

ภาคผนวก ฉ
เอกสารสอบเทียบเครื่องมือ

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP)	Tisch Environmental,Inc.	TE-5025A 3540	Jiranatee Associates Co., Ltd.	COF-045-67	4 Nov 24	3 Nov 25	-
2	U-Tube Manometer	Total Suspended Particulate (TSP)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	24P1250	10 Apr 24	9 Apr 25	-
3	Aneroid Barometer	Total Suspended Particulate (TSP)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24P1369	22 Apr 24	21 Apr 25	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	24H752	10 Apr 24	9 Apr 25	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778110	UAE Consultant Co.,Ltd.	17102024	17 Oct 24	16 Oct 25	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1200636462	UAE Consultant Co.,Ltd.	04102024	4 Oct 24	3 Oct 25	-
7	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NI91E15A0014	6 Jun 23	6 Jun 31	-
8	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778113	UAE Consultant Co.,Ltd.	04092024	4 Sep 24	3 Sep 25	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920012	UAE Consultant Co.,Ltd.	04092024	4 Sep 24	3 Sep 25	-
10	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NI91E15A0014	6 Jun 23	6 Jun 31	-
11	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201497730	UAE Consultant Co.,Ltd.	09092024	9 Sep 24	8 Sep 25	-
12	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201497732	UAE Consultant Co.,Ltd.	09092024	9 Sep 24	8 Sep 25	-
13	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0162121 2016PSIG	Airgas an Air Liquide company	E05NI91E15A0014	6 Jun 23	6 Jun 31	-

List of Instruments Certification for Air & Noise Quality Analysis

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Ambient									
14	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	-
15	Wind Speed/Wind Direction	WS/WD	LSI Lastem	DNA202/E-LOG BQ1705626/17037713	Jiranatee Associates Co., Ltd.	CWS-028-67	7 Aug 24	6 Aug 25	-
16	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 GAL13KSE	UAE Consultant Co.,Ltd.	19092024	19 Sep 24	18 Sep 25	-
17	Total Hydrocarbons Analyzer	Total Hydrocarbons	Thermo Scientific	55i 1182920025	UAE Consultant Co.,Ltd.	01102024	1 Oct 24	30 Sep 25	-
18	Standard Gas	Total Hydrocarbons	Linde	D824432	Linde	09042013	4 Aug 20	4 Aug 28	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	01dB	CAL31 84065	Innovative Instrument Co.,Ltd.	24-ACT-087	25 Jun 24	24 Jun 25	-
20	Sound Level Meter	L _{Aeq} 24 hrs	Larson Davis	LxT2 0005346	Innovative Instrument Co.,Ltd.	24-SLM-235	10 Jul 24	9 Jul 25	-
21	Sound Level Meter	L _{Aeq} 24 hrs	Larson Davis	LxT2 0005393	Innovative Instrument Co.,Ltd.	24-SLM-237	10 Jul 24	9 Jul 25	-
22	Sound Level Meter	L _{Aeq} 24 hrs	Larson Davis	LxT2 0005398	Innovative Instrument Co.,Ltd.	24-SLM-214	2 Jul 24	1 Jul 25	-
23	Sound Level Meter	L _{Aeq} 24 hrs	Larson Davis	LxT2 0005299	Innovative Instrument Co.,Ltd.	24-SLM-240	11 Jul 24	10 Jul 25	-

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Ecosence	pH100A 24H005156JEN	Technology Promotion Association (Thailand-Japan)	24CH1418	14 Nov 24	13 Nov 25	-
2	Conductivity Meter	Conductivity	Horiba	LAQUA-EC210 HC0K0005	Technology Promotion Association (Thailand-Japan)	24CH1060	28 Aug 24	27 Aug 25	-
3	Turbidity Meter	Turbidity	Thermo Scientific	EUTECH TN-100 3065434	Technology Promotion Association (Thailand-Japan)	24CH444	12 Apr 24	11 Apr 25	-
4	Salinity Meter	Salinity	YSI	Pro 30 22E105869	Technology Promotion Association (Thailand-Japan)	24CH821	10 Jul 24	9 Jul 25	-

CERTIFICATE OF CALIBRATION

Certificate No. : COF-045-67

Page 1 of 2 Pages

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

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

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 23.7 °C and 49.7 %RH.

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☐ Mr. Sotawat Thachalad
50 Mitapitrasong Lertsomphol



Approved signature:
Mr. Parinya Booncharoen
Calibration Department Manager

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement (Meter) (Roots Meter) Model GSGMACW24p. The WU CL-004 was used as a calibration guideline.

Traceability:
This certificate provides a "traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MN-0063-23.

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

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Office mmHg	Y	Standard Flow [Q _s] m ³ /min
1	0.702	755.241	23.67	22.37	57.134	1.612	1.268	0.651
2	1.000	755.312	23.55	22.71	61.323	1.248	0.921	0.921
3	1.117	755.334	23.36	22.72	41.180	4.809	1.301	1.058
4	1.365	755.361	23.37	22.77	30.028	4.806	1.374	1.119
5	1.417	755.397	23.65	23.10	29.199	7.191	1.681	1.365

Slope (m) : 1.98270
Intercept (b) : -0.02316
Correlation coefficient (r) : 0.99988
Uncertainty (k=2) : 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Office mmHg	Y	Standard Flow [Q _s] m ³ /min
1	0.702	755.241	23.67	22.37	57.134	1.612	0.736	0.652
2	1.000	755.312	23.55	22.71	61.323	1.248	1.129	0.921
3	1.117	755.334	23.36	22.72	41.180	4.809	1.301	1.058
4	1.365	755.361	23.37	22.77	30.028	4.806	1.374	1.119
5	1.417	755.397	23.65	23.10	29.199	7.191	1.681	1.365

Slope (m) : 1.24186
Intercept (b) : -0.01454
Correlation coefficient (r) : 0.99988
Uncertainty (k=2) : 0.015 m³/min

End of Certificate of Calibration

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

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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. : 24P1250
Page : 1 of 2

Equipment : U Tube Manometer
Manufacturer: Dwyer
Model : 1221-35-W/M
Serial No.: -
ID No.: UAE.EFM.076/2566

Condition As-Received: Used Item

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

Reference: 2404-0118WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1007 mbar

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

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

Condition of this result of calibration

1.Reference standards instruments :

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

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

3.Scale and conversion factor is $1 \text{ kPa} = 4.0146293 \text{ inH}_2\text{O}$

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

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

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

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

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

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

Calibrated by : Suksan Khankaew
Issue Date : 17 April 2024

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

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

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

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

Applied Pressure	High-port side	UUC Indication	Low-port side	ΔP	Error
0.00	0.00	0.00	0.00	0.00	0.00
2.00	1.00	-1.00	2.00	0.00	0.00
4.00	2.00	-2.00	4.00	0.00	0.00
6.00	3.00	-3.00	6.00	0.00	0.00
8.00	4.00	-4.00	8.00	0.00	0.00
10.00	5.05	-4.95	10.00	0.00	0.00
12.00	6.05	-5.95	12.00	0.00	0.00
14.00	7.05	-6.95	14.00	0.00	0.00
16.00	8.10	-7.95	16.05	0.05	0.05
18.00	9.10	-8.95	18.05	0.05	0.05
20.00	10.10	-9.95	20.05	0.05	0.05
22.00	11.10	-10.95	22.05	0.05	0.05
24.00	12.10	-11.95	24.05	0.05	0.05
26.00	13.15	-12.95	26.10	0.10	0.10
28.00	14.15	-13.95	28.10	0.10	0.10
30.00	15.20	-14.95	30.15	0.15	0.15
32.00	16.20	-15.95	32.15	0.15	0.15
34.00	17.20	-16.95	34.15	0.15	0.15
35.50	18.00	-17.70	35.70	0.20	0.20

The uncertainty of measurement was $\pm 0.11 \text{ inH}_2\text{O}$

* 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. : 24P1369
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE,ANV,013/2547

Condition As-Received: Used Item
Received Date: 05 April 2024
Calibration Date: 22 April 2024

Reference: 2404-0243WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1007 mbar
Submitted by: United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udumsuk 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-0094-23	03 May 2024

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

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

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 23 April 2024

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

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Cert.No.: 24P1369
Page: 2 of 2

Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range : 720 mmHg to 780 mmHg

Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

Applied Pressure (mmHg)	718,40	729,71	740,61	751,07	761,97	773,05	786,91
UUC* Indication (mmHg)	720,0	730,0	740,0	750,0	760,0	770,0	780,0
Error (mmHg)	1,60	0,29	-0,61	-1,07	-1,97	-3,05	-6,91

Decreasing Pressure

Applied Pressure (mmHg)	786,91	772,99	761,71	750,69	740,13	729,35	718,44
UUC* Indication (mmHg)	780,0	770,0	760,0	750,0	740,0	730,0	720,0
Error (mmHg)	-6,91	-2,99	-1,71	-0,69	-0,13	0,65	1,56

The uncertainty of measurement was ± 0,24 mmHg

* UUC = Unit Under Calibration

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

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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
to 18 April 2024

Reference: 2404-0247WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %
Submitted by: United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udumsuk 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	231238	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), NSQ-ONSC Accredited No. Calibration 0008

Calibrated by : Chakrit Waewwanjua
Issue Date : 18 April 2024

Approved Signatory :
[] Chakrit Waewwanjua
[✓] Vipom Tantiyawutti
[] Unnoppol 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 : 1201778110

Standard Gas Concentration

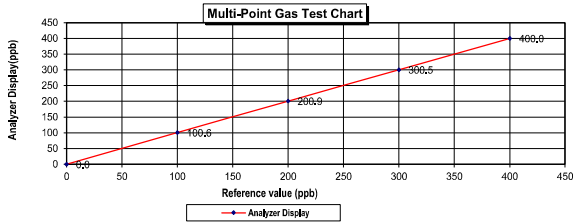
Sulphur Dioxide (SO₂) 42.89 PPM
Nitric Oxide (NO) 46.77 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 965.9 PPM
Cylinder No. : EB0159156
Expiration Date : Nov 6, 2026

Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero 0.0	0.0	0.00	0.00	0.00
Level 2 20.00%	100.6	0.60	0.60	0.60
Level 3 40.00%	200.9	0.90	0.45	0.45
Level 4 60.00%	300.5	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 $\pm 5\%$				



Calculate by
17 / 10 / 2567

Approve by
17 / Oct / 2024

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

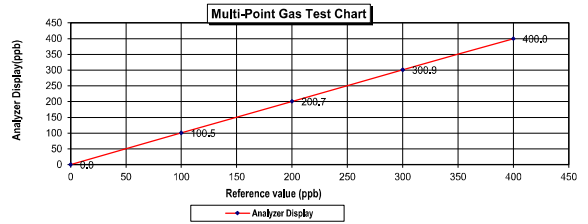
Sulphur Dioxide (SO₂) 42.89 PPM
Nitric Oxide (NO) 46.77 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 965.9 PPM
Cylinder No. : EB0159156
Expiration Date : Nov 6, 2026

Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero 0.0	0.0	0.00	0.00	0.00
Level 2 20.00%	100.5	0.50	0.50	0.50
Level 3 40.00%	200.7	0.70	0.35	0.35
Level 4 60.00%	300.9	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 $\pm 5\%$				



Calculate by
4 / 10 / 2567

Approve by
4 / Oct / 2024

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)
LTD.-
Part Number: E05N191E15A0014
Cylinder Number: EB0162121
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12023
Gas Code: CO, CO₂, NO, NO₂, SO₂, BALN
Reference Number: 160-402772205-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2016 PSIG
Valve Outlet: 650
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 800/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a 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.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	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	100.5 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	06/26/2023
CARBON DIOXIDE	8.000 %	7.982 %	G1	$\pm 1.2\%$ NIST Traceable	06/27/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMS	104202308	CC754364	98.36 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Jan 04, 2031
PRM	C2219101	AP61514048	100.15 PPM NITRIC OXIDE/NITROGEN	$\pm 0.3\%$	Feb 28, 2025
GMS	2023042525	CC754381	98.52 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Apr 25, 2031
PRM	12409	D912660	15.01 PPM NITROGEN DIOXIDE/AIR	$\pm 1.5\%$	Feb 17, 2023
GMS	153400202002	EB0130037	9.693 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 1.0\%$	Sep 29, 2025
NTRM	160102-22	KAL003820	97.69 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Nov 01, 2027
CO	230601	CC745902	249.47 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.3\%$	Dec 09, 2028
NTRM	130606-02	CC411730	13.359 % CARBON DIOXIDE/NITROGEN	$\pm 0.6\%$	May 14, 2025

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO ₂	FTIR	Jun 15, 2023
SIEMENS ULTRAMATE6 N1-C8-180	NDIR	Jun 14, 2023
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Jun 29, 2023
Nicolet iS50 FTIR AUP2010245 NO ₂	FTIR	Jun 15, 2023
Nicolet iS50 FTIR AUP2010245 SO ₂	FTIR	Jun 08, 2023

Approved for Release

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

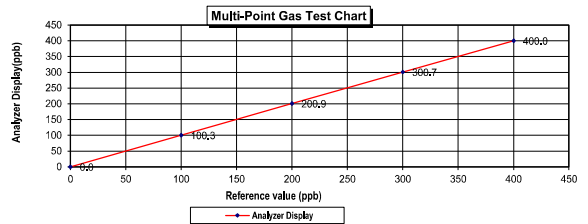
Sulphur Dioxide (SO₂) 42.89 PPM
Nitric Oxide (NO) 46.77 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 965.9 PPM
Cylinder No. : EB0159156
Expiration Date : Nov 06, 2026

Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero 0.0	0.0	0.00	0.00	0.00
Level 2 20.00%	100.3	0.30	0.30	0.30
Level 3 40.00%	200.9	0.90	0.45	0.45
Level 4 60.00%	300.7	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 (%)	0.20	
:Acceptable Limit $\pm 5\%$				



Calculate by
4 / 9 / 2567

Approve by
4 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 4, 2024

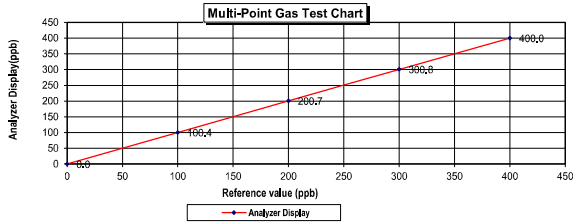
Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920012

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	PPM		
Cylinder No. :	EB01159156			
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%	100.4	0.40	0.40	0.40
Level 3	40.00%	200.7	0.70	0.35	0.35
Level 4	60.00%	300.8	0.80	0.27	0.27
Level 5	80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range 500.0 ppb Average Difference (%) 0.20
:Acceptable Limit $\pm 5\%$



Calculate by
Gurcharan C.
4 / 9 / 2567

Approve by
Pattana B.
4 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 9, 2024

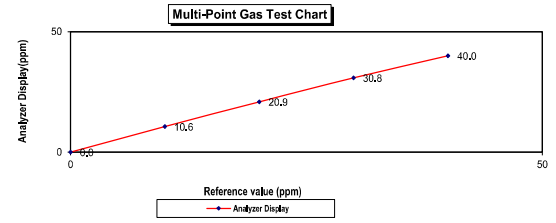
Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1201497730

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	PPM		
Cylinder No. :	EB01159156			
Expiration Date :	Nov 06, 2026			

Multi-point gas test data

	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.0	0.0
Level 2	20.00%	10.6	0.6	5.7	5.7
Level 3	40.00%	20.9	0.9	4.3	4.3
Level 4	60.00%	30.8	0.8	2.6	2.6
Level 5	80.00%	40.0	0.0	0.0	0.0

Remark : Measuring Range 50.0 ppm Average Difference (%) 2.51
:Acceptable Limit $\pm 5\%$



Calculate by
Gurcharan C.
9 / 9 / 2567

Approve by
Pattana B.
9 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 9, 2024

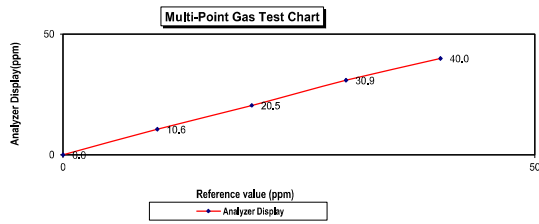
Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1201497732

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	PPM		
Cylinder No. :	EB01159156			
Expiration Date :	Nov 06, 2026			

Multi-point gas test data

	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.0	0.0
Level 2	20.00%	10.6	0.6	5.7	5.7
Level 3	40.00%	20.5	0.5	2.4	2.4
Level 4	60.00%	30.9	0.9	2.9	2.9
Level 5	80.00%	40.0	0.0	0.0	0.0

Remark : Measuring Range 50.0 ppm Average Difference (%) 2.20
:Acceptable Limit $\pm 5\%$



Calculate by
Gurcharan C.
9 / 9 / 2567

Approve by
Pattana B.
9 / Sep / 2024

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MODEL/TYPE : L31 Lastem
Data logger: E-LOG
SERIAL NUMBER : Sensor: BCI1705627
Data logger: 17037708
ID NUMBER :
CONDITION AS-RECEIVED :
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phra Khanong, 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 follows:
Temperature : 23.0 \pm 3.0 °C
Relative Humidity : 55.0 \pm 15.0 %RH
Atmospheric Pressure : 1010 \pm 30 hPa

PLACE OF CALIBRATION : Effel type wind tunnel of Iranattee Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area : 900 cm²
Wind direction frontal area : 195 cm²
Diameter of mounting pipe : - mm
Blockage ratio of test object : 0.217 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8) °C, (41.5) %RH and (1009.0) hPa.

