Report --

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Page 6 of 6

F-CAL-005 Ed.1

Certificate No.: CP20240290EA

Operation No.: CP2024070253

Certificate of Calibration

Equipment: Sound Level Meter

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

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRLxT1 (Preamplifier)

Serial No.: 0007306 (Meter), 345235 (Microphone), 077641 (Preamplifier)

ID No.: UAE.EFM.039/2566

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

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

Received Date: 25 July 2024

Calibrated Date: 5 - 6 August 2024

Issued Date: 7 August 2024

Calibrated by: Ms. Juntaporn Kunhakom

Approved by:

(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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

Page 1 of 6

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F-CAL-004 Ed.1



Certificate No.: CP20240290EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007306 (Meter), 345235 (Microphone), 077641 (Preamplifier)
ID No.: UAEFMC039/2566
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2787490	AA-1012-23	12 November 2024
2) Arbitrary Function Generator	AFG2021	C010063	CK20240048EA	23 June 2025
3) Programmable Attenuator	PA5	2755	EF-0040-23	1 October 2024
4) 6.5 Digit precision multimeter	8846A	9610014	CB20230200EA	15 November 2024
5) Pressure humidity and Temperature Transmitter	PTU301	L3950483	CL1-P240023 CD20240142FA	24 March 2025 12 June 2025
6) Pressure humidity and Temperature Transmitter	PTU301	L3950484	CL1-P240030 CD20240143FA	11 April 2025 12 June 2025
7) Performance Audio Analyzer	U8903B	MY56510003	CB20240035EB CK20230072EA	13 February 2025 13 September 2024

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

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

- Reference standards instrument for Acoustic function
- National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
- National Institute of Metrology (Thailand)
- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

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

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Page 2 of 6

F-CAL-005 Ed.1



Certificate No.: CP20240290EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
28.8

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	28.7
C-weighting	28.4
Z-weighting	34.5

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

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

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.1	0.0	0.0	±1.0
1000	-0.1	-0.1	-0.1	±0.7
8000	-0.4	-0.5	-0.4	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

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Page 3 of 6

F-CAL-005 Ed.1



Certificate No.: CP20240290EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

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

5.2 Time weighting at 1 kHz

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

Function : 6. Long-Term Stability

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

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

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

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

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Page 4 of 6

F-CAL-005 Ed.1



Certificate No.: CP20240290EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

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

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	136.0	0.0	±0.5
	2	118.8	-0.2	+1.0; -1.5
	0.25	109.7	-0.3	+1.0; -3.0
Slow	200	129.5	-0.1	±0.5
	2	109.8	-0.2	+1.0; -3.0
	0.25	100.9	-0.1	+1.0; -3.0

Function : 9. Peak C sound level

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

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Page 5 of 6

F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20240290EA

Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
142.6	142.6	0.0	±1.5

Function : 11. High-Level Stability

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

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

Uncertainty of measurement

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

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

-- End of Report --

Page 6 of 6

F-CAL-005 Ed.1

เอกสารไม่ควบคุม



Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tunbong Bang Rak Phantana, Amphur Bang Bus Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-es.com

Certificate No.: E24-080074

Page: 1 of 6

CERTIFICATE OF CALIBRATION

Customer	: United Analyst and Engineering Consultant Co., Ltd.
Address	: 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Description of Equipment	: Console meter
Manufacturer	: Apex Instrument
Model Number	: XC-572-V
Serial Number	: 0807047
ID./Control No.	: UAEANV 212/2551
Environment Conditions	: Temperature (25 ± 2) °C Humidity (50 ± 15) % RH
Cal. Date	: 26/08/2024
Issue Date	: 26/08/2024

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Technical Manager

เอกสารไม่ควบคุม



Certificate No.: E24-080074
Page : 2 of 6

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	26/08/2024	01:10 PM	Std Temp	293	K	
Console Serial Number	0807047	Calibration Reference No.	SER24-080032			Std Press	760	mm Hg	
DGM Model Number	SK25EX	Barometric Pressure	755.91	mmHg		K _i	0.386		
DGM Serial Number	00003580	Calibration Meter Gamma	1.001			Console Leak Check	PASS		

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice	Volume	Volume	Outlet Temp	Volume	Volume	Outlet Temp	Outlet Temp	
Elapsed	DH	Initial	Final	Initial	Initial	Final	Initial	Final	
(Q)	(P _{sc})	(V _{sc})	(V _{sc})	(t _{sc})	(V _{sc})	(V _{sc})	(t _{sc})	(t _{sc})	
(min)	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
11.88	13.0	1160.277	1160.417	24	24	249.83548	249.97320	25	25
11.87	13.0	1160.417	1160.557	23	23	249.97320	250.11036	25	25
8.47	26.0	1160.565	1160.705	23	23	250.11794	250.25472	25	25
8.43	26.0	1160.705	1160.845	23	23	250.25472	250.39116	25	25
13.70	40.0	1160.856	1161.136	24	24	250.39676	250.67384	25	25
13.63	40.0	1161.136	1161.416	24	24	250.67384	250.94928	25	25
10.27	70.0	1161.428	1161.708	25	25	250.95446	251.23044	25	25
10.23	70.0	1161.708	1161.988	26	26	251.23044	251.50574	25	25
8.98	90.0	1162.001	1162.281	26	26	251.51066	251.78586	24	24
8.95	90.0	1162.281	1162.561	27	27	251.78586	252.06032	24	24



เอกสารไม่ควบคุม



Certificate No.: E24-080074
Page : 3 of 6

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	26/08/2024	01:10 PM	Std Temp	293	K	
Console Serial Number	0807047	Calibration Reference No.	SER24-080032			Std Press	760	mm Hg	
DGM Model Number	SK25EX	Barometric Pressure	755.91	mmHg		K _i	0.386		
DGM Serial Number	00003580	Calibration Meter Gamma	1.001			Console Leak Check	PASS		

Calibration Data									
Results									
Standardized Data					Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor	Flowrate		Std & Corr	.0212 m ³ /min	Variation
(V _{sc})	(Q _{sc})	(V _{sc})	(Q _{sc})		Value	Variation			
(m ³)	(m ³ /min)	(m ³)	(m ³ /min)	(Y)	(ΔY)	(Q _{sc})	(ΔH _g)	(ΔH _g)	(ΔH _g)
0.137	0.012	0.135	0.011	0.981	0.005	0.011	44.831	-0.558	
0.137	0.012	0.134	0.011	0.977	0.001	0.011	45.071	-0.318	
0.137	0.016	0.134	0.016	0.974	-0.003	0.016	46.259	0.870	
0.137	0.016	0.133	0.016	0.971	-0.005	0.016	46.125	0.736	
0.275	0.020	0.271	0.020	0.985	0.008	0.020	45.532	0.143	
0.275	0.020	0.269	0.020	0.979	0.002	0.020	45.628	0.240	
0.276	0.027	0.270	0.026	0.978	0.001	0.026	45.368	-0.021	
0.276	0.027	0.269	0.026	0.976	-0.001	0.026	45.297	-0.092	
0.277	0.031	0.270	0.030	0.973	-0.003	0.030	44.935	-0.454	
0.277	0.031	0.269	0.030	0.971	-0.006	0.030	44.843	-0.546	
					0.977	Y Average	45.389	ΔH _g Average	

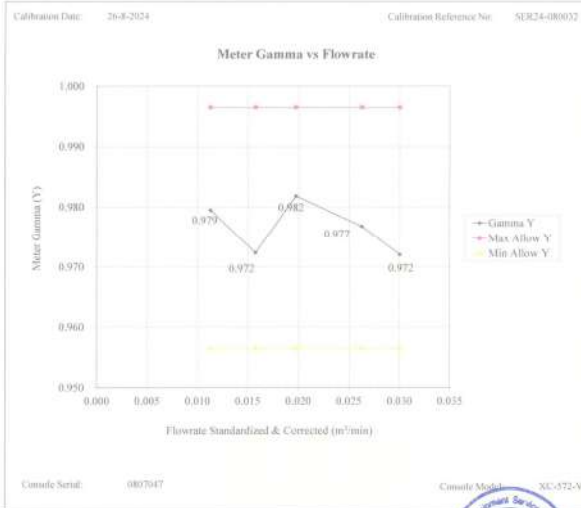
Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

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 (5.1 mm) H₂O.