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

Calibrated by:
Mr. Sorawat Thachalad
Mr. Mico Jitrasopon Lertsomphol



Approved signatory:
Mr. Pannya Booncharoen
Calibration Department Manager

Remarks:
1. Inside cross-section area of the wind tunnel
2. Projected cross-section area of the tested object includes mounting pipe.
3. Diameter of mounting pipe
4. Ratio "to 1"

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8457-82 and pilot tube with precision differential pressure meter model: DPM2500 in an effel type wind tunnel of Effel type wind tunnel with 900 cm² cross test section area. The NS-C1-087 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 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 NMIT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0055-23

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"

Certificate Number
CW5-027-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.093	23.98	24.05	0.9	-0.2	0.31
2.051	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
6.08	23.84	24.05	5.9	-0.2	0.31
6.99	23.52	24.05	6.8	-0.2	0.31
8.16	24.48	24.05	8.0	-0.2	0.31
9.12	23.50	24.05	9.1	-0.1	0.31
9.98	24.02	24.05	9.9	-0.1	0.31
11.04	23.46	24.05	11.1	0.0	0.31
12.05	23.64	24.05	12.1	0.1	0.31
13.02	23.46	24.05	13.0	-0.1	0.31
13.96	23.50	24.05	14.0	0.1	0.35
15.03	23.52	24.05	15.1	0.1	0.39
16.00	23.50	24.05	16.0	0.0	0.34

Remark:

¹ Calibration results only count 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 set-up of the Cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



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Certificate Number
CW5-027-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

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

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

- ☒ Mr. Sorawat Thachalad
- ☐ Miss Jittrapsorn Lertronsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

¹ Net area cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_1}{A_2}$

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

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Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D'_{true} Degree (°)	D'_{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.000	0	0	0.80
	45.000	46	1	0.80
	90.000	90	0	0.80
	135.000	135	0	0.80
	180.000	180	0	0.80
	225.000	225	0	0.80
	270.000	269	-1	0.80
	315.000	314	-1	0.80

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-180-67

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature	23.0 ± 3.0	°C
Relative Humidity	55.0 ± 15.0	%RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.



Calibrated by:

- ☐ Mr. Sorawat Thachalad
- ☐ Miss Jittrapsorn Lertronsomphol
- ☒ Miss Rungrojmal Phoommit

Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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Result of Calibration: ☐ Without Adjustment ☒ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with temperature sensor Model: DMA672.1, S/N: 24070579.
Dimension: Diameter 14.88 mm., Length 140 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (Before) (°C)	UUC Reading (After) (°C)	Error (°C)	Uncertainty (°C)
120	20.031	18.37	19.88	-0.15	0.082
120	25.028	23.31	24.82	-0.21	0.082
120	30.016	28.20	29.72	-0.29	0.082
120	35.004	33.10	34.63	-0.37	0.082
120	39.998	38.01	39.57	-0.43	0.082

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CRT-047-67

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

- Relative humidity with data logger

- LSI Lastem

- Data Logger: E-LOG

- Sensor: DMA672.1

- Data Logger: 17037708

- Sensor: 24070579

- New item

- United Analyst and Engineering Consultant Co., Ltd.

- 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,

- Bangkok 10260

RECEIVED DATE

10 Oct 2024

MEASUREMENT DATE

21 Oct 2024

ISSUE DATE

22 Oct 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CI-Q09 and WI-CI-Q10 according to comparison method with Standard, Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TH-0079-23 and Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

Uncertainty of Measurement:

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

Calibrated by:

- ☐ Mr. Sornrat Thachalad
- ☒ Miss Jitraporn Lertsomphol
- ☐ Miss Ruangsangul Phosmitt



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

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Measurement Results:

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.

Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
29.76	19.65	20.5	0.8	0.78
29.76	50.33	51.0	0.7	1.3
29.82	81.61	81.4	-0.2	2.1

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CPR-010-67

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

- Digital barometer

- LSI Lastem

- Sensor: DQA240.1

- Data logger: E-LOG

- Sensor: R1605260

- Data logger: 17037708

- Used item

- United Analyst and Engineering Consultant Co., Ltd.

- 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,

- Phrakhanong, Bangkok 10260

RECEIVED DATE

02 Aug 2024

MEASUREMENT DATE

09 Aug 2024

ISSUE DATE

09 Aug 2024

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument: Absolute Pressure Transducer

Model: CPQ2500

Serial No.: 4100128P

Certificate No.: MP-0009-24

Due Date: 27 Dec 2024

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

3. Calibration conditions:

4. Condition

Pressure transmitting medium

ρ_{10} (20°C, 1 bar)

μ_{10}

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

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μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

μ_{10} (20°C, 1 bar)

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

Calibrated by:

- ☐ Mr. Sornrat Thachalad
- ☒ Miss Jitraporn Lertsomphol



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CPR-010-67

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 800 mbar to 1100 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
800.16	800.1	0.0	0.28
830.12	830.0	-0.1	0.28
860.13	859.9	-0.2	0.28
890.13	890.0	-0.1	0.28
920.08	920.0	0.0	0.28
950.08	949.9	-0.2	0.28
980.07	979.9	-0.2	0.28
1010.08	1010.0	-0.1	0.28
1040.07	1040.1	0.0	0.28
1070.05	1070.0	-0.1	0.28
1100.07	1100.0	-0.1	0.28

Note: UUC* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

End of certificate



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CERTIFICATE OF CALIBRATION

Certificate No. : CPR-010-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer

MANUFACTURER : LSI Lastem

MODEL/TYPE : Sensor: DQA240.1

SERIAL NUMBER : Data logger: E-LOG

: Sensor: R1605260

: Data logger: 17037708

: >

: Used item

: United Analyst and Engineering Consultant Co., Ltd.

: 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,

: Phrakhanong, Bangkok 10260

RECEIVED DATE : 02 Aug 2024

MEASUREMENT DATE : 09 Aug 2024

ISSUE DATE : 09 Aug 2024

Calibration procedure:

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

Traceability:

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

Uncertainty of Measurement:

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	6100126P	MP-0009-24	27 Dec 2024

2. Calibration effort for calibration sequence B

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

4. Calibration conditions:

4. Condition	<input checked="" type="checkbox"/> Normal <input type="checkbox"/> Abnormal
Pressure transmitting medium	: Air
p _h (20°C, 1 bar)	: 1.19 kg/m ³
T _{amb}	: (25±15) °C
T _{max}	: (23±3) °C
p _{max}	: (1020±10) mbar

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

Calibrated by:

☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

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CALIBRATION REPORT

Calibration Number : RG-01062024

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger

Manufacturer : Data logger: LSI Lastem

: Rain gauge: LSI Lastem

Model/Type : Data logger: E-LOG

: Rain gauge: DQA230.1#C

Serial Number : Data logger: 17037708

: Rain gauge: PDI1705209

ID NO : >

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

Environmental Conditions

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

- Obtain rain gauge inlet area
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = $R^2 \times 3.14$ (UUC diameter = 20.3 cm, UUC radius = 10.15 cm)
Rain gauge area = 323.6 cm²
- Obtain theoretical correct rain gauge answer (number of tipping) using 323.6 cm² inlet area and 0.5 L of rain,
a) 10,000 cm³ / 323.6 cm² inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
b) 30.90 * 0.5 L volume = 15.45 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain,
c) Number of tipping = 15.45 / 0.2 mm = 77 tipping.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : Aug 08, 2023

Issued Date : Aug 09, 2023

Calibrated by:

☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.
The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	77	78	75 - 79
500	77	78	75 - 79
500	77	79	75 - 79
500	77	78	75 - 79
500	77	79	75 - 79

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within ± 2 different from the 77 tipping (correct range 75-79 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



Jiranatee Associates Co., Ltd.
63/14-15, 67/35-36
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Mobile: +66(0)999432
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department.

Certificate Number

CWS-028-67

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : ISI Lastem
MODEL/TYPE : Sensor: DINA202
SERIAL NUMBER : Data logger: E-LOG
 : Sensor: B01705626
 : Data logger: 17037713
ID NUMBER :
CONDITION AS-RECEIVED :
CUSTOMER : Used item
 : United Analyst and Engineering Consultant Co., Ltd.
 : 81 Soi Udomsak 41, Sukhumvit Road, Bangkok,
 : Phraekhanong, 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 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010hPa

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

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ : 900 cm²
 : Wind direction frontal area² : 195 cm²
 : Diameter of mounting pipe³ : mm
 : Blockage ratio of test object⁴ : 0.217 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.5°C, 43.0%RH and 1009.1 hPa.

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

Calibrated by:
☒ Mr. Sorawit Thaisakulad
☐ Miss Jittrapa Lertsompol



Approved signatory:

Mr. Parinya Booncharon
Calibration Department Manager

Remarks:
¹ Noddy cross-section area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio to ¹

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: 8455-82 and pilot tube with precision differential pressure meter model: DPM2500 in anemometer section of Effel-type wind tunnel with 900 cm² cross test section area. The WI-CL-087 tested 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 a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0007-24 and MW-0055-23

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)

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

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Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercise 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 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.001	24.08	24.75	0.91	-0.19	0.31
2.096	25.40	24.75	1.84	-0.22	0.31
3.148	24.10	24.75	2.91	-0.23	0.31
4.060	24.10	24.75	3.76	-0.30	0.31
5.10	23.80	24.75	4.91	-0.19	0.31
6.05	25.50	24.75	5.91	-0.13	0.31
6.99	23.90	24.75	6.83	-0.16	0.31
8.11	25.08	24.75	7.99	-0.12	0.31
9.12	24.10	24.75	9.06	-0.06	0.31
9.96	24.70	24.75	9.90	-0.06	0.31
11.05	24.20	24.75	11.05	0.00	0.31
12.01	24.52	24.75	11.97	-0.04	0.35
13.03	24.30	24.75	12.96	-0.07	0.31
13.99	24.44	24.75	13.96	-0.03	0.36
15.00	24.30	24.75	14.96	-0.04	0.37
16.01	24.30	24.75	16.02	0.01	0.34

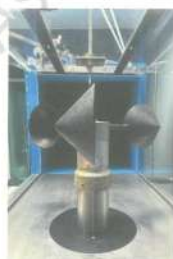
Remark:

¹ Calibration results only count 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 set-up of the Cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



End of Certificate of Calibration

เอกสารไม่ควบคุม

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

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

Wind direction measurement laboratory
Calibration services department.

Certificate Number

CWD-028-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : ISI Lastem
MODEL/TYPE : Sensor: DINA212
SERIAL NUMBER : Data logger: E-LOG
 : Sensor: 19050292
 : Data logger: 17037713
ID NUMBER :
CONDITION AS-RECEIVED :
CUSTOMER : Used item
 : United Analyst and Engineering Consultant Co., Ltd.
 : 81 Soi Udomsak 41, Sukhumvit Road, Bangkok,
 : Phraekhanong, Bangkok 10260

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

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

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

CALIBRATION CONDITION : Wind tunnel cross-section area¹ : 900 cm²
 : Wind direction frontal area² : 52 cm²
 : Diameter of mounting pipe³ : mm
 : Blockage ratio of test object⁴ : 0.058 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.3°C, 45.1%RH and 1009.1 hPa.

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

Calibrated by:
☒ Mr. Sorawit Thaisakulad
☐ Miss Jittrapa Lertsompol



Approved signatory:

Mr. Parinya Booncharon
Calibration Department Manager

Remarks:
¹ Noddy cross-section area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio to ¹

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AS-802075 DMD4-P55-U0 in anemometer section of Effel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 tested 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 a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0036-23.

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)

เอกสารไม่ควบคุม

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

Certificate Number
CWD-038-67

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D ₀ ¹ Degree (°)	D ₉₀ ² Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.04	0.000	0	0	0.80
	45.000	46	1	0.80
	90.000	91	1	0.80
	135.000	136	1	0.80
	180.000	181	1	0.80
	225.000	226	1	0.80
	270.000	270	0	0.80
	315.000	315	0	0.80

Remarks:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



เอกสารไม่ควบคุม



Jiranatee Associates Co., Ltd.
63/14-15, 83/35-36,
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E-mail: jna-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 170175 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CDT-181-67

MEASUREMENT ITEM : Temperature sensor with data logger
MANUFACTURER : LSI Lastem
MODEL/TYPE : E-LOG
SERIAL NUMBER : 17037713
ID NUMBER : -
CONDITION AS-RECEIVED : New item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,
Prakhanong, Bangkok 10260

RECEIVED DATE : 10 Oct 2024
MEASUREMENT DATE : 21 Oct 2024
ISSUE DATE : 22 Oct 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by in-house calibration method (as WFCL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability:

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: 77-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:

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

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM Evaluation of measurement data - Guide to the expression of uncertainty in measurement¹

Calibrated by:
☐ Mr. Sorapet Thachalad
☐ Miss Jitraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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เอกสารไม่ควบคุม



Continuation of Certificate of Calibration Number CDT-181-67

Page 2 of 2 Pages

Result of Calibration: ☐ Without Adjustment ☒ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with temperature sensor Model: DMA672.1, S/N: 24070483.
Dimension: Diameter 14.88 mm., Length 140 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (Before) (°C)	UUC Reading (After) (°C)	Error (°C)	Uncertainty (°C)
120	20.021	18.38	20.27	0.25	0.082
120	25.028	23.23	25.20	0.18	0.082
120	30.015	28.11	30.14	0.02	0.082
120	35.004	33.00	35.08	0.07	0.082
120	39.995	37.89	39.99	0.00	0.082

UUC*: Unit Under Calibration

End of Certificate of Calibration



เอกสารไม่ควบคุม



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

Relative humidity and Air Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CRT-048-67

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : LSI Lastem
MODEL/TYPE : Data Logger E-LOG
SERIAL NUMBER : Data Logger: 17037713
Sensor: 24070483
ID NUMBER : -
CONDITION AS-RECEIVED : New item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Prakhanong,
Bangkok 10260

RECEIVED DATE : 10 Oct 2024
MEASUREMENT DATE : 21 Oct 2024
ISSUE DATE : 22 Oct 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Relative humidity and Air Temperature calibration was done by in-house calibration method as W-G-000 and W-G-070 according to comparison method with standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TH-0079-23 and Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

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 measurement¹

Calibrated by:
☐ Mr. Sorapet Thachalad
☐ Miss Jitraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit



Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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เอกสารไม่ควบคุม

Measurement Results:

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (NRH)	UUC Reading (NRH)	Error (NRH)	Uncertainty ±(NRH)
29.87	19.70	20.3	0.6	0.75
29.80	50.53	51.2	0.7	1.3
29.81	81.68	82.0	0.3	2.1

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CPR-011-67

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

Digital barometer

LSI Lastem

Sensor: DQA240.1

Data logger: E-LOG

Sensor: R1605257

Data logger: 17037713

-

Used item

United Analyst and Engineering Consultant Co., Ltd.