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions	
Console Model Number	XC-572-V	Date	Time	26/08/2024	01:10 PM	Std Temp	293 K
Console Serial Number	0807047	Calibration Reference No. 81824-080032				Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure 755.91 mmHg				K ₁	0.386
DGM Serial Number	00003580	Calibration Meter Gamma 1.001				Console Leak Check	PASS



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	26/08/2024	01:10 PM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	SER24-080032			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.91	mmHg		K ₁	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	1.001			Console Leak Check	PASS	



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	26/08/2024	03:10 PM
Console Serial Number	0807047	Calibration Reference No.	SER24-080032		
DGM Model Number	SK25EX	Reference Thermometer	DIGI/CON		
DGM Serial Number	00003080	Serial Number	183169105		
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 19778				

Results									
Console Thermocouple Simulator									
Channel and test point	Meter Box Channel Temperature Reading (°C)								
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0
Stack	-17.0	25.0	38.0	92.0	147.0	256.0	368.0	485.0	590.0
Aux	-17.0	25.0	38.0	92.0	147.0				
Probe	-17.0	25.0	38.0	92.0	147.0				
Filter	-17.0	25.0	38.0	92.0	147.0				
Oven	-17.0	25.0	38.0	92.0	147.0				
Exit	-17.0	25.0	38.0						

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



เอกสารไม่ควบคุม

Envi Equipment Service Co., Ltd.
110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110
Tel. 098 362 9152, 089 478 7885
E-mail: sales@envi-ees.com

Certificate No.: E24-070061
Page: 1 of 6

CERTIFICATE OF CALIBRATION

Customer	: United Analyst and Engineering Consultant Co., Ltd.
Address	: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment	: Console meter
Manufacturer	: Apex Instrument
Model Number	: XC-572-V
Serial Number	: 0807048
ID/Control No.	: UAE/ANV. 213/2551
Environment Conditions	: Temperature (25 ± 2) °C
	: Humidity (50 ± 15) % RH
Cal. Date	: 23/07/2024
Issue Date	: 23/07/2024

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Technical Manager

เอกสารไม่ควบคุม

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

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	23/07/2024	09:30 AM	Std Temp	293	K
Console Serial Number	0807048	Calibration Reference No. SER24-070026				Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure 755.91 mmHg				K1	0.386	
DGM Serial Number	00003811	Calibration Meter Gamma 1.001				Console Leak Check PASS		

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

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

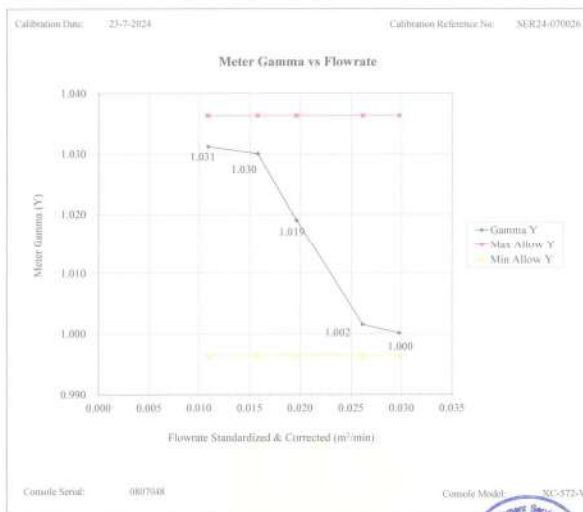
Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	23/07/2024	09:30 AM	Std Temp	293	K
Console Serial Number	0807048	Calibration Reference No.	SER24-070026			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.91			mmHg	K1	0.386
DGM Serial Number	00003811	Calibration Meter Gamma	1.001			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 _{wstd})	(Q _{wstd})	(Y)	(ΔY)	(Q _{scstd})	Std & Corr	.0212 m ³ /min	Variation
m ³	m ³ /min	m ³	m ³ /min			m ³ /min		mm H ₂ O	(ΔH _g)
0.136	0.011	0.140	0.011	1.032	0.015	0.011	47.552		1.450
0.136	0.011	0.140	0.011	1.031	0.014	0.011	48.128		2.026
0.136	0.015	0.141	0.016	1.032	0.016	0.016	45.752		-0.350
0.136	0.015	0.140	0.016	1.028	0.011	0.016	45.839		-0.263
0.273	0.019	0.279	0.020	1.022	0.006	0.020	45.695		-0.407
0.274	0.019	0.278	0.020	1.016	-0.001	0.020	45.918		-0.184
0.275	0.026	0.275	0.026	1.002	-0.014	0.026	45.607		-0.496
0.275	0.026	0.275	0.026	1.001	-0.016	0.026	45.485		-0.617
0.276	0.030	0.276	0.030	0.999	-0.017	0.030	45.521		-0.581
0.276	0.030	0.276	0.030	1.001	-0.015	0.030	45.524		-0.578
				1.016	Y Average				
								46.102	ΔH _g Average

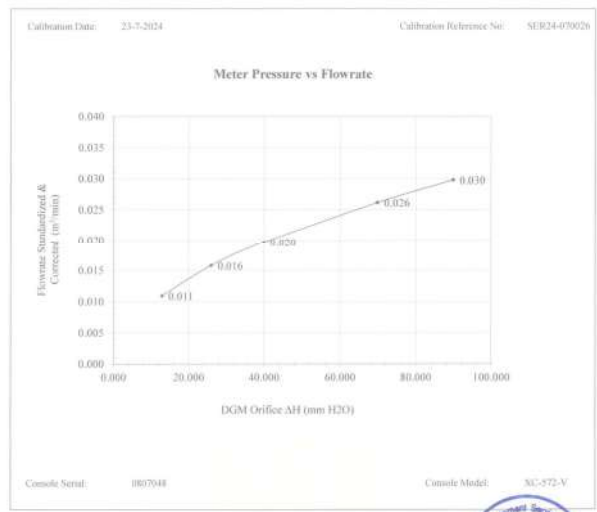
Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For ΔH_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm).



Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	23/07/2024	09:30 AM	Std Temp	293	K
Console Serial Number	0807048	Calibration Reference No. SER24-070026				Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure 755.91 mmHg				K ₂	0.386	
DGM Serial Number	00003811	Calibration Meter Gamma 1.001				Console Leak Check PASS		



Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	23/07/2024	09:30 AM	Std Temp	293	K
Console Serial Number	0807048	Calibration Reference No.		SER24-070026		Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure		755.91		mmHg	K1	0.386
DGM Serial Number	00003811	Calibration Meter Gamma		1.001		Console Leak Check		
						PASS		



THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	0807048
DGM Model Number	SK25EN
DGM Serial Number	00003811
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 08944

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

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

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



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Instrument description	Flue Gas Analyzer
Instrument model	Testo 350 New
Control unit serial no.	0345171/0419
Instrument serial no.	6165806/0419
ID no. or control no.	UAE-EPN 112/2560
Manufacturer	Testo SE & Co. KGaA
Probe description	-
Probe model	-
Probe serial no.	-
Customer name	United Analyst and Engineering Consultant Co.,Ltd.
Customer address	81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrahanong, Bangkok 10260

Total pages of certificate	3 Pages
Receiving no.	L-240859
Receiving date.	04-Mar-24
Parameter of calibration	Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.14,302.1003 ppm, Nitrogen Dioxide 30.34,81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)

Condition of UUC: Used

Ambient condition: All of the Measurement were carried out the stabilized laboratory

Temperature: ± 23 ± 5 °C

Humidity: ± 55 ± 15 %RH

Calibration place: 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsoonthong, 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: 08-Mar-24

Mr. Kwanchoi Kiansung
Calibration TechnicianMr. Nongkua Wongphat
Technical Manager

FM-CL-09-C Rev.8

Page 1 of 3

Issued Date 25/07/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Ngamwongwan 47 Yaek 48, Toongsoonthong, Lakki, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

เอกสารไม่ควบคุม

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2432/23	Linde	27-Aug-27
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	18-Jan-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) 81.32 ppm	3546/23	Linde	14-Jan-26
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-Sep-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: 23.7 °C Humidity: 66.2 %RH Pressure: 1011.4 mbar

Calibration conditions

Gas Temperature: 23 °C Flow rate: 1,280 ml/min Gas pressure: 1016.9 mbar

Calibration Results (Before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (1)
O ₂ (%Vol)	2.50	2.46	-0.04	0.15
O ₂ (%Vol)	10.04	9.92	-0.12	0.20
O ₂ (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1001	-2	12
NO ₂ (ppm)	30.34	28.5	-1.84	8.0
NO ₂ (ppm)	81.32	77.8	-3.52	8.0
NO ₂ (ppm)	201.9	193.4	-8.5	12
NO (ppm)	30.01	28	-2.01	8.0
NO (ppm)	151.5	146	-5.5	8.0
NO (ppm)	322.5	305	-17.5	12
SO ₂ (ppm)	50.36	49	-1.36	6.0
SO ₂ (ppm)	100.8	97	-3.8	6.0
SO ₂ (ppm)	600.8	586	-14.8	13

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (1)
O ₂ (%Vol)	2.500	2.46	-0.04	0.15
O ₂ (%Vol)	10.04	9.92	-0.12	0.20
O ₂ (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1001	-2	12
NO ₂ (ppm)	30.34	29.7	-0.64	8.0
NO ₂ (ppm)	81.32	82.5	1.18	8.0
NO ₂ (ppm)	201.9	203.7	1.8	12
NO (ppm)	30.01	30	-0.01	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO ₂ (ppm)	50.36	52	1.64	6.0
SO ₂ (ppm)	100.8	102	1.2	6.0
SO ₂ (ppm)	600.8	604	3.2	13

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

End of Report

FM-CL-09-C Rev.8

Page 2 of 3

Issued Date 25/07/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Ngamwongwan 47 Yaek 48, Toongsoonthong, Lakki, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

เอกสารไม่ควบคุม

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (1)
O ₂ (%Vol)	2.500	2.46	-0.04	0.15
O ₂ (%Vol)	10.04	9.92	-0.12	0.20
O ₂ (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1001	-2	12
NO ₂ (ppm)	30.34	29.7	-0.64	8.0
NO ₂ (ppm)	81.32	82.5	1.18	8.0
NO ₂ (ppm)	201.9	203.7	1.8	12
NO (ppm)	30.01	30	-0.01	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO ₂ (ppm)	50.36	52	1.64	6.0
SO ₂ (ppm)	100.8	102	1.2	6.0
SO ₂ (ppm)	600.8	604	3.2	13

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

End of Report

FM-CL-09-C Rev.8

Page 3 of 3

Issued Date 25/07/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Ngamwongwan 47 Yaek 48, Toongsoonthong, Lakki, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

เอกสารไม่ควบคุม

Certificate No: G 670125
Date of issue : 23-Feb-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03349608/0419
Instrument serial no. : 61659816/0419
ID no. or control no. : UAE-FPM-123/2563 (No.9)
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 Road, Bangchak, Prakanong, Bangkok 10260

Total pages of certificate : 3 Pages
Receiving no. : L-240665
Receiving date : 19-Feb-24
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.04, 21.02 %Vol, Carbon Monoxide 80.14, 302, 1003 ppm, Nitrogen Dioxide 30.34, 81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)

Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakse, 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 are invalid 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 : 23-Feb-24


Mr. Kierachai Namdang
Calibration Technician


Mr. Nongluck Wongnitham
Technical Manager

Certificate No.: G 670125

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Linde	27-Aug-27
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	18-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) 81.32 ppm	3546/23	Linde	14-Jan-26
Nitrogen Dioxide (NO ₂) 201.9 ppm	1915/23	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 : 22.9 °C Humidity : 62.2 %RH Pressure : 1009.4 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1019.2 mbar

Calibration Results (Before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
O ₂ (%Vol)	2.50	2.52	0.02	0.15
O ₂ (%Vol)	10.04	9.93	-0.11	0.20
O ₂ (%Vol)	21.02	21.14	0.12	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1003	1003	0	12
NO ₂ (ppm)	30.34	18.8	-11.54	8.0
NO ₂ (ppm)	81.32	64.2	-17.12	8.0
NO ₂ (ppm)	201.9	152.3	-49.6	12
NO (ppm)	30.01	29	-1.01	8.0
NO (ppm)	151.5	150	-1.5	8.0
NO (ppm)	322.5	320	-2.5	12
SO ₂ (ppm)	50.36	47	-3.36	6.0
SO ₂ (ppm)	100.8	94	-6.8	6.0
SO ₂ (ppm)	600.8	586	-14.8	13

Certificate No.: G 670125

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
O ₂ (%Vol)	2.500	2.52	0.02	0.15
O ₂ (%Vol)	10.04	9.93	-0.11	0.20
O ₂ (%Vol)	21.02	21.14	0.12	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1003	1003	0	12
NO ₂ (ppm)	30.34	32.2	1.86	8.0
NO ₂ (ppm)	81.32	83.5	2.18	8.0
NO ₂ (ppm)	201.9	200.6	-1.3	12
NO (ppm)	30.01	29	-1.01	8.0
NO (ppm)	151.5	150	-1.5	8.0
NO (ppm)	322.5	320	-2.5	12
SO ₂ (ppm)	50.36	50	-0.36	6.0
SO ₂ (ppm)	100.8	100	-0.8	6.0
SO ₂ (ppm)	600.8	598	-2.8	13