81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,

Phrakhanong, Bangkok 10260

-

02 Aug 2024

09 Aug 2024

09 Aug 2024

Calibration procedure:

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

Traceability:

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

Uncertainty of Measurement:

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	41001269	MP-0009-24	27 Dec 2024

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

3. Calibration conditions:

4. Condition

Pressure transmitting medium

ρ (20°C, 1 bar)

ρ_{air} (20°C, 1 bar)

ρ_{water} (20°C, 1 bar)

ρ_{oil} (20°C, 1 bar)

ρ_{mercury} (20°C, 1 bar)

ρ_{silicone oil} (20°C, 1 bar)

ρ_{glycerol} (20°C, 1 bar)

ρ_{ethanol} (20°C, 1 bar)

ρ_{acetone} (20°C, 1 bar)

ρ_{benzene} (20°C, 1 bar)

ρ_{toluene} (20°C, 1 bar)

ρ_{hexane} (20°C, 1 bar)

ρ_{heptane} (20°C, 1 bar)

ρ_{octane} (20°C, 1 bar)

ρ_{nonane} (20°C, 1 bar)

ρ_{decane} (20°C, 1 bar)

ρ_{undecane} (20°C, 1 bar)

ρ_{dodecane} (20°C, 1 bar)

ρ_{tridecane} (20°C, 1 bar)

ρ_{tetradecane} (20°C, 1 bar)

ρ_{pentadecane} (20°C, 1 bar)

ρ_{hexadecane} (20°C, 1 bar)

ρ_{heptadecane} (20°C, 1 bar)

ρ_{octadecane} (20°C, 1 bar)

ρ_{nonadecane} (20°C, 1 bar)

ρ_{eicosane} (20°C, 1 bar)

ρ_{heneicosane} (20°C, 1 bar)

ρ_{docosane} (20°C, 1 bar)

ρ_{tricosane} (20°C, 1 bar)

ρ_{triacontane} (20°C, 1 bar)

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ρ_{triacontane} (20°C, 1 bar)

ρ_{triacontane} (20°C, 1 bar)

CERTIFICATE OF CALIBRATION

Certificate No. : CFR-011-67

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 600 mmHg to 825 mmHg

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

STD (mmHg)	UUC* (mmHg)	Error (mmHg)	Uncertainty (k=2) (mmHg)
600.18	600.1	0.0	0.21
622.65	622.6	-0.1	0.21
645.16	645.0	-0.1	0.21
667.63	667.5	-0.1	0.21
690.15	690.1	0.0	0.21
712.65	712.5	-0.1	0.21
735.14	735.1	0.0	0.21
757.63	757.6	-0.1	0.21
780.13	780.1	0.0	0.21
802.62	802.6	-0.1	0.21
825.13	825.0	-0.1	0.21

Note: UUC* Unit Under Calibration

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

End of certificate



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CALIBRATION REPORT

Calibration Number : R0-01122024
Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger

Manufacturer : Data logger: LSI Lasten
Rain gauge: LSI Lasten

Model/Type : Data logger: G-400
Rain gauge: DQA230.1

Serial Number : Data logger: 17037713
Rain gauge: 19050180

ID NO :

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

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±0.1)°C and relative humidity of (50±10)%.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge inlet area:

Rain gauge precise diameter in cm = Diameter/2 = R (radius)

Rain gauge area = πR^2 3.14 UUC diameter = 20.3 cm, UUC radius = 10.15 cm

Rain gauge area = 323.6 cm²

2. Obtain theoretical correct rain gauge number (number of tipping) using 323.6 cm² inlet area and 0.6 L of rain.

a) 10,000 cm³ / 323.6 cm² inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)

b) 30.90 * 0.5 L volume = 15.45 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain

gauge area = 15.45 mm of rain.

c) Number of tipping = 15.45 / 0.2 mm = 77 tipping.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : Dec 12, 2024

Issued Date : Dec 13, 2024

Calibrated by:

☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Pwinya Booncharom
Calibration Department Manager

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

เอกสารไม่ควบคุม

Continuation of Calibration of Calibration Number

Calibration Number: R0-01122024
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	77	77	75 - 79
500	77	76	75 - 79
500	77	76	75 - 79
500	77	76	75 - 79
500	77	76	75 - 79

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within ±5% different from the 77 tipping (correct range: 75-79 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



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MULTI-POINT GAS TEST REPORT

Test Date : Sep 19, 2024

Equipment : Hydrocarbon Analyzer

Model : APHA-370

Manufacturer : HORIBA

Serial Number : GAL13KSE

Standard Gas Concentration

Sulphur Dioxide (SO₂) : - PPM
Nitric Oxide (NO) : - PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : - PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

Dilutor Detail

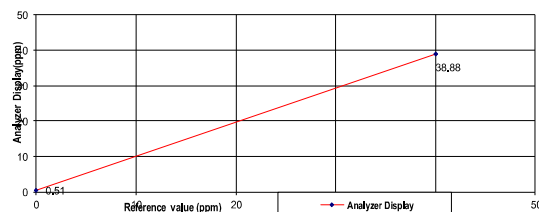
Manufacturer :
Model :
Serial Number :

Multi-point gas test data

	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.00	0.51	0.51	0.51
Level 2	80.00%	40.00	38.88	-1.12	-2.88
Remark :	Measuring Range	50.00 ppm		Average Difference (%)	1.70

:Acceptable Limit ± 5%

Multi-Point Gas Test Chart



Calculate by
Sorawit Thachalad
19/9/2567

Approve by
Pwinya Booncharom
19 Sep, 2024

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Oct 1, 2024

Equipment : Hydrocarbon Analyzer Model : 55i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920025

Standard Gas Concentration

Sulphur Dioxide (SO₂) : PPM
Nitric Oxide (NO) : PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

Dilutor Detail

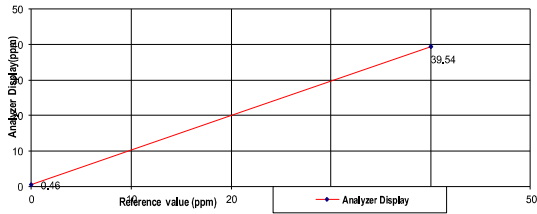
Manufacturer :
Model :
Serial Number :

Multi-point gas test data

	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.00	0.46	0.46	0.46
Level 2	80.00%	40.00	39.54	-0.46	-1.16
Remark : Measuring Range	50.00 ppm			Average Difference (%)	0.81

Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

1 / 10 / 2567

Approve by

1 / Oct / 2024

เอกสารไม่ควบคุม

Certificate of Analysis
Special Gases Mixture

Customer Details
Name: United Analyst & Engineering Co., Ltd.
Address: 3 Soi Udomsuk 41, Sukhumvit Rd., Bang Chak, Khet Phrakhanong, Bangkok 10260
Customer Tag No.:

Certificate Details
Number: 3384/20
Date of Issue: 4-Aug-2020
Expiry date: 4-Aug-2028
Material Details: 90161442
Production Order: 400480-AL-34
Gas content: 6.60 M³
Cylinder Owner: LINDE
Filling pressure: 137.0 bar
Cylinder Material: Aluminum
Valve: D824432
Cylinder Size: CGA 510 BRASS 50L

Laboratory Report
Component: Methane
Normal Concentration: 40.0 ppm
Analysis Result: 39.8 ppm
Uncertainty: $\pm 1\%$ relative
Method of Analysis: (6) + PB-112
Assay Date: 4-Aug-2020

Reference Standard used in Assay
Reference Standard: Methane
Cylinder number: 25519956
Concentration: 39.29 \pm 0.39 ppm
Expiry date: 4-Oct-2028

Analytical Instruments used in Assay
Instrument/Make/Model: FTIR Spectrometers Nicolet 650
Analytical Principle: FTIR-CH4
Last Multi-point Calibration: 4-Aug-2020

Recommend usage condition
Minimum utilization: 5% of actual content or before expiry date whichever comes first.
Storage condition: Keep in well ventilation and secure area.

Comments
When re-ordering, please quote the material number

Note:
1. All results expressed in this report are in metric units, unless otherwise specified. The Assay of this standard has been performed in accordance with the EPA Volatility Protocol (EPA-800/9-12/201) for the Assay and Certification of Gaseous Calibration Standards using gravimetric (G).
2. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.
The measurement of this material is traceable to the SI through the reference gas standard which is traceable to the National Standard of Metrology after assigned national metrology institutes.
3. (1) Gas Chromatography, (2) Paramagnetic Oxygen Analyzer, (3) Electrochemical Oxygen Analyzer, (4) Electrochemical Methane Analyzer, (5) Total Hydrocarbon Analyzer, (6) Other - Specified

Sukanya Panayassontorn
Signatory for and on behalf of Linde (Thailand) Co., Ltd.

Page 1 of 1
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Linde (Thailand) Public Company Limited
197 Hosi, Bangna Tower 6, 27th floor 14, Bangna Road, A.S. Road, Bangnae
Bangkok, Thailand 10150. Tel: (66) 2388-6100 Fax: (66) 2388-6103
Bangkok Branch: 105 Moo 1, Bangpakong, A.Bangpakong, Chachoengsao 24100
Thailand. Tel: (66) 38 570 479-81 Fax: (66) 38 570 479-82



Certificate of Calibration

Customer

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

Certificate No : 24-ACT-087
Request No : Req-2024-1365

Unit Under Calibration Details

Measurement item : Acoustic Calibrator
Manufacturer : 01dB
Model : CAL31
Serial Number : 84065
ID : UAE-EFM.167/2561

Class : 1
Range : 94 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

Temperature : (23 \pm 2 °C)
Humidity : (50 \pm 20 %RH)
Barometric Pressure : (1013 \pm 10.0 hPa)
Received Date : 20 June 2024
Calibration Date : 25 June 2024
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

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

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

Note :

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

Calibrated By : Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : Mr. Pachi Mathavorn
Calibration Engineer Supervisor
Issue Date : 25 June 2024



Certificate No : 24-ACT-087
Request No : Req-2024-1365

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	93.78	-0.22	-	-	0.13	0.25	Pass

Frequency of Sound pressure level

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

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

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (%)	Acceptance limit Class 1 (%)	Result
	Measured (%)	Measured (%)			
94 dB / 1000 Hz	0.14	-	0.40	2.5	Pass

Note :

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

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



Certificate No : 24-ACT-087
Request No : Req-2024-1365

Decision Rule for Statements of Conformity

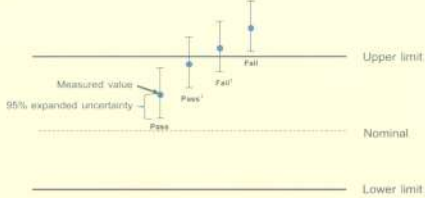
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2018, Guidelines on the Reporting of Compliance with Specification as following Fig. and statements:

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

Pass¹ - The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ - The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Calibration

เอกสารไม่ควบคุม



Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260
Certificate No : 24-SLM-235
Request No : Req-2024-1454

Unit Under Calibration Details

Measurement Item : Sound Level Meter
Manufacturer : Larson Davis
Model : LX72
Serial Number : 0065346
ID : UAEJFM.0432563
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 375802
Microphone S/N : 11798
Preamplifier Model : PRMLX72B
Preamplifier S/N : 036138
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 1 July 2024
Calibrated Date : 10 July 2024
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 :2013 Electroacoustics - Sound level meters - Part 3: Periodic tests
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	29 August 2024	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	26 July 2024	TSI
Audio Generator	SvanteK	Svan401	131	8 October 2024	W/K Electric

Note

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

Calibrated By :
Mr. Nopadon Luangrat
Service Calibration Engineer

Approved By :
Mr. Pachi Mathavon
Calibration Engineer Supervisor
Issue Date : 10 July 2024

เอกสารไม่ควบคุม



Certificate No : 24-SLM-235
Request No : Req-2024-1454

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY	Acceptance Limit	Result
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR	(± dB)	(± dB)	
Calibrator Setting (dB)	(dB)	(dB)	(dB)	(dB)	(dB)			
1000 Hz 114.0B	113.76	115.3	1.54	113.8	+0.04	0.20	0.30	Pass

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 30679

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
A	31.4	0.10

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

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
A	31.1	0.10
C	30.3	0.10
Z	33.0	0.10

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

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY	Acceptance Limit	Result
FAST / 37-139	A	C	Z	(± dB)	(± dB)	
STD Setting	(dB)	(dB)	(dB)			
125 Hz	0.0	0.1	0.1	0.60	1.5	Pass
1000 Hz	0.0	0.0	0.0	0.60	1.0	Pass
4000 Hz	1.1	1.1	1.1	0.60	3.0	Pass
8000 Hz	2.6	2.5	2.6	0.70	5.0	Pass

เอกสารไม่ควบคุม



Certificate No : 24-SLM-235
Request No : Req-2024-1454

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

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY	Acceptance Limit	Result
FAST / 37-139	A	C	Z	(± dB)	(± dB)	
STD Setting	(dB)	(dB)	(dB)			
63 Hz	-0.1	0.0	0.1	0.20	2.0	Pass
125 Hz	-0.1	0.0	0.0		1.5	Pass
250 Hz	-0.1	0.0	0.0		1.5	Pass
500 Hz	0.0	0.1	0.0		1.5	Pass
1000 Hz	0.0	0.0	0.0		1.0	Pass
2000 Hz	0.0	0.1	0.0		2.0	Pass
4000 Hz	0.0	-0.1	0.0		3.0	Pass
8000 Hz	-0.1	-0.1	0.0		5.0	Pass
16000 Hz	-0.1	-0.1	-0.1		+5, -INF.	Pass

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit	Result
FAST / 37-139	REF	UUC	ERR	(± dB)	(± dB)	
UUC Weighting	(dB)	(dB)	(dB)			
A	114.00	114.0	0.0	0.20	0.20	Pass
C	114.00	114.0	0.0		0.20	Pass
Z	114.00	114.0	0.0		0.20	Pass

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit	Result
37-139 / A	REF	UUC	ERR	(± dB)	(± dB)	
UUC Time Response	(dB)	(dB)	(dB)			
Fast	114.00	114.0	0.0	0.20	0.10	Pass
Slow	114.00	114.0	0.0		0.10	Pass
Lsq	114.00	114.0	0.0		0.10	Pass

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7. Long Term Stability

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

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance	Result
FAST / A / 37-139	REF	UUC	ERR	Limit	
STD dB	(dB)	(dB)	(dB)	(± dB)	(± dB)
139.00	139	139.0	0.0	1.1	Pass
134.00	134	134.0	0.0	1.1	Pass
129.00	129	129.0	0.0	1.1	Pass
124.00	124	124.0	0.0	1.1	Pass
119.00	119	119.0	0.0	1.1	Pass
114.00	114	114.0	0.0	1.1	Pass
109.00	109	109.0	0.0	1.1	Pass
104.00	104	104.0	0.0	1.1	Pass
99.00	99	99.0	0.0	1.1	Pass
94.00	94	94.0	0.0	1.1	Pass
89.00	89	89.0	0.0	1.1	Pass
84.00	84	84.0	0.0	1.1	Pass
79.00	79	79.0	0.0	1.1	Pass
74.00	74	74.0	0.0	1.1	Pass
69.00	69	69.0	0.0	1.1	Pass
64.00	64	64.0	0.0	1.1	Pass
59.00	59	59.0	0.0	1.1	Pass
54.00	54	54.0	0.0	1.1	Pass
49.00	49	49.1	0.1	1.1	Pass
44.00	44	44.2	0.2	1.1	Pass
41.00	43	43.3	0.3	1.1	Pass
42.00	42	42.3	0.3	1.1	Pass
41.00	41	41.4	0.4	1.1	Pass