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

End of Report

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

รายการใบรับรองสอบเทียบ/พวนสอบ 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	MS603S/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 C252436235	National Food Institute, Ministry of Industry, Thailand	2402420-003-01	19 Apr 24	18 Apr 25	-

Calibration Certificate

Certificate No.: 2402284-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: MS6035/01

Serial No.: 8007010311

ID No.: UAE.TOX.008/2553

Order No.: 2402284

Operation No.: 2402284-001

Date of Receipt: 2 April 2024

Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong
Scientist

Approved by
(Mr.Pheraphat Tuanjit)
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

Calibration Report

Certificate No.: 2402284-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: MS6035/01
Serial No.: 8007010311
Capacity: 620
Resolution: 0.001
ID No.: UAE.TOX.008/2553

Page 2 of 3

Date of Calibration: 2 April 2024
Environment Condition: Ambient Temperature: 24.5 ± 0.5 °C Relative Humidity: 48 ± 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-HA-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	810567572	TCS	M3040535	8 April 2024
Standard Weight Class E2	500g	810567696	TCS	M3040545	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 017/23	Quality Ration	QR24-0344	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)
200	0.0002
600	0.00048

2. Off-Center Error:

A mass of 200 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)
200.000	199.997	199.999	199.999	199.998	200.000	0.003

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

Calibration Report

Certificate No.: 2402284-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: MS6035/01
Serial No.: 8007010311
Capacity: 620
Resolution: 0.001
ID No.: UAE.TOX.008/2553

Date of Calibration: 2 April 2024

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0 - 600 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (g)	Coverage Factor k
unloaded	0.0000	0.000	0.000	0.00082	2.00
0.1	0.1000	0.100	0.000	0.00082	2.00
0.5	0.5000	0.500	0.000	0.00082	2.00
1	1.0000	1.000	0.000	0.00082	2.00
2	2.0000	2.000	0.000	0.00082	2.00
3	3.0000	3.000	0.000	0.00082	2.00
5	5.0000	5.000	0.000	0.00082	2.00
10	10.0000	10.000	0.000	0.00082	2.00
20	20.0000	20.000	0.000	0.00082	2.00
50	50.0000	50.000	0.000	0.00082	2.00
100	100.0001	100.000	0.000	0.00082	2.00
150	150.0001	150.000	0.000	0.00084	2.00
200	200.0002	200.000	0.000	0.00086	2.00
300	300.0002	299.999	0.001	0.00090	2.00
400	400.0003	399.998	0.002	0.00100	2.00
500	500.0003	499.997	0.003	0.00111	2.00
600	600.0004	599.996	0.004	0.0012	2.00

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

----- End -----

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

Equipment: Electronic Balance	Model: MS6035/01	ID No.: UAE.TOX.008/2553	U + Error Total Error (g)	Judgement (g)	Result (Pass / Fail)
401-01	Metler-Toledo	1: 8007010311	Uncertainty (U)	Correction	Error
Standard Value	Average Reading	Uncertainty (U)	Correction	Error	
(g)	(g)	(g)	(g)	(g)	
0	0.0000	0.000	0.000	0.000	Pass
0.1	0.1000	0.000	0.000	0.000	Pass
0.5	0.5000	0.000	0.000	0.000	Pass
1	1.0000	0.000	0.000	0.000	Pass
2	2.0000	0.000	0.000	0.000	Pass
5	5.0000	0.000	0.000	0.000	Pass
10	10.0000	0.000	0.000	0.000	Pass
20	20.0000	0.000	0.000	0.000	Pass
50	50.0000	0.000	0.000	0.000	Pass
100	100.0001	0.000	0.000	0.000	Pass
150	150.0001	0.000	0.000	0.000	Pass
200	200.0002	0.000	0.000	0.000	Pass
300	300.0002	0.001	0.001	0.001	Pass
400	400.0003	0.002	0.002	0.002	Pass
500	500.0003	0.003	0.003	0.003	Pass
600	600.0004	0.004	0.004	0.004	Pass
: Unit Under Calibration					
cs					

เอกสารไม่ควบคุม

Calibration Certificate

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

Page 1 of 3

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: MS204TS/00

Serial No.: C252436235

ID No.: UAE.AIR.023/2566

Order No.: 2402420

Operation No.: 2402420-003

Date of Receipt: 19 April 2024

Date of Calibration: 19 April 2024

Calibrated by Mr. Pheraphat Tuanjit
Scientist

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

Date of Issue: 23 April 2024

The uncertainties are for a confidence probability of approximately 95%

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

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

Calibration Report

Certificate No.: 2402420-003-01
Equipment: Electronic Balance
Model: MS204TS/00
Serial No.: C252436235
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE.AIR.023/2566

Date of Calibration: 19 April 2024

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (±g)	Coverage Factor k
Unload	0.00000	0.00000	0.00000	0.0000094	2.00
0.1	0.10000	0.10000	0.00000	0.0000094	2.00
1	0.99998	1.00000	0.00000	0.0000097	2.00
5	4.99997	5.00000	0.00000	0.0000096	2.00
10	10.00002	10.00000	0.00000	0.000012	2.00
20	20.00003	20.00001	-0.00001	0.000014	2.00
30	30.00000	30.00003	0.00003	0.000012	2.00
70	70.00000	70.00005	0.00005	0.000017	2.00
100	99.99997	100.00006	0.00006	0.000017	2.00
150	149.99994	150.00012	0.00012	0.000022	2.00
200	200.00001	200.00015	0.00015	0.000028	2.00

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

----- End -----

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

Calibration Report

Certificate No.: 2402420-003-01
Equipment: Electronic Balance
Model: MS204TS/00
Serial No.: C252436235
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE.AIR.023/2566

Date of Calibration: 19 April 2024

Page 2 of 3

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

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

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

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

2. Reference Standards:

Reference Standard Model Serial No. Calibrated By Certificate No. Due Date

Standard Weight Class E2 1-500mg 15880 TCS P02111815 28 November 2024

Standard Weight Class E2 1-500g 15882 TCS P02111815 28 November 2024

Instrument Model Serial No. Calibrated By Certificate No. Due Date

Thermo-Hygro Meter 608-H1 NFI.BTH.019/23 Quality Room QR24-0492 4 March 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:

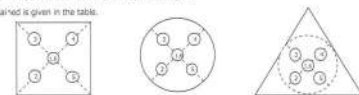
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.000024
200	0.000024

2. Off-Center Error:

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

The balance reading obtained is given in the table.