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of **เอกสารไม่ควบคุม**
ISM-708-SLM-01 Rev.04 Issue date:5/8/24

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance	Result
FAST / A	REF	UUC	ERR	Limit	
UUC Range	(dB)	(dB)	(dB)	(± dB)	(± dB)
37-139	46.40	46.5	0.1	1.1	Pass
	114	114.0	0.0	1.1	Pass

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance	Result
A / 37-139	Toneburst	Ref	UUC	ERR	Limit	
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)	(± dB)
Fast	200	135.0	134.9	-0.1	1.0	Pass
	2	118.0	117.8	-0.4	+1.0, -2.5	Pass
	0.25	109.0	108.5	-0.5	+1.5, -5.0	Pass
Slow	200	128.6	128.4	-0.2	1.0	Pass
	2	109.0	108.8	-0.2	+1.0, -5.0	Pass
	200	129.0	129.0	0.0	1.0	Pass
SEL	2	109.0	108.8	-0.2	+1.0, -2.5	Pass
	0.25	100.0	99.7	-0.3	+1.5, -5.0	Pass

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance	Result
FAST / C / 95-142	REF	UUC	ERR	Limit	
STD Setting	(dB)	(dB)	(dB)	(± dB)	(± dB)
Complete cycle	137.4	136.8	-0.60	3.0	Pass
Positive half cycle	136.4	136.2	-0.20	2.0	Pass
Negative half cycle	136.4	136.2	-0.20	2.0	Pass

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of **เอกสารไม่ควบคุม**
ISM-708-SLM-01 Rev.04 Issue date:5/8/24

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance	Result
FAST / A / 37-139	UUC		Limit	
STD Setting	(dB)	(± dB)	(± dB)	
Positive one-half cycle	145.4			
Negative one-half cycle	145.3			
Deviated	0.1			

13. High Level Stability

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

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

* Acceptance limit and Maximum-permitted Uncertainty was IEC 61072-1:2013

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of **เอกสารไม่ควบคุม**
ISM-708-SLM-01 Rev.04 Issue date:5/8/24

Decision Rule for Statements of Conformity

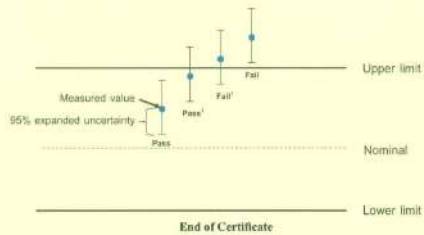
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:2019, Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



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ISM-708-SLM-01 Rev.04 Issue date:5/8/24

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit	Result
		UUC	ERR			
FAST / A	REF	(dB)	(dB)	(± dB)	(± dB)	
UUC Range	(dB)	(dB)	(dB)			
	43.80	43.9	0.1		1.1	Pass
37-139	114	114.0	0.0	0.30	1.1	Pass

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance Limit	Result
			Ref	UUC	ERR		
A / 37-139	Toneburst	(ms)	(dB)	(dB)	(dB)	(± dB)	
Fast	200	135.0	134.9	-0.1		1.0	Pass
	2	118.0	117.9	-0.1		+1.0, -2.5	Pass
	0.25	109.0	108.7	-0.3		+1.5, -3.0	Pass
Slow	200	128.6	128.4	-0.2		1.0	Pass
	2	109.0	108.8	-0.2		+1.0, -5.0	Pass
	200	129.0	129.0	0.0		1.0	Pass
SEL	2	109.0	109.1	+0.1		+1.0, -2.5	Pass
	0.25	100.0	99.9	-0.1		+1.5, -5.0	Pass

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance Limit	Result
		UUC	ERR			
FAST / C / 95-142	REF	(dB)	(dB)	(± dB)	(± dB)	
STD Setting	(dB)	(dB)	(dB)			
Complete cycle	137.4	136.8	-0.60		3.0	Pass
Positive half cycle	136.4	136.2	-0.20	0.20	2.0	Pass
Negative half cycle	136.4	136.2	-0.20		2.0	Pass

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.

เอกสารไม่ควบคุม

PM-700-SLM-01 Rev.04 Issue date 5/6/24

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit	Result
FAST / A / 37-139	UUC	(± dB)	(± dB)	
STD Setting	(dB)			
Positive one-half cycle	142.6			
Negative one-half cycle	142.6			
Deviated	0.0	0.20	1.5	Pass

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit	Result
FAST / A / 37-139	UUC	(± dB)	(± dB)	
STD Setting	(dB)			
Initial	138.0			
Final	138.0			
Deviated	0.0	0.10	0.30	Pass

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.80 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1 kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

* Acceptance Limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.

เอกสารไม่ควบคุม

PM-700-SLM-01 Rev.04 Issue date 5/6/24

Decision Rule for Statements of Conformity

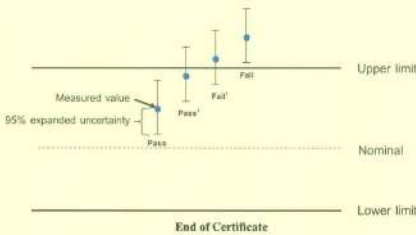
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:2019, Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass^h = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail^l = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability is not outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.

เอกสารไม่ควบคุม

PM-700-SLM-01 Rev.04 Issue date 5/6/24

Certificate of Calibration

Customer

Name

:

UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Address

:

81 Soi Udomrak 41, Sakdumvit Road, Bangkok, Prakhong, Bangkok 10260

Certificate No

:

24-SLM-214

Request No

:

Req-2024-1379

Unit Under Calibration Details

Measurement Item

:

Sound Level Meter

Manufacturer

:

Larson Davis

Model

:

LxT2

Serial Number

:

0005396

ID

:

UAE.EFM.635/2564

Resolution

:

0.1 dB

Microphone Class

:

2

Microphone Model

:

375A04

Microphone S/N

:

328075

Preamplifier Model

:

PRMLxT2C

Preamplifier S/N

:

073793

Instrument Status

:

Used

Calibration Environment and Details

Temperature

:

23 °C ± 2 °C

Humidity

:

50 %RH ± 20 %RH

Barometric Pressure

:

1013 hPa ± 10 hPa

Received Date

:

24 June 2024

Calibrated Date

:

2 July 2024

Calibration Procedure

:

In-house method CP-SLM-01 based on IEC 61672-1:2013 Electroacoustics - Sound level meters - Part 3: Periodic tests

Location of Calibration

:


Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	20 August 2024	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	28 July 2024	TSI
Audio Generator	Svante	Svante401	131	8 October 2024	WK Electric

Note

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

Calibrated By : 
Mr. Noppadon Luangrat
Service Calibration Engineer

Approved By : 
Mr. Paet Muthavorn
Calibration Engineer Supervisor
Issue Date : 2 July 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.

เอกสารไม่ควบคุม

PM-700-SLM-01 Rev.04 Issue date 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / A / 37-139	Level	UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)			
Calibrator Setting								
1000 Hz 114 dB	113.76	114.0	0.24	113.8	-0.04	0.20	0.30	Pass

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 58079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.8	0.10

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

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.1	0.10
C	27.9	0.10
Z	32.1	0.10

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

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / 37-139	A	C	Z			
STD Setting	(dB)	(dB)	(dB)			
125 Hz	-0.1	0.1	0.1	0.60	1.5	Pass
1000 Hz	0.0	0.0	0.0	0.60	1.0	Pass
4000 Hz	0.6	0.6	0.6	0.60	3.0	Pass
8000 Hz	0.5	0.4	0.4	0.70	5.0	Pass

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing body.
เอกสารไม่ควบคุม

File: 708-51.34-01 Rev.04 Issue date: 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

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

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / 37-139	A (dB)	C (dB)	Z (dB)			
STD Setting						
63 Hz	-0.1	0.0	0.0	0.20	2.0	Pass
125 Hz	-0.1	0.0	0.0		1.5	Pass
250 Hz	-0.1	0.0	0.0		1.5	Pass
500 Hz	0.0	0.0	0.0		1.5	Pass
1000 Hz	0.0	0.0	0.0		1.0	Pass
2000 Hz	0.1	0.1	0.0		2.0	Pass
4000 Hz	0.0	0.0	0.1		3.0	Pass
8000 Hz	0.0	0.0	0.1		5.0	Pass
16000 Hz	0.0	0.0	-0.1		+5, -INF	Pass

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / 37-139	REF	UUC (dB)	ERR (dB)			
UUC Weighting						
A	114.00	114.0	0.0	0.20	0.20	Pass
C	114.00	114.0	0.0		0.20	Pass
Z	114.00	114.0	0.0		0.20	Pass

UUC Setting	STD	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
37-139 / A	REF	UUC (dB)	ERR (dB)			
UUC Time Response						
Fast	114.00	114.0	0.0	0.20	0.10	Pass
Slow	114.00	114.0	0.0		0.10	Pass
Lsq	114.00	114.0	0.0		0.10	Pass

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เอกสารไม่ควบคุม

File: 708-51.34-01 Rev.04 Issue date: 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

7. Long Term Stability

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

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / A / 37-139	REF	UUC (dB)	ERR (dB)			
STD dB	(dB)	(dB)	(dB)			
110.00	139	139.0	0.0	0.30	1.1	Pass
134.00	134	134.0	0.0		1.1	Pass
129.00	129	129.0	0.0		1.1	Pass
124.00	124	124.0	0.0		1.1	Pass
119.00	119	119.0	0.0		1.1	Pass
114.00	114	114.0	0.0		1.1	Pass
109.00	109	109.0	0.0		1.1	Pass
104.00	104	104.0	0.0		1.1	Pass
99.00	99	99.0	0.0		1.1	Pass
94.00	94	93.9	-0.1		1.1	Pass
89.00	89	88.9	-0.1		1.1	Pass
84.00	84	83.9	-0.1		1.1	Pass
79.00	79	78.9	-0.1		1.1	Pass
74.00	74	73.9	-0.1		1.1	Pass
69.00	69	68.9	-0.1		1.1	Pass
64.00	64	63.9	-0.1		1.1	Pass
59.00	59	58.9	-0.1		1.1	Pass
54.00	54	53.9	-0.1		1.1	Pass
49.00	49	49.0	0.0		1.1	Pass
44.00	44	44.0	0.0		1.1	Pass
39.00	39	39.3	0.3		1.1	Pass
34.00	34	34.4	0.4		1.1	Pass

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เอกสารไม่ควบคุม

File: 708-51.34-01 Rev.04 Issue date: 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / A	REF	UUC (dB)	ERR (dB)			
UUC Range						
37-139	43.60	43.7	0.1	0.30	1.1	Pass
	114	114.0	0.0		1.1	Pass

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
A / 37-139	Toneburst	Ref	UUC (dB)	ERR (dB)			
UUC Time Response	(ms)						
Fast	200	135.0	135.0	0.0	0.20	1.0	Pass
	2	118.0	117.6	-0.2		+1.0, -2.5	Pass
	0.25	109.0	108.6	-0.4		+1.5, -5.0	Pass
Slow	200	128.6	128.5	-0.1		1.0	Pass
	2	109.0	108.9	-0.1		+1.0, -5.0	Pass
	0.25	100.0	99.8	-0.2		+1.5, -5.0	Pass
SEL	200	129.0	129.0	0.0		1.0	Pass
	2	109.0	109.0	0.0		+1.0, -2.5	Pass
	0.25	100.0	99.8	-0.2		+1.5, -5.0	Pass

11. Peak C Sound level

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

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เอกสารไม่ควบคุม

File: 708-51.34-01 Rev.04 Issue date: 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

12. Overload indication

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance	Result
FAST / A / 37-139	UUC		Limit	
STD Setting	(dB)		(± dB)	
Positive one-half cycle	142.0			
Negative one-half cycle	142.1			
Deviated	-0.1	0.20	1.5	Pass

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance	Result
FAST / A / 37-139	UUC		Limit	
STD Setting	(dB)		(± dB)	
Initial	138.0			
Final	138.0			
Deviated	0.0	0.10	0.30	Pass

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

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

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FM-708-SLM-01 Rev.04 Issue date 5/6/24

Certificate No : 24-SLM-214
Request No : Req-2024-1379

Decision Rule for Statements of Conformity

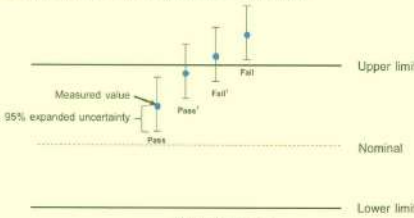
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Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass' = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail' = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Certificate

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

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FM-708-SLM-01 Rev.04 Issue date 5/6/24

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-SLM-240
Request No : Req-2024-1459

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : Larson Davis
Model : LxT2
Serial Number : 6005299
ID : UAE-EFM-114-2562
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 375A04
Microphone S/N : 323471
Preamplifier Model : P90MLST2C
Preamplifier S/N : 071493
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 2 July 2024
Calibrated Date : 11 July 2024
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-1 : 2013 Electroacoustics - Sound level meters - Part 1: Periodic tests
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	20 August 2024	GRAS
Multi-frequency Calibrator	Quest	Quest-cal	EFA000234	26 July 2024	TSI
Audio Generator	Svanick	Svan401	131	8 October 2024	WK Electric

Note

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

Calibrated By : 
Mr. Noppadon Luangrit
Service Calibration Engineer

Approved By : 
Mr. Pichit Muthavorn
Calibration Engineer Supervisor
Issue Date : 11 July 2024

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

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FM-708-SLM-01 Rev.04 Issue date 5/6/24

Certificate No : 24-SLM-240
Request No : Req-2024-1459

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
FAST / A / 37-139	Level	UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)			
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)			
1000 Hz 114 dB	113.76	115.3	1.54	113.8	+0.04	0.20	0.30	Pass

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, S/N: 58079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting	(dB)	(± dB)
A	27.1	0.10

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

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting	(dB)	(± dB)
A	26.6	0.10
C	26.2	0.10
Z	30.6	0.10

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

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY (± dB)	Acceptance Limit (± dB)	Result
	A (dB)	C (dB)	Z (dB)			
FAST / 37-139	(dB)	(dB)	(dB)			
STD Weighting	(dB)	(dB)	(dB)			
125 Hz	0.0	0.2	0.1	0.60	1.5	Pass
1000 Hz	0.0	0.0	0.0	0.60	1.0	Pass
4000 Hz	0.2	0.3	0.4	0.60	3.0	Pass
8000 Hz	-0.5	-0.4	-0.2	0.70	5.0	Pass

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

เอกสารไม่ควบคุม

FM-708-SLM-01 Rev.04 Issue date 5/6/24

Certificate No : 24-SLM-240
Request No : Req/2024-1459

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

UUC Setting	Deviation from various Frequency			UNCERTAINTY	Acceptance	Result
FAST / 37-139	Weighting Response curve				Limit	
STD Setting	A (dB)	C (dB)	Z (dB)	(± dB)	(± dB)	
63 Hz	-0.2	0.0	0.0	0.20	2.0	Pass
125 Hz	-0.1	0.0	0.0		1.5	Pass
250 Hz	-0.1	0.0	0.0		1.5	Pass
500 Hz	-0.1	0.0	0.0		1.5	Pass
1000 Hz	0.0	0.0	0.0		1.0	Pass
2000 Hz	0.0	0.0	0.0		2.0	Pass
4000 Hz	0.0	0.0	0.0		3.0	Pass
8000 Hz	0.0	0.0	0.0		5.0	Pass
16000 Hz	-0.1	-0.1	-0.1		+5, -INF	Pass

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
		REF	ERR			
FAST / 37-139						
UUC Weighting	(dB)	(dB)	(dB)			
A	114.00	114.0	0.0	0.20	0.20	Pass
C	114.00	114.0	0.0		0.20	Pass
Z	114.00	114.0	0.0		0.20	Pass