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

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

Calibration Report

Certificate No.: 2402420-003-01
Equipment: Electronic Balance
Model: MS204TS/00
Serial No.: C252436235
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE.AIR.023/2566

Date of Calibration: 19 April 2024

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (±g)	Coverage Factor k
Unload	0.00000	0.00000	0.00000	0.0000094	2.00
0.1	0.10000	0.10000	0.00000	0.0000094	2.00
1	0.99998	1.00000	0.00000	0.0000097	2.00
5	4.99997	5.00000	0.00000	0.0000096	2.00
10	10.00002	10.00000	0.00000	0.000012	2.00
20	20.00003	20.00001	-0.00001	0.000014	2.00
30	30.00000	30.00003	0.00003	0.000012	2.00
70	70.00000	70.00005	0.00005	0.000017	2.00
100	99.99997	100.00006	0.00006	0.000017	2.00
150	149.99994	150.00012	0.00012	0.000022	2.00
200	200.00001	200.00015	0.00015	0.000028	2.00

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

----- End -----

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

รายงานผลการปฏิบัติงานตามตารางป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม
โครงการปรับปรุงคุณภาพน้ำดิบ บริษัท บางจาก คอร์ปอเรชั่น จำกัด (มหาชน)
ประจำปี พ.ศ. 2567

รายการใบรับรองสอบเทียบ/พาสสอบ 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 / 1231155210	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.	C07240167	9 Apr 24	8 Apr 25	-
3	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (SS) ของแข็งทั้งหมด (TS)	Mettler-Toledo	XS2050DU / C090971872	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	XS2050DU / C210685394	National Food Institute, Ministry of Industry, Thailand	2402283-002-01	2 Apr 24	1 Apr 25	-
5	Hot Air Oven		Memmert	UF55 / B212.0411	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 / C117635043	Technology Promotion Association (Thailand-Japan)	24MM293	11 May 24	10 May 25	-
7	BOD Incubator	บีโอดี (BOD)	Arco	UC4-1320 / (UAE:WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	24TM303	10 Feb 24	8 Feb 25	-
8	BOD Incubator		Arco	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	HI83980-02 / H0185001	Hanna Instruments (Thailand) Ltd.	HIT-2412-0389	18 Mar 24	17 Mar 25	-
10	COD Reactor (Heating Block)		Hanna	HI83980-02 / 1147807	Hanna Instruments (Thailand) Ltd.	HIT-2417-0568	23 Apr 24	22 Apr 25	-
11	UV-VIS Spectrophotometer	ไนโตรเจน (CN), ฟีนอล (Phenol), ซีโอดี (COD) ฟีนอล (Phenol)	Agilent Technologies	Cary60 G6860A / MY1541.0009	DOE Services Co.Ltd.	SP24-018	7 May 24	6 May 25	-
12	UV-VIS Spectrophotometer		Htachi	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 AA240FS / MY13160001	Thailand Institute of Scientific and Technological Research (TISTR)	MTC.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 / KIT0A0153	Analytik Jena FarEast 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 Certificate

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

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
ID No.: UAE.WAT.010/2553
Order No.: 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 Team
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.

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

PTB (Physikalisch-Technische Bundesanstalt) is the national metrology institute of Germany. It is the only metrology institute in Germany that is accredited for all metrological fields. PTB is the only metrology institute in Germany that is accredited for all metrological fields. PTB is the only metrology institute in Germany that is accredited for all metrological fields.

Calibration Report

Certificate No.: 2401718-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
Type: Bench top
ID No.: UAE.WAT.010/2553

Page 2 of 5

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

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fuke	23E2053	14 June 2024
2.2 Digital Thermometer	2709007	Fuke	CC 660570-01	30 October 2024
2.3 Thermo-Hygro Meter	NF1.BTH.01423	Isoo	CC 660553-01	3 April 2024
Certified Reference Material				
	Lot No.	Manufacturer	Ref No	Expire Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	888842	CPAchem	TY218.L5	12 April 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	888843	CPAchem	PH217.L5	13 April 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	888844	CPAchem	PH220.L5	13 April 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	003109	HACH LANGE GmbH	S11M004	15 October 2025

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

3.1 Instruments Ng 2.1 through NSC-TIS-118 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments Ng 2.2 and 2.3 through NSC-TIS-118 17025 Laboratory Accreditation of Calibration No.0061
3.3 Certified Reference Material Ng 2.4 to 2.6 traceable to Primary measurement method: Hamed cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited in ISO 17024 and ISO/IEC 17025

3.4 Certified Reference Material Ng 2.7 traceable to PTB Certificate Nr. PTB-PH04.563/30504Q23 and Certificate Nr. PTB-PH08.555/30620Q22 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany)

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

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

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

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Calibration Report

Certificate No.: 2401718-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
Type: Bench top
ID No.: UAE.WAT.010/2553

Date of Calibration: 11 March 2024
Page 3 of 5

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 mV	Uncertainty (±mV)	Coverage Factor (k)
0	414.121	414	0.05	2.50
2	295.614	296	2.00	0.58
4	177.464	178	4.00	0.58
6	59.160	59	6.00	0.58
7	0.001	0	7.00	0.58
8	-59.159	-59	8.00	0.58
10	-177.461	-177	10.00	0.58
12	-295.611	-296	12.00	0.58
14	-414.118	-414	14.00	0.58

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

Equipment: pH Electrode Type: Combined Electrode
Manufacturer: METTLER TOLEDO Model: InLab Solids
Serial No.: 3065701 ID No.: N/A

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

Certified Value (25 °C (pH))	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	186	-	0.0071	2.00
7.001	7.00	13	98.9	0.0086	2.00
10.019	10.01	-160	97.2	0.0085	2.00
6.865	6.87	21	-	0.0074	2.00

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

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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.: UAE.WAT.010/2553
Manufacturer: METTLER TOLEDO

Date of Calibration: 11 March 2024
Page 4 of 5

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

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

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2115154	PSL-T 087786	06-Jun-24	TISTR
Platinum Resistance Thermometer (PRT)	5027A	877332			

Support Equipment : - Low Temperature Bath (SOCAL-6), Model: Europa-6 Plus Basic, SN: 3418922

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: 20-04-65

PTB (Physikalisch-Technische Bundesanstalt) is the national metrology institute of Germany. It is the only metrology institute in Germany that is accredited for all metrological fields. PTB is the only metrology institute in Germany that is accredited for all metrological fields. PTB is the only metrology institute in Germany that is accredited for all metrological fields.

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.: UAE.WAT.0102553
Manufacturer: METTLER TOLEDO
Date of Calibration: 11 March 2024 Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.

Description of probe, model: N/A SN: N/A

Dimension of probe: Diameter 4 mm, Length 120 mm.

Sheath material: Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	14.996	0.1	0.099
25.1	24.996	0.1	0.099
35.1	34.997	0.1	0.099

3028
- UUC* : Unit Under Calibration

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

End

F-CS-012 Revision: 01 Date: 29-04-05

2533 Sukhumvit Road, Bangkok 10260, Thailand
2533 Sukhumvit Road, Bangkok 10260, Thailand
Phone: +66 2033 7000 Email: info@dksh.com Website: www.dksh.com/thailand

เอกสารไม่ควบคุม



Certificate of Calibration

Equipment: pH METER Certificate No.: C07240167
Model: SevenEasy Issued Date: 9 April 2024
Serial No. (or ID.): 1230525212 (UAE.WAS.003/2553) Job No.: WO-00024208
Manufacturer: METTLER TOLEDO Page: 1 of 3
Electrode Serial No.: 1156883 Model: InLab Solids Brand: METTLER TOLEDO
Condition: In Condition

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

Environment Condition: Temperature 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

Calibration Place: Environment Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangkok,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Miss.Orawan Khlaiphioi
Calibration Date: 9 April 2024
The Method used: In house method, CAL-WI-50, base on ASTM E 70-07
Traceability: This certificate is traceable to SI Units. Sample Test is assured through primary measurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 936377, 931965, 931984 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20230350EA.