UUC Setting	STD	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
		REF	ERR			
37-139 / A						
UUC Time Response	(dB)	(dB)	(dB)			
Fast	114.00	114.0	0.0	0.20	0.10	Pass
Slow	114.00	114.0	0.0		0.10	Pass
Leq	114.00	114.0	0.0		0.10	Pass

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the owner.
FM-708-SLM-01 Rev.04 Issue date 3/6/24

เอกสารไม่ควบคุม

Certificate No : 24-SLM-240
Request No : Req/2024-1459

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
FAST / A / 37-139	UUC			
STD Setting	(dB)			
Initial	114.0			
Final	114.0			
Deviation	0.0			
		0.10	0.30	Pass

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
		REF	UUC	ERR		
FAST / A / 37-139	(dB)	(dB)	(dB)	(dB)		
STD dB	(dB)					
139.00	139	139.0	0.0	0.30	1.1	Pass
134.00	134	134.0	0.0		1.1	Pass
129.00	129	129.0	0.0		1.1	Pass
124.00	124	124.0	0.0		1.1	Pass
119.00	119	119.0	0.0		1.1	Pass
114.00	114	114.0	0.0		1.1	Pass
109.00	109	109.0	0.0		1.1	Pass
104.00	104	104.0	0.0		1.1	Pass
99.00	99	99.0	0.0		1.1	Pass
94.00	94	94.0	0.0		1.1	Pass
89.00	89	89.0	0.0		1.1	Pass
84.00	84	84.0	0.0		1.1	Pass
79.00	79	79.0	0.0		1.1	Pass
74.00	74	74.0	0.0		1.1	Pass
69.00	69	69.0	0.0		1.1	Pass
64.00	64	64.0	0.0		1.1	Pass
59.00	59	59.0	0.0		1.1	Pass
54.00	54	54.0	0.0		1.1	Pass
49.00	49	49.0	0.0		1.1	Pass
44.00	44	44.0	0.0		1.1	Pass
39.00	39	38.2	0.2		1.1	Pass
34.00	34	34.5	0.5		1.1	Pass
29.00	29	37.4	0.4		1.1	Pass
24.00	24	26.5	0.5		1.1	Pass

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FM-708-SLM-01 Rev.04 Issue date 3/6/24

เอกสารไม่ควบคุม

Certificate No : 24-SLM-240
Request No : Req/2024-1459

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
		REF	ERR			
FAST / A						
UUC Range	(dB)	(dB)	(dB)			
37-139	41.90	42.1	0.2	0.30	1.1	Pass
	114	114.0	0.0		1.1	Pass

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
			Ref	UUC	ERR		
A / 37-139							
UUC Time Response	(ms)	(dB)	(dB)	(dB)			
Fast	200	135.0	134.9	-0.1	0.20	1.0	Pass
	2	118.0	117.9	-0.1		+1.0, -2.5	Pass
	0.25	109.0	108.8	-0.2		+1.5, -5.0	Pass
Slow	200	128.6	128.5	-0.1		1.0	Pass
	2	109.0	108.9	-0.1		+1.0, -5.0	Pass
	200	129.0	129.0	0.0		1.0	Pass
SEL	2	109.0	109.1	+0.1		+1.0, -2.5	Pass
	0.25	100.0	100.0	0.0		+1.5, -5.0	Pass

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
		REF	ERR			
FAST / C / 95-142						
STD Setting	(dB)	(dB)	(dB)			
Complete cycle	137.4	136.6	-0.80	0.20	3.0	Pass
Positive half cycle	136.4	136.2	-0.20		2.0	Pass
Negative half cycle	136.4	136.2	-0.20		2.0	Pass

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FM-708-SLM-01 Rev.04 Issue date 3/6/24

เอกสารไม่ควบคุม

Certificate No : 24-SLM-240
Request No : Req/2024-1459

12. Overload indication

UUC Setting	Measured	UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
FAST / A / 37-139	UUC			
STD Setting	(dB)			
Positive one-half cycle	140.6			
Negative one-half cycle	140.7			
Deviation	-0.1	0.20	1.5	Pass

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY (\pm dB)	Acceptance Limit (\pm dB)	Result
FAST / A / 37-139	UUC			
STD Setting	(dB)			
Initial	138.0			
Final	138.0			
Deviation	0.0			
		0.10	0.30	Pass

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1 kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

> Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the owner.
FM-708-SLM-01 Rev.04 Issue date 3/6/24

เอกสารไม่ควบคุม

Certificate No : 24-SLM-240
Request No : Req-2024-1459

Decision Rule for Statements of Conformity

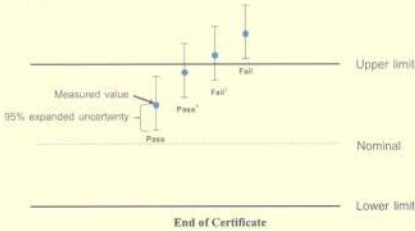
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements:

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

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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EM-708-SLM-002 Rev.04 Issue date 5/6/24



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



Certificate of Calibration

Cert.No.: 24CH1418
Page.: 1 of 3

Equipment : pH Meter
Manufacturer : EcoSense
Model : pH100A
Serial No. : 24H005156JEN
ID No. : UAE.EFM.038/2567(EFM.pH.01/67)
Condition As-Received: Used Item
Received Date : 13 November 2024
Calibration Date : 14 November 2024
Reference : 2411-0421WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage standard and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lemgagtrakul

Approved by : 
Approved Signatory

() Unnopphol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 20 November 2024

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



Cert.No.: 24CH1418
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

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

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

2. Certified Reference Materials :The measurement results are traceable to SI through Hach Lenge GmbH Ltd., Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00
:The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	1034203	27 Sep 2026
pH 6.999	Hach Lenge GmbH	C03145	28 Feb 2026
pH 10.010	CPA chem	1034205	27 Sep 2025

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N: 24H005156JEN	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

Cert.No.: 24CH1418
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N: 240904SIA605377	4.008	4.01	175	0.0071	2.00
	6.999	7.00	0	0.0096	2.00
	6.999	7.00	0	0.0096	2.00
	10.010	10.00	-172	0.0092	2.00

Function : Temperature Measurement

(°) Without adjustment

This equipment was connected with Temperature Probe;

- Model : -
- Serial No. : 240904SIA605377
Dimension of probe
- Length : 110 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
15.0	15.002	15.1	0.098	0.13	2.00
30.0	30.003	30.1	0.097	0.13	2.00
45.0	45.005	45.0	-0.005	0.13	2.00

Remark - UUC* = Unit Under Calibration

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

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เอกสารไม่ควบคุม



Certificate of Calibration

Cert.No.: 24CH1060
Page.: 1 of 3

Equipment : Conductivity Meter
Manufacturer : Horiba
Model : LAQUA-EC210
Serial No. : HC0K0005
ID No. : UAE.EFM.204/2564(EFM.SCT.09/64)
Condition As-Received: Used Item
Received Date : 27 August 2024
Calibration Date : 28 August 2024
Reference : 2408-0885WSC-3
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In-house method :
- CP-CH6 by direct measurement
with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard
Calibrated by : Warakorn Lernagatrakul
Approved by : Approved Signatory
() Unnopphol Harachai
() Ponpan Paipim
(✓) Sathip Meangmai
Issue Date : 29 August 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	24I426	24 Apr 2025
2) Ref. Std. Thermometer	2188080	130RC044	231216	10 Oct 2024

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

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI
through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.1 µS/cm	CPA Chem	970856	25 Apr 2025
12.880 mS/cm	CPA Chem	940112	02 Nov 2024

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) °C

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413.1 µS/cm

Conductivity Electrode Serial No.: 9B0K0123

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.1 µS/cm	1331 µS/cm	1413 µS/cm	9.4 µS/cm	2.00
12.880 mS/cm	11.80 mS/cm	12.78 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration

เอกสารไม่ควบคุม



Cert.No.: 24CH1060
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

This equipment was connected with Temperature Probe;

- Model : 9383
- Serial No. : 9B0K0123

Dimension of probe;

- Length : 113 mm
- Diameter : 16 mm
- Immersion Depth : 90 mm

Calibration Result : Without adjustment

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor k
25.0	25.001	25.0	-0.001	0.13	2.00
30.0	30.001	30.0	-0.002	0.13	2.00
35.0	35.002	35.0	-0.003	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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Certificate of Calibration

Equipment : Turbidity Meter
Manufacturer : Thermo Scientific
Model : EUTECH TN-100
Serial No. : 3065434
ID. No. : UAE.EFM.021/2565(TM.02/65)
Condition As-Received: Used Item
Received Date : 11 April 2024
Calibration Date : 12 April 2024
Reference : 2404-0366WSC-3
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 20) %
Calibration Procedure : In-house method : CP-CH11
Direct measurement by
using Formazin standard solution
Calibrated by : Walalak Sirithean
Approved by : Approved Signatory
(✓) Unnopphol Harachai
() Ponpan Paipim
() Sathip Meangmai
Issue Date : 17 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Calibration and Testing Equipment Services.

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Cert.No. : 24CH444
Page. : 2 of 2

Condition of this calibration result

1. Reference Standard Instruments :
This certification is traceable to the International System of unit (SI unit) through:-
- Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due date
1) Thermo-Hygrograph	1103328	130EC010	23H1361	13 June 2024
2) Electronic Balance	14233821	110RC001	23MM405	16 July 2024

2. Standard Material : The Formazin suspension has been prepared gravimetric from

Material	Manufacturer	Lot No.	Assay
1) Hexamethylenetetramine	HIMEDIA	0000493947	99.65%
2) Hydrazinium Sulfate	HIMEDIA	0000522014	99.40%

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

Calibration result

Performing four - Formazin suspension standard curve by using 0,20,100,800 NTU
Turbidity Meter Serial Number : 3065434

Standard Formazine suspension (NTU)	UUC* Reading (NTU)	Uncertainty of Measurement (± NTU)	Coverage Factor k
0.1	0.15	0.022	2.00
20	19.9	0.38	2.00
100	99.6	0.70	2.00
800	801	2.1	2.07

Remark - UUC* = Unit Under Calibration
- NTU = Nephelometric Turbidity Units

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

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

Certificate of Calibration

Cert.No.: 24CH821
Page.: 1 of 2

Equipment : Salinity Meter
Manufacturer : YSI
Model : Pro 30
Serial No. : 22E105869
ID No. : UAE.EFM.069/2566 (EFM.SCT.05/66)
Condition As-Received: Used Item
Received Date : 09 July 2024
Calibration Date : 10 July 2024
Reference : 2407-0331WSC-2
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (65 ± 15) %
Calibration Procedure: In - house method : Direct measurement
by using Sodium Chloride Solution
Calibrated by : Walalak Sirinthean
Approved by :
() Unnopphol Harachai
() Ponpan Paipim
(✓) Salthip Meangmai
Issue Date : 16 July 2024

Approved Signatory

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 24CH821
Page.: 2 of 2

Condition of this result of calibration

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Thermometer	9549224	130RC003	24H426	24 Apr 2025
2) Thermo-Hygrograph	1102794	130EC009	23H2522	07 Dec 2024

2. Reference Standard Material :
- Sodium chloride solution, solution, Eutech Instruments Pte Ltd., The measurement results are traceable to SI
through ThermoFisher Scientific Water and Lab Products.
- Calibrated Total Dissolved Solids solution temperature controlled by Water bath at (25 ± 0.1) °C
- Sodium chloride solution has been prepared dilution from

Material	Manufacturer	Lot No.	Exp. Date
25 ppt	Eutech	133/01	31 Mar 2026

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

Calibration results (*) Without Adjustment

Probe Serial No. : 23A100616

Standard NaCl Solution	UUC* Reading	Uncertainty of Measurement (±)
2.50 ppt	2.6 ppt	0.063 ppt
5.00 ppt	5.1 ppt	0.077 ppt
10.00 ppt	10.2 ppt	0.12 ppt

Remark: - UUC* = Unit Under Calibration
- ppt = ppt of NaCl
- ppt = Parts per Thousand

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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List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*
1	Analytical Balance	FAT OIL AND GREASE	Mettler Toledo	AB204-S/FACT / 1129361010	United Analyst and Engineering Consultant Co., Ltd.	250422 1 BL002 25	23/4/2025	22/4/2026
2	Analytical Balance	TOTAL DISSOLVED SOLIDS	Mettler Toledo	XSR205DU / C210685394	National Food Institute, Ministry of Industry, Thailand	2502226-002-01	20/3/2025	19/3/2026
3	Analytical Balance	SUSPENDED SOLIDS	Mettler Toledo	XSR205DU / C009071872	National Food Institute, Ministry of Industry, Thailand	2502226-001-01	20/3/2025	19/3/2026
4	Auto Clave	TOTAL COLIFORM BACTERIA	ALP Co., Ltd. (Japan)	CL-40L / 810010	National Food Institute Ministry of Industry (Thailand)	2503287-001-01	5/6/2025	4/6/2026
5	BOD Incubator	BIOCHEMICAL OXYGEN DEMAND	ARCO	UC4-1320 / 1021	Technology Promotion Association (Thailand-Japan)	24TM1114	11/7/2024	10/7/2025
6	Continuous Flow Analyzer(CFA)	CYANIDE	Skalar Analytical B.V., the Netherlands	San++5000-02 / 182688	DKSH (Thailand) Ltd.	WO-00074079	23/5/2025	22/5/2026
7	Cold Vapor Atomic Fluorescence Spectrometer (Mercury Analyzer)	TOTAL MERCURY	Analytik Jena AG	Mercur duo plus / K 170A0153	Analytik Jena FarEast Thailand Ltd.	PM-OQ	3/2/2025	2/2/2026
8	DO Meter	DO	Horiba	LAQUA-DO210 / HE9M0028	Technology Promotion Association (Thailand-Japan)	25TW19	23/1/2025	21/1/2026
9	DO Meter	BIOCHEMICAL OXYGEN DEMAND	YSI	5100 / 11B 101863	Technology Promotion Association (Thailand-Japan)	25TW29	18/2/2025	16/2/2026
10	SCT Meter	SALINITY	Horiba	LAQUA-EC210 / HC9L0013	Technology Promotion Association (Thailand-Japan)	25CH167	5/2/2025	3/2/2026
11	SCT Meter	CONDUCTIVITY (umhos/cm)	Horiba	LAQUA-EC210 / HC0J0017	Technology Promotion Association (Thailand-Japan)	24CH1585	26/12/2024	24/12/2025
12	Fluorescence spectrometer	TPH	Perkin Elmer	FL8500 / FL85K22062801	Perkin Elmer	FLR_3005/2025	28/5/2025	27/5/2026

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*
13	Heating Block	CHEMICAL OXYGEN DEMAND	Hanna Instruments Italia Srl.	HI 839800-02 / H 018500 I	Hanna Instruments (Thailand) Ltd.	HIT-2510-0375	7/3/2025	6/3/2026
14	Hot Air Oven	SUSPENDED SOLIDS TOTAL DISSOLVED SOLIDS	Memmert	UF55 / B216.1666	National Food Institute, Ministry of Industry, Thailand	2500116-001-01	8/10/2024	7/10/2025
15	Incubator	FECAL COLIFORM BACTERIA TOTAL COLIFORM BACTERIA	Binder	KB400 / 20220000022479	Technology Promotion Association (THAILAND-JAPAN)	24TM938	9/7/2024	8/7/2025
16	Inductively Coupled Plasma- Optical Emission Spectrometer(ICP-OES)	CADMIUM CALCIUM LEAD ZINC	Agilent Technologies, USA	5110 VDV(G8015AA) / MY8030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	4/11/2024	3/11/2025
17	pH Meter	pH	YSI Environmental	pH 100A / JC02743	Technology Promotion Association (Thailand-Japan)	24CH814	10/7/2024	8/7/2025
18	UV-VIS Spectrophotometer	NITRATE NITRATE NITROGEN PHOSPHATE (ug/L) PHOSPHATE PHOSPHORUS SULPHIDE	Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP25-001	3/1/2025	2/1/2026
19	UV/VIS Spectrophotometer	PHENOLS	Hitachi	U-5100 / 23A4-008	DQE Services Co.,Ltd.	SP24-028	11/9/2024	9/9/2025
20	Turbidity Meter (Portable)	TURBIDITY (NTU)	Oakton Instruments(China)	T100IR / 1120501017	Technology Promotion Association (Thailand-Japan)	24CH1115	6/9/2024	5/9/2025
21	Water Bath	FECAL COLIFORM BACTERIA	Memmert	WNE 14 / L414.1407	Technology Promotion Association (Thailand-Japan)	25TM501	19/3/2025	18/3/2026

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



Certificate of Calibration

Cert.No.: 24CH814
Page.: 1 of 3

Equipment : pH Meter
Manufacturer : EcoSense
Model : pH100A
Serial No. : JC02743
ID No. : UAE.EFM.196/2561(ENV.pH.05/61)
Condition As-Received: Used Item
Received Date : 09 July 2024
Calibration Date : 10 July 2024
Reference : 2407-0334WSC-2
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udumsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lemgagtrakul

Approved by : _____
Approved Signatory

() Unnopphol Harachai
() Ponpan Paipim
(✓) Salthip Meangmai

Issue Date : 14 July 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.