(Miss.Orawan Khlaiphioi)
Person in charge

(Mr. Nitnun Srihawan)
Authorized signatory

This certificate is issued 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 เทคโนโลยี เคซี จำกัด
DKSH Technology Limited
2533 สุขุมวิท ถนนสุขุมวิท กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2033 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CAL-FM-C07-14: 9 Apr 2024

Certificate No.: C07240167 Page 2 of 3

Calibration Results:

pH Scale

Input (mV)	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414	-0.12	0.00	0.58	2.00
354.96	355	0.04	1.00	0.58	2.00
295.8	296	0.20	2.00	0.58	2.00
236.64	237	0.36	3.00	0.58	2.00
177.48	178	0.52	4.00	0.58	2.00
118.32	118	-0.32	5.00	0.58	2.00
59.16	59	-0.16	6.00	0.58	2.00
0	0	0.00	7.00	0.58	2.00
-59.16	-59	0.16	8.00	0.58	2.00
-118.32	-118	0.32	9.00	0.58	2.00
-177.48	-177	0.48	10.00	0.58	2.00
-236.64	-236	0.64	11.00	0.58	2.00
-295.8	-296	-0.20	12.00	0.58	2.00
-354.96	-355	-0.04	13.00	0.58	2.00
-414.12	-414	0.12	14.00	0.58	2.00

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CAL-FM-C07-14: 9 Apr 2024

Certificate No.: C07240167 Page 3 of 3

Practical slope and zero point*

The three-point calibration using three standard buffer solutions; pH 4.008, pH 6.985 and pH 9.997

-During calibration, display of pH meter reading: pH 4.00, pH 7.00 and pH 10.01

The practical slope of the pH electrode; 57.01 (mV/pH), 96.37%

The zero point of the pH electrode; 6.88 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	3.99	-0.016	0.0070	2.00
6.985	7.00	0.015	0.0091	2.00
9.997	10.02	0.023	0.0074	2.00

* Calibration Marked * Not TISI Accredited * In this Certificate have been included for completeness.

The End of Certificate

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CAL-FM-C07-14: 9 Apr 2024



Certificate No.: C15240373
Page: 2 of 2



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 Soi Udomsuk 41 Sukhumvit Road,
Bangkok, 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, Bangkok,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Natookarn 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. Natookarn 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 อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certidto-thailand
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CAL-FM-C15-14: 09 Dec 2022

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:

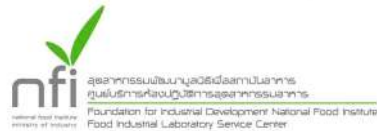
Without Adjustment

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 อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
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CAL-FM-C15-14: 09 Dec 2022



Calibration Certificate

Certificate No.: 2402283-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakanong, 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. Phuraporn Panyasri)

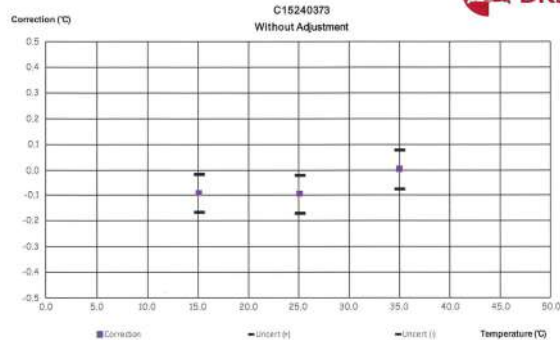
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

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 established 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



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25006 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
25006 So. 36, Asoi Asoi Road, Bang 11 Khan Sukhumvit, Bang Phra District, Bangkok 10700, Thailand
Tel: +66(0)2 2639 7000 Fax: +66(0)2 2639 7000

เอกสารไม่ควบคุม



Calibration Report

Certificate No.: 2402283-001-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C09071872

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: 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	8505567572	TCS	M23040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608 HI	NFI.BTH.016/23	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	0.000052
80	0.000063
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

2008 บางนา-สุขุมวิท 36 หมู่ 5 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel :+66(0) 2462 8588 Fax :+66(0) 2462 8545 nfi.or.th

Calibration Report

Certificate No.: 2402283-001-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C09071872

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
Unloaded	0.000000	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	0.050006	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	1.00003	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	10.00009	10.00009	0.00001	0.000026	2.00
20	20.00031	20.00002	0.00001	0.000037	2.00
30	30.00040	30.00003	0.00001	0.000052	2.00
50	50.00028	50.00004	-0.00001	0.000068	2.00
80	80.00068	80.00005	0.00002	0.00011	2.00

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

2008 บางนา-สุขุมวิท 36 หมู่ 5 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel :+66(0) 2462 8588 Fax :+66(0) 2462 8545 nfi.or.th

Calibration Report

Certificate No.: 2402283-001-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C09071872

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
90	90.00010	90.0000	0.00001	0.000015	2.00
100	100.00006	100.0000	0.00001	0.000015	2.00
110	110.00007	110.0001	0.00000	0.000017	2.00
120	120.00009	120.0000	0.00001	0.000018	2.00
130	130.00010	130.0000	0.00001	0.000019	2.00
140	140.00014	140.0000	0.00001	0.000020	2.00
150	150.00009	150.0001	0.00000	0.000020	2.00
160	160.00010	160.0001	0.00000	0.000022	2.00
170	170.00012	170.0001	0.00000	0.000023	2.00
200	200.00016	200.0000	0.00002	0.000028	2.00

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

----- End -----

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

2008 บางนา-สุขุมวิท 36 หมู่ 5 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel :+66(0) 2462 8588 Fax :+66(0) 2462 8545 nfi.or.th

Calibration Certificate

Certificate No.: 2402283-002-01

Client name:

UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Address:

3 SOI UDOMSUK 41, SUKHUMVIT ROAD,
Bangchack, Prakhonong, Bangkok 10260

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
Scientist

Approved by
(Mr.)

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

2008 บางนา-สุขุมวิท 36 หมู่ 5 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 36, Aun Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel :+66(0) 2462 8588 Fax :+66(0) 2462 8545 nfi.or.th

Calibration Report

Certificate No.: 2402283-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 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.FA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	N23040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo Hygro Meter	508 H1	NF1.BTH 016/23	Quality Reborn	Q624-0343	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:

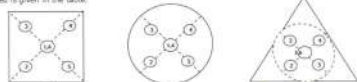
1. Repeatability of Reading:

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 pans.

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 ถนนพหลโยธิน แขวงสามยุค กรุงเทพมหานคร เขตบางเขน กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 35, Aun Aiam Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10710, Thailand
Tel : +662 2422 8688 Fax : +662 2422 8545

Calibration Report

Certificate No.: 2402283-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 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
Unloaded	0.00000	0.00000	0.00000	0.0000086	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	0.000068	2.00
80	80.000068	80.00002	0.00005	0.00011	2.00

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

2008 ถนนพหลโยธิน แขวงสามยุค กรุงเทพมหานคร เขตบางเขน กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 35, Aun Aiam Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10710, Thailand
Tel : +662 2422 8688 Fax : +662 2422 8545

Calibration Report

Certificate No.: 2402283-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 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
90	90.00010	90.0001	0.0000	0.00015	2.00
100	100.00006	100.0001	0.0000	0.00015	2.00
110	110.00007	110.0001	0.0000	0.00016	2.00
120	120.00009	120.0000	0.0001	0.00017	2.00
130	130.00010	130.0000	0.0001	0.00019	2.00
140	140.00014	140.0000	0.0001	0.00020	2.00
150	150.00009	150.0001	0.0000	0.00020	2.00
160	160.00010	160.0001	0.0000	0.00022	2.00
170	170.00012	170.0001	0.0000	0.00023	2.00
200	200.00016	200.0002	0.0000	0.00028	2.00

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 %.

----- End -----

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

2008 ถนนพหลโยธิน แขวงสามยุค กรุงเทพมหานคร เขตบางเขน กรุงเทพมหานคร เอกสารไม่ควบคุม
2008 Soi 35, Aun Aiam Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10710, Thailand
Tel : +662 2422 8688 Fax : +662 2422 8545



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & 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.: 24TM589

Page: 1 of 3

Equipment: Hot Air Oven

Manufacturer: Memmert

Model: UF 55

Serial No.: B212.0411

ID No.: UAE.WAO.005/2556

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 ± 1) °C

Relative Humidity: (50 ± 3) %

Calibrated by: Krisda Malee

Approved by: [Signature]

() Ponpan Paipim

(✓) Suwit Imjai

() Kunchit Promprat

Issue Date: 5 April 2024

The Uncertainties are for a confidence probability of approximately 95 %

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

เอกสารไม่ควบคุม
A 0050565



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.

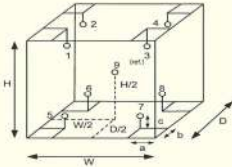
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :

a = 5.0 cm D = 0.50 m
b = 5.0 cm W = 0.80 m
c = 5.0 cm 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

เอกสารไม่ควบคุม
a 1209739



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0004OC-3
Result of Calibration :- (*) Without Adjustment
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 k
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 %.

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เอกสารไม่ควบคุม
a 1209738



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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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 :

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

เอกสารไม่ควบคุม



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 (k)
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)

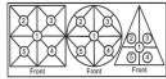
Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00007
200	0.00007

เอกสารไม่ควบคุม



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



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



Cert. No.: 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,
Bangkok 10260
Location : Lab Floor 2
Relative Humidity : (26 ± 10) °C
(50 ± 30) %
Calibrated by : Tawatchai Pama
Approved by :
() Pornthipa Tamevakul
(✓) Unnopphol Harachai
() Suwit Imjai

Issue Date : 19 February 2024

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

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

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	19.565	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 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 : 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.

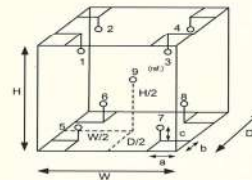
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	26	31
REL.Humid. (%)	70	65
AC Supply (Volt)	233	234



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

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-29 FAX: 0-2719-9484



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

Certificate of Calibration

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 Udumruk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Lab Floor 2
Location :
Received Order : 01 April 2024
Calibration Date : 01 April 2024
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Krisda Malee
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 5 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม
A 0065063



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

Cert. No.: 24TM587
Page : 2 of 3

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.

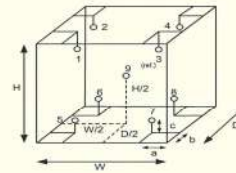
Remark : TPA : Technology Promotion Association (Thailand - Japan)

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



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

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

เอกสารไม่ควบคุม
a 1209743



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 standard 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
a 1209742



Hanna Instruments (Thailand) Ltd.
410/67-68 Soi Ratchadapisek 24, Ratchadapisek Rd., Samsen-nok,
Huykwang, 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 : $(25 \pm 2) ^\circ\text{C}$
Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udumruk 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. : H0185001
Resolution : 0.1°C
Temperature of Reaction : 150°C
Made in : Romania
Reference : RE240478
Relative Humidity : $(50 \pm 15)\%RH$

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

Approved by :
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.

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

Condition of this calibration result:

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

Instruments	Model	Serial No.	Certificate No.	Traceable
Data Acquisition Switch Unit	34970A	MY44065265	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)
149.235	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

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,
Phra Khanong, 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 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

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 **

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, Phra Khanong, 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 : 
Ms. Tanawut Rutitach
Technical Manager

Approved by : 
(Ms. Chonticha 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 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 DQE Services Co., Ltd.

เอกสารไม่ควบคุม

DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

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CALIBRATION DATA

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 Starna 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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DQE Services Co.,Ltd.

DQE Services

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ISO 17025:2017
CALIBRATION DATA

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

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CALIBRATION DATA

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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DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230

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CALIBRATION DATA

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	684.1	-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 99%

- * Indicates ISO 17025 accredited

- End of Certificate -

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Phone : +66 (0)2 538 2054, Email : dgeservicesinfo@gmail.com


ISO 17025
CALIBRATION DATA

CERTIFICATE OF CALIBRATION

Certificate No. : SP24-008Page 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 : Approved by : 
(Mr. Tanawat Rattidach) (Ms. L. Rattidach)
Technical Manager 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 conformity to recognized national standards and to the unit of measurement confirmed 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

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.
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Phone : +66 (0)2 538 2054, Email : dgeservicesinfo@gmail.com


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CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-008Page 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 Starma 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

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
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ISO 17025
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-008Page 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	0.000	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	0.0053	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.558	0.0013	0.0031	2.00
	1.0518	1.051	0.0008	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dgeservicesinfo@gmail.com


ISO 17025
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-008Page 4 of 5

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

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co., Ltd. 32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

REPORT OF CALIBRATION

Certificate No. : SP24-008 Page 5 of 5

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

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 Udomsuk 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 (Mr. Atipat Ratana) Approved by (Miss Subadda Dawyung)

Director of Analytical Chemistry Laboratory Ref. 2015267020100454001 Issued Date : 11 March 2024

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%

- * Indication on TIS is accredited

- End of Certificate -

FM-BL-MTC.002 Rev.4

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Request No. 25-67 / 0275 1 / 5 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	-0.0003	-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
	-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	0.0001	0.0003
	0.0004	0.0019	-0.0008	-0.0001	-0.0004	0.0003	0.0002	0.0008
Average Absorbance	0.000	0.001	-0.001	0.000	0.000	0.000	0.000	0.000

Continue 2 / 5

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Request No. 25-67 / 0275 2 / 5 MTC. ACL. No. 358 / 67

2. Precision

Element	Conc. (mg/l)	Absorbance	Ave. Abs.	SD	%RSD									
Cd	0.02	0.0078	0.0076	0.0009	0.0075	0.0071	0.0070	0.0076	0.0074	0.0077	0.0067	0.0007	0.0004	5.15
	0.30	0.1008	0.1007	0.0999	0.0997	0.1000	0.0996	0.1008	0.1002	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
Cr	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
	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
Cu	0.05	0.0061	0.0062	0.0064	0.0061	0.0069	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
	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
Fe	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
Pb	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	0.0551	0.0548	0.0552	0.0555	0.0547	0.0546	0.0544	0.0544	0.0549	0.0547	0.055	0.0004	0.64
Mn	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
	0.30	0.0650	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
Ni	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	0.0443	0.0433	0.0438	0.0444	0.0430	0.0437	0.0444	0.0437	0.0438	0.0434	0.044	0.0005	1.09
	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
Zn	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	0.1995	0.1985	0.1974	0.2004	0.199	0.0003	0.47
	0.70	0.4027	0.4031	0.4019	0.4021	0.4023	0.3981	0.4042	0.4025	0.3993	0.3997	0.402	0.0003	0.47