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	2188080	130RC044	23I1216	10 Oct 2024

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

2. Certified Reference Materials

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: JC02743	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

Cert.No.: 24CH814
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 231018SIA605377	4.008	4.01	173	0.0079	2.00
	6.986	7.00	-1	0.011	2.00
	6.986	7.00	-1	0.0093	2.00
	9.997	10.00	-177	0.0085	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : -
- Serial No. : 231018SIA605377
Dimension of probe
- Length : 110 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.003	25.1	0.097	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.003	35.0	-0.003	0.13	2.00

Remark - UUC* = Unit Under Calibration

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

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Certificate of Calibration

Cert.No.: 24CH1115
Page.: 1 of 2

Equipment : Turbidity Meter
Manufacturer : Oakton
Model : T100IR
Serial No. : 1120501017
ID. No. : UAE.WAT.056/2563
Condition As-Received: Used Item
Received Date : 05 September 2024
Calibration Date : 06 September 2024
Reference : 2409-0177DSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udumsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 20) %
Calibration Procedure : In - house method : CP-CH11
Direct measurement by
using Formazin standard solution

Calibrated by : Walalak Sirithean

Approved by : _____
Approved Signatory

() Unnopphol Harachai
() Ponpan Paipim
(✓) Salthip Meangmai

Issue Date : 9 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No. : 24CH1115
Page. : 2 of 2

Condition of this calibration result

1. Reference Standard Instruments :

Instruments	Serial No.	ID No.	Certificate No.	Due date
1) Thermo-Hygrograph	1103328	130EC010	24H1372	12 July 2025
2) Electronic Balance	1126143764	140RC004	22MM22	20 Feb 2025

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

2. Standard Material : The Formazin suspension has been prepared gravimetric from

Material	Manufacturer	Lot No.	Assay
1) Hexamethylenetetramine	HIMEDIA	0000493947	99.65%
2) Hydrazinium Sulfate	HIMEDIA	0000522014	99.40%

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

Calibration result

Performing five - Formazin suspension standard curve by using 0,20,100,400,800 NTU Turbidity Meter Serial Number : 1120501017

Standard Formazine suspension (NTU)	UUC* Reading (NTU)	Uncertainty of Measurement (± NTU)	Coverage Factor k
0	0.00	0.0081	2.06
20	20.2	0.39	2.00
100	100	0.75	2.00
400	401	1.5	2.06
800	801	2.1	2.17

Remark - UUC* = Unit Under Calibration
- NTU = Nephelometric Turbidity Units

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 PATANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH1585
Page.: 1 of 3

Equipment :	Conductivity Meter
Manufacturer :	Horiba
Model :	LAQUA-EC210
Serial No. :	HCOJ0017
ID No. :	UAE.EFM.077/2564(EFM.SCT.03/64)
Condition As-Received:	Used Item
Received Date :	24 December 2024
Calibration Date :	25 December 2024
Reference :	2412-0605WSC-1
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure:	In -house method : - CP-CH6 by direct measurement with certified reference material (CRM) - CP-CH8 by comparison with temperature standard
Calibrated by :	Warakorn Lernagatrakul
Approved by :	 Approved Signatory
() Pornthippa Tameyakul () Ponpan Paipim (✓) Sathip Meangmai	
Issue Date :	25 December 2024

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 24CH1585
Page. : 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Ref. Std.Thermometer	2188080	130RC044	24I1022	16 Sep 2025
2) Ref. Std.Thermometer	4982054	110RC044	24I757	14 July 2025

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

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1412.9 µS/cm	CPA Chem	1005307	15 June 2025
12.881 mS/cm	CPA Chem	1005308	15 June 2025

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) °C

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1412.9 µS/cm

Conductivity Electrode Serial No.: 9B0J0094

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1412.9 µS/cm	1386 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.881 mS/cm	12.17 mS/cm	12.62 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration



Cert.No.: 24CH1585
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

This equipment was connected with Temperature Probe;

- Model :	9383
- Serial No. :	9B0J0094

Dimension of probe:

- Length :	104 mm
- Diameter :	16 mm
- Immersion Depth :	90 mm

Calibration Result : Without adjustment

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor k
15.0	15.002	15.0	-0.002	0.13	2.00
30.0	30.002	30.0	-0.003	0.13	2.00
45.0	45.003	45.0	-0.003	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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Certificate of Calibration

Cert. No.: 24TM938
Page : 1 of 3

Equipment : Incubator
Manufacturer : Binder
Model : KB 400 E6
Serial No. : 2022000022479
ID No. : UAE.MIC.028/2566
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 09 July 2024
Calibration Date : 09 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Khit Ruttanaprapachai
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 19 July 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 : Incubator
Condition As-Received : Used Item
Reference : 2407-0153OC-4
Procedure Used :-

Cert. No.: 24TM938
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:-

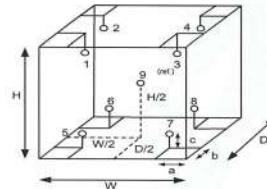
Instrument	Serial No.	Cert. No.	Traceable	Due Date
1.) Data Acquisition	MY49001451	24LM44	TPA	17 Mar 2025

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)	23	24
REL.Humid. (%)	52	54
AC Supply (Volt)	221	222



Probe Installation Details :

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

Dimension of Chamber :

D = 0.47 m
W = 0.65 m
H = 1.2 m
Capacity = 0.37 m³

Position :	Ref. Std. ID No.:
1	19RTD-2/1
2	19RTD-2/2
3	19RTD-2/3
4	19RTD-2/4
5	19RTD-2/5
6	24-19RTD-2/6
7	19RTD-2/7
8	19RTD-2/8
9 (ref.)	19RTD-2/9

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2407-0153OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 24TM938
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
35.0	35.0	35.0	0.030	0.31	0.33	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	35.093	35.011	35.081	35.118	34.840	35.054	34.924	34.978	34.824	0.30

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



Certificate of Calibration

Cert. No.: 24TM1114
Page : 1 of 3

Equipment : BOD Incubator
Manufacturer : ARCO
Model : UC4-1320
Serial No. : -
ID No. : UAE.WAO.018/2559
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 11 July 2024
Calibration Date : 11 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Tawatchai Pama
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 14 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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

Cert. No.: 24TM1114
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

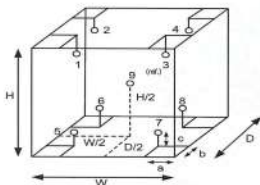
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



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

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

Probe Installation Details :

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

Dimension of Chamber :

D = 0.62 m
W = 1.2 m
H = 1.2 m
Capacity = 0.89 m³

เอกสารไม่ควบคุม



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

Cert. No.: 24TM1114
Page : 3 of 3

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

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

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

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

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

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

UUC* : Unit Under Calibration

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

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

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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.: 25CH167
Page.: 2 of 3

Certificate of Calibration

Cert.No.: 25CH167
Page.: 1 of 3

Equipment : Conductivity Meter
Manufacturer : Horiba
Model : LAQUA-EC210
Serial No. : HC9L0013
ID No. : UAE.EFM.011/2563(EFM.SCT.05/63)
Condition As-Received: Used Item
Received Date : 04 February 2025
Calibration Date : 05 February 2025
Reference : 2502-0107WSC-3
Submitted by : United Analyst and Engineering Consultant Co.,Ltd,
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In -house method :
- CP-CH6 by direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lerngagtrakul

Approved by : Approved Signatory

() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Sathip Meangmai

Issue Date : 06 February 2025

The Uncertainties are for a confidence probability of approximately 95%

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Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	24I995	09 Sep 2025
2) Ref. Std. Thermometer	4982054	110RC044	24I757	14 July 2025

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

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1412.9 µS/cm	CPA Chem	1005307	15 June 2025
12.881 mS/cm	CPA Chem	1005308	15 June 2025

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) °C

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1412.9 µS/cm

Conductivity Electrode Serial No.: 9B9F0286

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1412.9 µS/cm	1444 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.881 mS/cm	12.94 mS/cm	12.66 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration



Cert.No.: 25CH167
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

This equipment was connected with Temperature Probe;

- Model : 9383
- Serial No. : 9B9F0286

Dimension of probe;

- Length : 110 mm
- Diameter : 16 mm
- Immersion Depth : 100 mm

Calibration Result : Without adjustment

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor k
15.0	15.003	15.0	-0.003	0.13	2.00
30.0	30.004	30.0	-0.004	0.13	2.00
45.0	45.003	45.0	-0.003	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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



Certificate of Calibration

Cert. No.: 25TM501
Page : 1 of 3

Equipment : Water Bath
Manufacturer : Memmert
Model : WNE 14
Serial No. : L414.1407
ID No. : UAE.MIC.006/2558
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (302)
Received Order : 19 March 2025
Calibration Date : 19 March 2025
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Krisda Malee
Approved by : Kunchit
() Chakrit Waewwanjua
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 27 March 2025

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2503-0436OC-1
Procedure Used :-

Cert. No.: 25TM501
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

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	MY57013823	23LM71	TPA	12 May 2025

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.

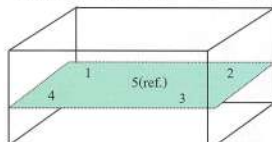
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	50	220
Finished of Calibration	25	53	221



Front

Position :	Ref. Std. S/N.:
1	4804539-006
2	4804539-007
3	4804539-008
4	4804539-009
5(ref.)	4804539-010



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2503-0436OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 25TM501
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
44.5	44.4	44.4	44.508	44.531	44.495	44.537	44.510	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
44.5	0.092	0.048	2

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

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.

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

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

เอกสารไม่ควบคุม



Certificate of Testing

Cert.No.: 25TW19
Page.: 1 of 2

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0028
ID No. : UAE.EFM.013/2563 (EFM.DO.02/63)
Received Date : 22 January 2025
Test Date : 23 January 2025
Reference : 2501-0774WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by : 
Approved Signatory
() Ponthippa Tameyakul
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 24 January 2025



Cert.No.: 25TW19
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :
This certification is traceable to the International System of Unit through the reference standards
Laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).
- | Instruments | Serial No. | ID No. | Certificate No. | Due Date |
|-------------|------------|----------|-----------------|--------------|
| 1. Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2. Balance | 14233821 | 110RC001 | 24MM131 | 04 July 2025 |
2. Standard Material :-
- | Material | Manufacturer | Lot.No. | Assay |
|---------------------------------|--------------|------------|-------|
| Sodium Thiosulfate 5-Hydrate AR | KEMAUS | 2203162447 | 99.6% |

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 9K9G0090

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.21	0.0045

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the laboratory

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Certificate of Calibration

Cert. No.: 25LM11
Page.: 1 of 2

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0028
ID No. : UAE.EFM.013/2563(EFM.DO.02/63)
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 22 January 2025
Calibrated Date : 23 January 2025
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Warakorn Lernagatrakul
Approved by : 
Approved Signatory
() Chakrit Waewwanjua
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 29 January 2025

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2501-0774WSC-2

Cert. No.: 25LM11
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with
Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
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) Digital Thermometer | 2188080 | 2411022 | TPA | 17 Sep 2025 |
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 : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K9G0090

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
15.0	90	15.002	15.0	-0.002	0.16	2.00
30.0	90	30.002	30.0	-0.002	0.16	2.00
45.0	90	45.003	45.0	-0.003	0.16	2.00

UUC* : Unit Under Calibration

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

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Certificate of Testing

Cert.No.: 25TW29
Page.: 1 of 2

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

เอกสารไม่ควบคุม



Cert.No.: 25TW29
Page.: 2 of 2

Condition of this result of calibration

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

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

2. Standard Material :-

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

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

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

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the laboratory

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United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Tel: 0 2763 2828 Fax: 0 2763 2800 www.uaec consultant.com E-mail: uaec@uaec consultant.com



Certificate of Calibration

Certificate No.: 250422-1-BL002-25
Code No.: BL002-25
Page: 1 of 3

Customer Name: United Analyst and Engineering Consultant Co., Ltd.
Address: 3 Soi Udomsuk 41, Sukhumvit Rd., Bang Chak, Phrakhanong, Bangkok 10260

Equipment: Electronic Balance
Manufacturer: Mettler Toledo
Model: AB204-S/FACT
Serial No.: 1129361010
Asset No.: UAE.WAS.002/2552
Building: N/A Floor: 1 Room: 107

Received Date: April 22, 2025
Date of Calibration: April 23, 2025
Calibration Conditions: Temperature 22.8 °C to 23.4 °C
Humidity 54.8 % to 68.9 %
Pressure 756.6 mmHg to 758.2 mmHg

Calibrated by: Sakkarin Srirahang

Approved by: Suwit Chotnok

Signature:

Issued Date: April 25, 2025

- Note : 1) The Uncertainties are for a confidence probability of approximately 95%
2) This Certificate is valid only to the item calibrated on date and place of calibration.
3) 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 United Analyst and Engineering Consultant Co., Ltd. (UAE)

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เอกสารไม่ควบคุม

Certificate No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 2 of 3

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

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

Condition of Equipment:

Condition of This Result of Calibration:

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

2. Reference Standards:

Reference Standard:	Model	Serial No.	Calibrated By	Certificate No.	Traceability	Due Date
Standard Weight Class E2 (OIML)	1 mg to 1 kg	8749109122	AMARC	25-009359	Mettler-Toledo	21-Jan-27
Standard Weight Class F1 (OIML)	1 mg to 200 g	11119512	AMARC	24-013840	Mettler-Toledo	04-Feb-26
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Traceability	Due Date
Thermo-Hydro-Baro Meter	MHB-3825D	AK.46457	SUCCESS	SG-H-00997/67	Success Gateway	21-Nov-25
Thermo-Hydro-Baro Meter	MHB-3825D	AK.46457	TPA	25PT95	TPA	25-Feb-26

3. This certification is traceable to SI Unit

4. This certification 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. Through the reference standard laboratory of AMARC 25-009359 Calibration 0152

Calibration Result:

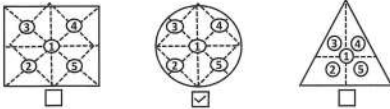
1. Repeatability of Reading:

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

2. Eccentric or off-center loading

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

The Balance reading obtained is given in the table.



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

เอกสารไม่ควบคุม

Calibration Certificate

Certificate No.: 2500116-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Phrakhanong, Bangkok 10260

Page 1 of 3

Equipment: CHAMBER (Hot Air Oven)
Manufacturer: MEMMERT
Model: UF55
Serial No.: B216.1666
ID No.: UAE.WAO.027/2559
Order No.: 2500116
Operation No.: 2500116-001
Date of Receipt: 8 October 2024
Date of Calibration: 8 October 2024

Calibrated by Mr.Yothin Charoensuk
Scientist

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

Date of Issue: 15 October 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-C-009 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม



Certificate No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 3 of 3

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

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

Calibration Result: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

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

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

4. Effect of Tare test:

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

Remark:

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

เอกสารไม่ควบคุม

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Calibration Report

Certificate No.: 2500116-001-01
Equipment: CHAMBER (Hot Air Oven)
Model: UF55
Resolution: 0.1 °C
ID No.: UAE.WAO.027/2559
Manufacturer: MEMMERT

Date of Calibration: 8 October 2024

Page 2 of 3

Location: Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Environment Condition:
Ambient Temperature (30.3 ± 1) °C
Relative Humidity (55 ± 1) %
Line Voltage (230 ± 3) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 9 standard thermometer into its chamber and calibration according to W-TE-014 Based on TLAS G-20-1/02-08 (E): Guidelines for Calibration and Checks of Temperature Controlled Enclosures.
- The temperature scale used was based on ITS - 90.
- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No./ID No.	Certificate No.	Due Date	Through
Digital Thermometer with sensor	34972A	MYS7003188	TE 670486-01	8 June 2025	NATIONAL FOOD INSTITUTE
	RTD	CH#201-209/ RTD#201-209			

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

UUC Description :

Time of Record 1 Hour 9 Minute At 104.0,140.0 and 180.0 °C
Fresh air Damper - Open Position -
X Close Fan 40%
- Not Available

7. Result of Calibration : X Without adjustment After adjustment

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

เอกสารไม่ควบคุม



Calibration Report

Certificate No.: 2500116-001-01
Equipment: CHAMBER (Hot Air Oven)
Model: UF55 **Serial No.:** B216.1666
Resolution: 0.1 °C **ID No.:** UAE.WAO.027/2559
Manufacturer: MEMMERT

Date of Calibration: 8 October 2024
Calibration point: 104.0, 140.0 and 180.0 °C

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
MIN	29.3	54	227.0
MAX	31.2	56	232.0

Table 1 : Reporting of Temperature

Calibration point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9	
104.0	103.89	103.66	103.88	103.89	104.40	103.98	103.70	104.10	104.15	0.53
140.0	139.85	139.53	139.87	139.88	140.67	140.00	139.60	140.25	140.23	0.73
180.0	179.63	179.22	179.71	179.76	181.03	180.06	179.41	180.87	180.39	0.90

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall Variation
	MIN	MAX	Average			
104.0	104.0	104.0	104.0	0.15	0.49	0.88
140.0	140.0	140.0	140.0	0.13	0.71	1.2
180.0	180.0	180.0	180.0	0.13	1.2	1.9

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "
UUC* = Unit Under Calibration
Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.
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.
Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.
The report uncertainty of measurement was based on standard uncertainty multiplied by coverage factor k= 2, providing a level of confidence of approximately 95 %.

----- End -----

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

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Calibration Certificate

Certificate No.: 2502226-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsak 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.: 2502226

Operation No.: 2502226-001

Date of Receipt: 19 March 2025

Date of Calibration: 20 March 2025

Calibrated by Mr.Yothin Charoensuk **Approved by** *Mr. N. Nijphat*
Scientist (Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
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

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Calibration Report

Certificate No.: 2502226-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025
Environment Condition: Ambient Temperature: 21.2 ± 0.6 °C Relative Humidity: 48 ± 3.5 %
Place of Calibration: 208 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Condition of Equipment: Good Condition
Condition of This Results of Calibration:

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

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	8505567572	TC5	M24041005	19 April 2025
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 017/23	Quality Reborn	QR25-0542	10 February 2026

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

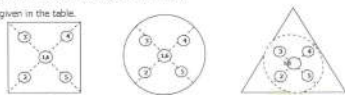
Calibration Results:

1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
40	0.000052
80	0.000042
100	0.000000
200	0.000000

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.
The balance reading obtained is given in the table.



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

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

เอกสารไม่ควบคุม เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2502226-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025
Calibration Results: (Continued)
Calibration Range: 0-80 g
Calibration Adjustment: Internal Calibration

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

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Unload	0.000000	0.000000	0.000000	0.0000089	2.00
0.001	0.001003	0.001000	0.000000	0.0000092	2.00
0.005	0.005002	0.005000	0.000000	0.0000094	2.00
0.01	0.010003	0.010000	0.000000	0.0000091	2.00
0.05	0.049996	0.050000	0.000000	0.0000098	2.00
0.1	0.100011	0.100000	0.000001	0.000011	2.00
0.5	0.500016	0.500000	0.000002	0.000014	2.00
1	1.000003	1.000001	-0.000001	0.000016	2.00
2	2.000023	2.000005	-0.000003	0.000017	2.00
5	5.000015	5.000005	-0.000003	0.000021	2.00
10	10.000009	10.000005	-0.000004	0.000026	2.00
20	20.000030	20.000012	-0.000009	0.000037	2.00
30	30.000039	30.000012	-0.000008	0.000050	2.00
50	50.000028	50.000014	-0.000011	0.000068	2.00
80	80.000067	80.000020	-0.000013	0.00011	2.00

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

เอกสารไม่ควบคุม เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2502226-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 Page 4 of 4

Calibration Results: (Continued)

Calibration Range: >80-200 g

Calibration Adjustment: Internal Calibration

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

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
90	90.00010	90.00002	-0.00001	0.00015	2.00
100	100.00006	100.00001	0.00000	0.00016	2.00
110	110.00007	110.00001	0.00000	0.00017	2.00
120	120.00009	120.00002	-0.00001	0.00018	2.00
130	130.00010	130.00002	-0.00001	0.00019	2.00
140	140.00013	140.00002	-0.00001	0.00019	2.00
150	150.00009	150.00002	-0.00001	0.00021	2.00
160	160.00010	160.00003	-0.00001	0.00022	2.00
170	170.00012	170.00003	-0.00001	0.00023	2.00
200	200.00013	200.00002	-0.00001	0.00028	2.00

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

----- End -----

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

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เอกสารไม่ควบคุม

Calibration Certificate

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

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Order No.: 2502226

Operation No.: 2502226-002

Date of Receipt: 19 March 2025

Date of Calibration: 20 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by *for N. Nigrobat*
(Mr.Pheraphat Tuanjit)

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

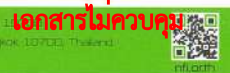
Date of Issue: 25 March 2025

The uncertainties are for a confidence probability of approximately 95%

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

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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 Page 2 of 4

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

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

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	8505567572	TCS	M24041005	19 April 2025
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NF18TH 017/23	Quality Return	QR25-0542	10 February 2026

3. This certification is traceable to SI UNIT

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

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

Calibration Results:

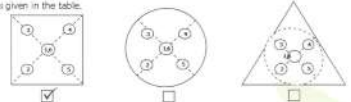
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
40	0.0000042
80	0.0000042
100	0.000000
200	0.000000

2. Off-Center Error:

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

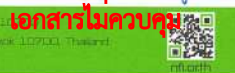
The balance reading obtained is given in the table.



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

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

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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 Page 3 of 4

Calibration Results: (Continued)

Calibration Range: 0-80 g

Calibration Adjustment: Internal Calibration

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

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Unloaded	0.000000	0.00000	0.00000	0.0000087	2.00
0.001	0.001003	0.00100	0.00000	0.0000090	2.00
0.005	0.005002	0.00501	-0.00001	0.0000092	2.00
0.01	0.010003	0.01002	-0.00002	0.0000089	2.00
0.05	0.049996	0.05001	-0.00001	0.0000096	2.00
0.1	0.100011	0.10002	-0.00001	0.000011	2.00
0.5	0.500016	0.50004	-0.00002	0.000014	2.00
1	1.000023	1.00005	-0.00003	0.000016	2.00
2	2.000023	2.00006	-0.00004	0.000017	2.00
5	5.000015	5.00006	-0.00005	0.000020	2.00
10	10.000009	10.00005	-0.00004	0.000026	2.00
20	20.000030	20.00007	-0.00004	0.000037	2.00
30	30.000039	30.00009	-0.00005	0.000050	2.00
50	50.000028	50.00008	-0.00005	0.000068	2.00
80	80.000067	80.00013	-0.00006	0.00011	2.00

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

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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 Page 4 of 4

Calibration Results: (Continued)

Calibration Range: >80-200 g

Calibration Adjustment: Internal Calibration

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

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (±g)	Coverage Factor k
90	90.00010	90.00002	-0.00001	0.00015	2.00
100	100.00006	100.00001	0.00000	0.00016	2.00
110	110.00007	110.00002	-0.00001	0.00017	2.00
120	120.00009	120.00002	-0.00001	0.00018	2.00
130	130.00010	130.00002	-0.00001	0.00019	2.00
140	140.00013	140.00002	-0.00001	0.00019	2.00
150	150.00009	150.00002	-0.00001	0.00021	2.00
160	160.00010	160.00002	-0.00001	0.00022	2.00
170	170.00012	170.00002	-0.00001	0.00023	2.00
200	200.00013	200.00002	-0.00001	0.00028	2.00

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

----- End -----

FCS-012 Revision: 01 Date: 20-04-65

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เอกสารไม่ควบคุม

Calibration Certificate

Certificate No.: 2503287-001-01
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: Autoclave
Manufacturer: ALP
Model: CL-40L
Serial No.: 810010
ID No.: UAE.MIC.032/2565
Order No.: 2503287
Operation No.: 2503287-001
Date of Receipt: 5 June 2025
Date of Calibration: 5 June 2025

Calibrated by Mr.Pheraphat Tuanjit Scientist
Approved by
(Miss Preeyaporn Jaengkarnkit)
Vice President, Department of Laboratory Services
Responsible for the Technical Management Team
Date of Issue: 11 June 2025

The uncertainties are for a confidence probability of approximately 95 %.
This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2503287-001-01
Equipment: Autoclave
Model: CL-40L
Resolution: 1 °C
Serial No.: 810010
ID No.: UAE.MIC.032/2565
Manufacturer: ALP
Date of Calibration: 5 June 2025 Page 2 of 3

Location: Room 301 Media Preparation, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Environment Condition: Ambient Temperature (26 ± 1) °C
Relative Humidity (55 ± 5) %
Line Voltage (230 ± 5) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 3 standard Data loggers with RTD into its autoclave and calibration according to W-TE-018 based on BS 2646-1:2021, Autoclaves for sterilization in laboratories Part 1: Design, construction, safety and performance - Specification.
- The temperature scale used was based on ITS - 90.
- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with RTD (Data Logger)	HiTemp140-PT	T20627	NC-25-03-18-181	11-Mar-26	MADGETECH, INC.
	DM-CP-HITEMP-140	R56916	2502081-002-01	11-Mar-26	NATIONAL FOOD INSTITUTE
	PRTemp140	R38546	2501835-001-01	22-Feb-26	NATIONAL FOOD INSTITUTE

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. This standard does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical.

7. Condition of Calibrated item : Good

UUC Description : Setting program function sterilization : STERILIZE/NORMAL
Time of sterilization 20 Minute At 115 and 121 °C

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

11 June 2025

FCS-012 Revision: 01 Date: 20-04-65

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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2503287-001-01
Equipment: Autoclave
Model: CL-40L
Resolution: 1 °C
Serial No.: 810010
ID No.: UAE.MIC.032/2565
Manufacturer: ALP
Date of Calibration: 5 June 2025 Page 3 of 3

Calibration point: 115 and 121 °C

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
Min	25.8	50	225
Max	26.8	59	235

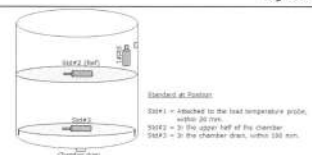


Table1 : Reporting of Temperature

Calibration Point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.2 is REF)			Uncertainty ± (°C)
	Std.# 1	Std.# 2 (Ref)	Std.# 3	
115	115.46	115.43	115.42	0.70
121	121.59	121.54	121.51	0.70

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading				Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	Min (°C)	Max (°C)	Average (°C)	MPa			
115	115	115	115	0.08	0.24	0.17	0.50
121	121	121	121	0.12	0.24	0.19	0.52

Note

The quoted uncertainty include " Stability " and " Loading effect (20% of Uniformity)" .

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

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.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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 -----

FCS-012 Revision: 01 Date: 20-04-65

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Tel: +66(0) 4242 8588 Fax: +66(0) 4242 8545



เอกสารไม่ควบคุม

FL 8500 - Preventive Maintenance report			
Company Name:	United Analyst and Engineering Consultant Co., Ltd.		
Address:	3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District, Phrakhanong District, Bangkok, THAILAND 10260		
User Name:	Mr.Karnphong Boonpoung	WO Number:	WO-03299388
Telephone Number:	094-623-3880	PM Number:	1 of 1 G
Customer Support Engineer:	Tanapakorn Tungmana	report Number:	FLR_3005/2025
PM Performed: (DD-MMM-YYYY)	28-May-2025	Next PM Due Date: (DD-MM-YYYY)	28-May-2026

Scope

The purpose of this preventive maintenance is to ensure the continued functionality of the PerkinElmer Fluorescence Spectrophotometer by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the preventive maintenance. Always check with the customer before making any changes that may affect the customer's analysis. Should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the preventive maintenance sticker and instrument logbook as required.

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เอกสารไม่ควบคุม Page 1

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Perform general inspection of system for cleanliness.

2. Optical checks:

- ☒ Lamp Alignment/Intensity
- ☒ Sample Compartment Windows
- ☒ Mirror and Grating Alignment
- ☒ Cell Holder Alignment

3. Mechanical:

- ☒ Physical Inspection
- ☒ Grating Drive Mechanism.
- ☒ Slit Drive Mechanism.

4. Test:

Refer to Appendix A for the specifications of the instrument being tested.

- ☒ Water Raman Spectrum

	Actual Value	Validation Criteria
Raman Peak Wavelength	397.80	392.0 - 402.0 (nm)

- ☒ Water Raman Sensitivity

	Actual Value	Validation Criteria
Signal to Noise	218307.49	>= 4000
Drift	0.31	<= 10%

เอกสารไม่ควบคุม Page 3

Component List

Component Model	Serial #	Software Version	Configuration Notes
FL8500	FL85K22062801	Spectrum FL 1.4.0	ES
-	-	-	-
-	-	-	-

Parts Lists

Test standard Used					
Part Number (if applicable)	Description				
N4202000	LAMP HG/AR				
L2251365	Sealed Water Cell				
N4202027	Sealed Rhodamine Cell				
Additional Tools Required for preventive maintenance					
Part Number (if applicable)	Description	Quantity	Serial #		Calibration Due Date (MM/YY)
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Additional Reagents and Standards Required for preventive maintenance					
Part Number (if applicable)	Description	Quantity	Batch/Lot #		Expiration Date (MM/YY)
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

เอกสารไม่ควบคุม Page 2

- ☒ Emission Wavelength Accuracy.

Emission Wavelength Accuracy(Hg)		Actual Value	Validation Criteria
Target Peak (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	253.6	253.65	± 0.5 nm
Target Peak # 2	365.0	364.89	± 0.5 nm
Target Peak # 3	404.7	404.45	± 0.5 nm
Emission Wavelength Accuracy(Ar)		Actual Value	Validation Criteria
Target Peak (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	696.5	696.76	± 0.5 nm
Target Peak # 2	772.3	772.43	± 0.5 nm
Target Peak # 3	826.3	826.64	± 0.5 nm

- ☒ Emission Wavelength Repeatability.

Emission Wavelength Repeatability(Hg)		RSD	Validation Criteria
Target Peak (nm)		(nm)	Repeatability Limit +/- (nm)
Target Peak # 1	253.7	0.002	≤ 0.2 nm
Target Peak # 2	365.0	0.001	≤ 0.2 nm
Target Peak # 3	404.7	0.003	≤ 0.2 nm
Emission Wavelength Repeatability(Ar)		RSD	Validation Criteria
Target Peak (nm)		(nm)	Repeatability Limit +/- (nm)
Target Peak # 1	696.5	0.003	≤ 0.2 nm
Target Peak # 2	772.3	0.003	≤ 0.2 nm
Target Peak # 3	826.3	0.002	≤ 0.2 nm

เอกสารไม่ควบคุม Page 4

☒ Excitation Wavelength Accuracy.