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Request No. 25-67 / 0275

3 / 5

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	0.74	

Continue 4 / 5

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Request No. 25-67 / 0275

4 / 5

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	0.34	± 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	

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5 / 5

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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

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End of Certificate

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analytikjena
an independent laboratory

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur DUO /
mercur DUO plus

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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 ยูไนเต็ด แอนาไลซิส 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	

Maintenance Protocol mercur D103 mercur D103 plus | update 21.06.2018 | version 2.1 Final
Analytik Jena AG | Kunitz-Str. 9 | 08746 Jena, Germany

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Maintenance works basic unit

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

Maintenance works Autosampler

Serial No.:

N/A

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

Maintenance Protocol mercur D103 mercur D103 plus | update 21.06.2018 | version 2.1 Final
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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	2.5ml/min ± 1 ml	2.5 ml/min
Red.-agent	2.5ml/min ± 1 ml	2.5 ml/min
Sample	10ml/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

Maintenance Protocol mercur D103 mercur D103 plus | update 21.06.2018 | version 2.1 Final
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เอกสารไม่ควบคุม 4.5

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

Signature Customer

Place, Date (DD/MM/YYYY)

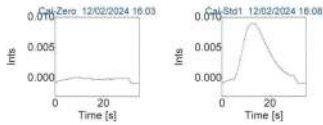
Place, Date (DD/MM/YYYY)

Maintenance Protocol mercur D103 mercur D103 plus | update 21.06.2018 | version 2.1 Final
Analytik Jena AG | Kunitz-Str. 9 | 08746 Jena, Germany

เอกสารไม่ควบคุม 5.5

Peak plots

Hg



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		
AZ time	5 s	Peak smoothing	12/5
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

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QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	3(0.100 ng/L)
QC std.1 limit	± 20.00%	QC std.2 limit	± 20.00%
QC std. act.	flag + continue	Reaction	flag + continue
Expect. blank abs.	0.0100± 0.0100	Reaction	off
QC precision	off	QC Recal.factor	Off

Calibration settings

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

Sample statistics

Stat. mode	Mean	Meas. cycles	3
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	off		

Calibration standards

Hg

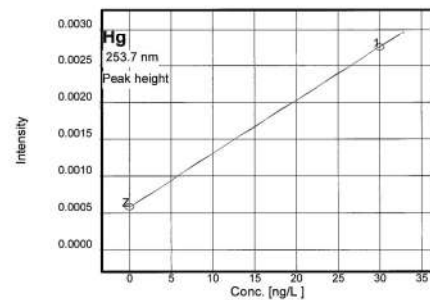
No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	##	0.000	H: 0.000587 A: 0.01383	0.000024 0.000359	4.137 2.597
2	Cal-Std1	(-)	##	30.000	H: 0.002754 A: 0.04276	0.000049 0.000186	1.814 0.437

Mercur

เอกสารไม่ควบคุม

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

Ints=k1+k2*conc		Recal. factor:	---
k1=0.000588	k2=0.000072		
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)

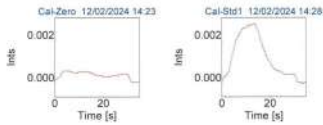
Without Enrichment / FBR / 30 µg/L_PM_12-02-2024							
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000588				PkH	14:23
		0.000564					14:24
		0.000612					14:25
	0ng/L	0.000587		0.000024310	4.137		14:25
Cal-Std1		0.002810				PkH	14:28
		0.002740					14:29
		0.002713					14:30
	30.00ng/L	0.002754		0.000049960	1.814		14:30
Calibration	Calibration function: 01						14:31

Mercur

เอกสารไม่ควบคุม

Peak plots

Hg



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

เอกสารไม่ควบคุม

Mercur

เอกสารไม่ควบคุม

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(30.000 µg/L)
QC std.1 no.	1(30.000 µg/L)	QC std.2 limit	± 50.00%
QC std.1 limit	± 50.00%	Reaction	flag + continue
QC std. act.	flag + continue	Reaction	flag + continue
Expect. blank abs.	0.0100± 0.0100	QC Recal.factor	Off
QC precision	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: 0.01659	0.000018 0.000277	0.417 1.673
2	Cal-Std1	(-)	##	30.000	H: 0.01710 A: 0.06278	0.000152 0.000616	0.889 0.982

Mercur

เอกสารไม่ควบคุม

Calibration function 1

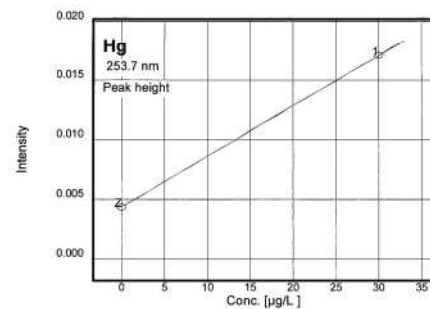
12/02/2024 14:55 Calibration (Peak height)

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)

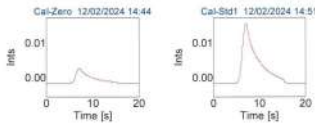
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.004343				PkH	14:44
		0.004378					14:46
		0.004352					14:47
	0 µg/L	0.004358		0.000018180	0.417		14:47
Cal-Std1		0.01726				PkH	14:51
		0.01695					14:52
		0.01708					14:54
	30.00 µg/L	0.01710		0.0001520	0.889		14:54
Calibration	Calibration function: 01						14:55

Mercur

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Peak plots

Hg



Mercur

เอกสารไม่ควบคุม

Mercur

Report file: C:\WinAAS\TMP\2024\Result\WOIPro_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		
AZ time	5 s	Peak smoothing	12/5
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. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(100.00 ng/L)	QC std.2 no.	1(100.00 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 0.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal factor	Off

Mercur

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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
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards

Hg

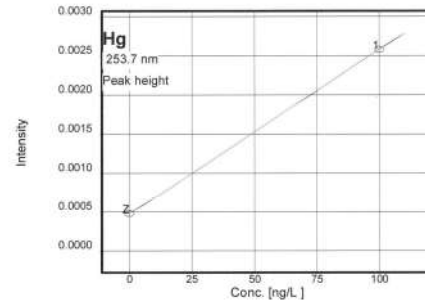
No	Name	State	Pos	Conc./ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000478 A: 0.005393	0.000331 0.002260	69.26 41.90
2	Cal-Std1	(-)	##	100.00	H: 0.002580 A: 0.034199	0.000081 0.002697	3.171 7.887

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
sc0	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	---

Mercur

เอกสารไม่ควบคุม

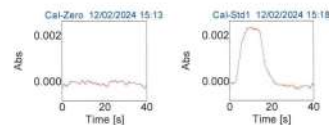


Measurements and events (sorted by time)

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
Cal-Std1		0.002638				PkH	15:18
		0.002615					15:19
		0.002487					15:21
	100 ng/L	0.002580		0.000081841	3.171		15:21
Calibration	Calibration function: 01						15:22

Peak plots

Hg



Mercur

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