Excitation Wavelength Accuracy		Actual Value	Validation Criteria
Target Peak (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	300.0	300.14	± 0.5 nm
Target Peak # 2	400.0	399.55	± 0.5 nm
Target Peak # 3	500.0	499.73	± 0.5 nm
Target Peak # 4	600.0	600.02	± 0.5 nm
Target Peak # 5	700.0	700.09	± 0.5 nm
Target Peak # 6	800.0	800.09	± 0.5 nm

☒ Excitation Wavelength Repeatability.

Excitation Wavelength Repeatability		RSD	Validation Criteria
Target Peak (nm)		(nm)	Repeatability Limit +/- (nm)
Target Peak # 1	300.0	0.00	≤ 0.2 nm
Target Peak # 2	400.0	0.00	≤ 0.2 nm
Target Peak # 3	500.0	0.00	≤ 0.2 nm
Target Peak # 4	600.0	0.00	≤ 0.2 nm
Target Peak # 5	700.0	0.00	≤ 0.2 nm
Target Peak # 6	800.0	0.00	≤ 0.2 nm

☒ Stray Light

	Actual Value	Validation Criteria
Stray Light at 240nm	1.04	< 3.0 %
Stray Light at 300nm	0.05	< 0.3 %

เอกสารไม่ควบคุม Page 5

5. Accessory (where applicable):

- ☐ Micro Plate Reader
- ☐ Integrating Sphere
- ☐ Multi Cell Holder
- ☐ Water Jacketed Cell Holder
- ☐ etc. ...Solid Sample Holder.....

6. Review:

- ☒ Review with the customer preventive maintenance work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach preventive maintenance sticker.
- ☒ Update Logbook.

Additional Comments

Additional Comments Regarding the preventive maintenance
Lamp Time = 414 of 1200

Review

The preventive maintenance checks and if applicable performance tests for FL 8500 have been completed.

This FL 8500 Passes ☒ Fails ☐ the preventive maintenance.

Review of Preventive Maintenance:

Authorized PerkinElmer Representative:	Date: 28-May-2025 (DD-MM-YYYY)
Authorized Customer Representative:	Date: 28-May-2025 (DD-MM-YYYY)

เอกสารไม่ควบคุม Page 6

Certificate No. : HIT-2510-0375

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater

Meter Model : HI839800-02 **Serial No. :** H0185001

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

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

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

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

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

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

Received date : 5 March 2025


Calibrate date : 7 March 2025

Issue date : 7 March 2025

Calibrated Location : Hanna Instruments (Thailand) Ltd.

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

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

Approved by : 
Mr. Anan Suwanchaisakul
Authorized Signatory

This certificate was certified only for the instrument we calibrated.

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

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

approval of the head of Hanna Instrument (Thailand)เอกสารไม่ควบคุม

Condition of this calibration result:

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

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

Calibration Result:

Measurement Temperature Source Accuracy for COD Reactor.

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

Unit : °C

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

Figure: Shows the location of the temperature source.

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

** End of certificate **

เอกสารไม่ควบคุม

Serial-No.: K170A0153 Customer-No.: C04-006
Date: 3 February 2025 Carried out by: Mr. Srichai Fak-On

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

Company	บริษัท ชูในเต็ด แอนนาไลซิส 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

Atomic Fluorescence Spectrometer mercur DUO / mercur DUO plus

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Maintenance Protocol mercur DUO mercur DUO plus | update 27.06.2016 Version 2.1 Koss
Analytik Jena AG | Konrad-Zuse-Str. 1 | 07745 Jena | Germany

เอกสารไม่ควบคุม

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"/>

เอกสารไม่ควบคุม

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	0.173 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.816 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.068 NL/min
Valve 4	10 Nl/h or 0.166 NL/min	0.162 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	0	0
450	2	1
500	4	4
550	10	9
575	14	13
600	19	18

เอกสารไม่ควบคุม

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: 451 V		
Blank-solution		Int. 0.0003
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int. 0.0028 RSD 1.24 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 444 V		
Blank-solution		Int. 0.0013
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int. 0.0137 RSD 1.72 %
Fok.-factor (Int ₂ / Int ₁)	> 3.5	4.89
Analytical parameters Absorption cell		
Blank-solution		Ext. 0.0005
without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext. 0.0032 RSD 2.91 %
Comments		


Signature Technician

3 February 2025
Place, Date (DD/MM/YYYY)



Signature Customer

3 February 2025
Place, Date (DD/MM/YYYY)

Maintenance Protocol mercur DUO/mercur DUO plus | update 27.06.2016 Version 2.3 Kioc
Analytik Jena AG | Konrad-Zuse-Str. 1 | 07745 Jena | Germany

เอกสารไม่ควบคุม

Service Report

Customer's address :		Customer's Ref. No.	
บริษัท อโนติก เจนา (ประเทศไทย) จำกัด 3 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260			
E-mail :		Phone :	Fax :
Job No. 2502070RB	User : ศุภกร ทรัพย์	Service Engineer : ศุภกร ทรัพย์	Date : 3/2/2025 Page : 1/1
Instrument model : Mercury	Serial No. K170A0153	Software Version No. 4.7.10	
<input type="checkbox"/> Repair (RE) <input checked="" type="checkbox"/> Maintenance (PM) <input type="checkbox"/> Installation (IN) <input type="checkbox"/> Warranty <input type="checkbox"/> Application (AP) <input type="checkbox"/> Site Prep.(SP) <input type="checkbox"/> Visit(VI)			
Fault / Claim : Preventive maintenance Contract Year 2025 (PM 6/6) <input type="checkbox"/> <input type="checkbox"/> Error Code			
Action taken : Maintenance work basic unit			
• Check device parameters # ตรวจเช็คพารามิเตอร์ (0.0028 - 0.0013)			
• Check gas flows # ตรวจเช็คแก๊สไหล			
• Check liquid flow			
• Check adventitious light-values			
Device parameter test # ตรวจเช็คพารามิเตอร์ (0.0032 - 0.0013)			
• Analytical parameter fluorescence cell # ตรวจเช็คพารามิเตอร์			
• Analytical parameter abstraction cell			
Action Pending / Recommendation : รอส่งซ่อม/เปลี่ยน			
<input type="checkbox"/> Spare Part <input checked="" type="checkbox"/> Instrument Configuration :			
Item No.	Name	Quantity	Unit Price
1. 407-170-240	Gas-liquid separator	1	
2. 401-580	GI clamp	1	
3. 3V	PM 3 Year (2 Year/1 Year)	1	
4. 407-170-050	Sample inlet tube	1	
5. 407-170-057	Reagents and connector tubing as on	1	
6. 407-170-059	Precharging unit	1	
7. 407-170-062	Tubing tubing for acid and reagent	2	
8.			
Hereby the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.		Date / Signature of Customer	Date / Signature of Service Engineer
		ศุภกร ทรัพย์	
			Work completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Services are subject to the General Terms and Conditions of Analytik Jena AG, which will be sent on request.

เอกสารไม่ควบคุม

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Mercur

Report file: C:\WinAAS\TMP\2025\result\WO\Pro_039
Program version: 4.7.9.0 Printed on: 3/02/2025 13:44
Recording started on 3/02/2025 13:32 GMT+7.0

Operator:
Laboratory:
Code:

Remarks:

Method parameters

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	236 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		

Working mode	w/o enrich.	System cleaning	Acid
FBR technique	off	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Purge time1	40 s		

QC parameters

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

Mercur

เอกสารไม่ควบคุม

3/02/2025 13:44 Page 2/3

Calibration settings

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

Sample statistics

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

Calibration standards

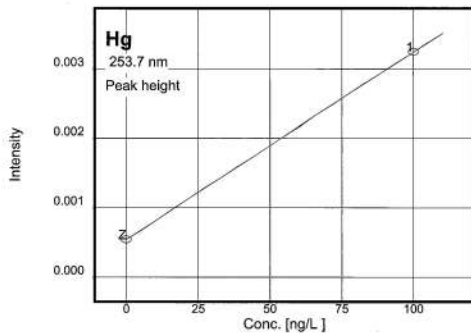
No	Name	State	Pos	Conc./ ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000544 A: 0.005800	0.000115 0.004748	21.26 81.87
2	Cal-Std1	(-)	##	100.00	H: 0.003251 A: 0.042341	0.000094 0.003312	2.921 7.824

Calibration function 1 3/02/2025 13:43 Calibration (Peak height)

Abs=k1+k2*conc k1=0.000544 k2=0.000027 Recal. factor: ---			
Slope	0.00003 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	161.087 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

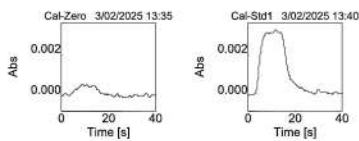
Mercur

เอกสารไม่ควบคุม



Measurements and events (sorted by time)

Hg ID	Without enrichment / FBR 100 ng/L PM_12-02-2024	3/02/2025 13:32
Conc.	Abs	BG SD RSD/% Int. type Time
Cal-Zero	0.000564	PkH 13:35
	0.000420	13:36
	0.000649	13:37
0ng/L	0.000544	0.00011577 21.26 13:37
Cal-Std1	0.003268	PkH 13:40
	0.003336	13:41
	0.003148	13:43
100.ng/L	0.003251	0.000094975 2.921 13:43
Calibration	Calibration function: 01	13:43
Peak plots		Hg



Mercur

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Mercur

Report file: C:\WinAAS\TMP\2025\result\WO\Pro_040
 Program version: 4.7.9.0 Printed on: 3/02/2025 17:37
 Recording started on 3/02/2025 17:26 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters

Method Without Enrichment / FBR / 30 µg/L_PM_3-02-2025
 Created on 3/02/2025 Time 10:33
 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

Hg

Mercur

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

Calibration settings

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

Sample statistics

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

Calibration standards

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	##	0.000	H: 0.000272 A: 0.005693	0.000004 0.000207	1.830 3.646
2	Cal-Std1	(-)	##	30.000	H: 0.002794 A: 0.03861	0.000034 0.000754	1.243 1.953

Hg

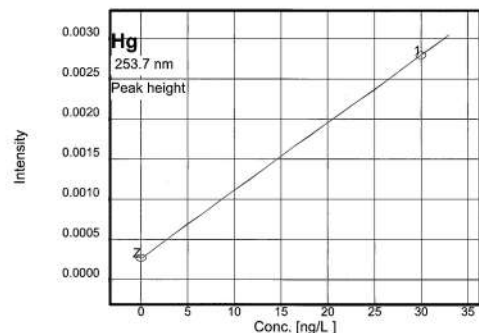
Mercur

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Calibration function 1

3/02/2025 17:36 Calibration (Peak height)

Ints=k1+k2*conc			
k1=0.000272	k2=0.000084	Recal. factor:	---
Slope	0.00008 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

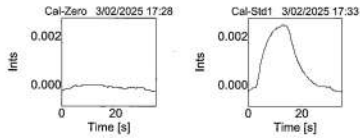
Hg ID	Without Enrichment / FBR / 30 µg/L_PM_3-02-2025	3/02/2025 17:26
Conc.	Ints	BG SD RSD/% Int. type Time
Cal-Zero	0.000276	PkH 17:28
	0.000266	17:29
	0.000273	17:30
0ng/L	0.000272	0.000004982 1.830 17:30
Cal-Std1	0.002754	PkH 17:33
	0.002812	17:34
	0.002816	17:35
30.00ng/L	0.002794	0.000034720 1.243 17:35
Calibration	Calibration function: 01	17:36

Mercur

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Peak plots

Hg



Mercur

Report file: C:\WinAAS\TMP\2025\result\WO\Pro_041
 Program version: 4.7.9.0 Printed on: 3/02/2025 17:59
 Recording started on 3/02/2025 17:46 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters

Hg

Method With Enrichment / FBR / 30 µg/L_PM_3-02-2025
 Created on 3/02/2025 Time 12:45
 Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	20 s
PMT	444 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		
Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	20 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	10 s	Gas wash time3	10 NL/h
Heat.time coll.1	20 s	Cool. time coll.1	25 s

Mercur

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Mercur

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QC parameters

QC type
 QC check samp. 1
 Conc.
 Error limit
 Rep. measurement
 QC std.1 no.
 QC std.1 limit
 QC std. act.
 Expect. blank abs.
 QC precision

QC check samp. 2
 Conc.
 Error limit
 Reaction
 QC std.2 no.
 QC std.2 limit
 Reaction
 QC Recal.factor

Calibration settings

Calib. meth
 No. standards
 Type of standards
 Output unit
 Calib. stat.
 Stock sol. 1
 Stock sol. 3
 Type of cal. curve
 Weighted cal.
 Check of cal. curve

Calibr. unit
 Conversion fac.
 Standard prep.
 Blank correct.
 Recalib. std. no.
 Conversion fac.
 Meas. cycles
 Blind cycles
 Stock sol. 2
 Stock sol. 4
 Intercept
 Grubbs stat.

Sample statistics

Stat. mode
 Confid. level
 Grubbs stat.

Meas. cycles
 Blind cycles

Calibration standards

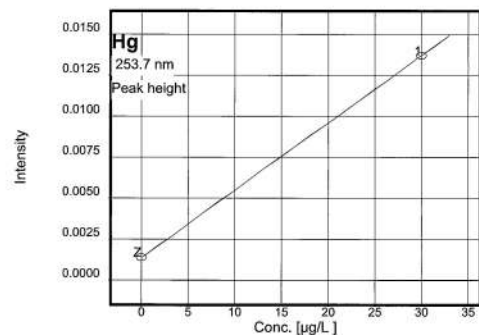
No	Name	State	Pos	Conc./ µg/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.001392 A: 0.006235	0.000048 0.000289	3.475 4.635
2	Cal-Std1	(--)	##	30.000	H: 0.01371 A: 0.05663	0.000237 0.001010	1.729 1.784

Hg

Calibration function 1

3/02/2025 17:59 Calibration (Peak height)

Ints=k1+k2*conc			
k1=0.001392		k2=0.000411	
Recal. factor:		---	
Slope	0.00041 Ints/(µg/L)	R2-adjusted	1.0000
sc0	1.00000 µg/L		
Lower limit	0 µg/L	Upper limit	33.0 µg/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg ID	With Enrichment / FBR / 30 µg/L_PM_3-02-2025					3/02/2025	17:46
	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.001438				PkH	17:50
		0.001397					17:51
		0.001342					17:53
	0µg/L	0.001392		0.000048370	3.475		17:53
Cal-Std1		0.01348				PkH	17:56
		0.01369					17:57
		0.01395					17:59
	30.00µg/L	0.01371		0.0002370	1.729		17:59
Calibration	Calibration function: 01						17:59

Mercur

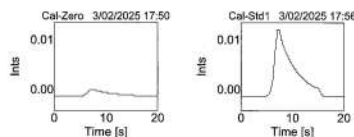
เอกสารไม่ควบคุม

Mercur

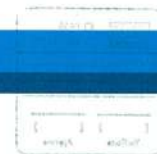
เอกสารไม่ควบคุม

Peak plots

Hg



Agilent CrossLab Start Up Services

**Agilent 5100 5110 ICP-OES
Preventive Maintenance**


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

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

Revision: A.02, Issued: 21 January 2022
Document Number: G8014-90075
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Mercur

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เอกสารไม่ควบคุม

Agilent 5100, 5110 Preventive Maintenance Checklist

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Agilent 5100, 5110 Preventive Maintenance Checklist

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- Need to place a service call?** [Flexible Repair Options | Agilent](#)

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Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page.
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section.
- Ask the customer to sign the Service Verification section including the customer's and your signature.

Instrument Maintenance

System Information

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

Instrument System Name and ID	5110 VDV ICP-OES
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8059A	77 14030001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	SeaSpray (OneNeb) Conical Other
Spray Chamber	Cyclonic Single Pass (Cyclonic Double Pass) Other
Torch	Radial (Dual View) Other
Torch Type	One Piece (Semi Demountable) Fully Demountable Other
Injector Diameter	2.4mm (1.8mm) 1.4mm 0.8mm Other
Injector Material	Quartz Ceramic Other

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. 1111
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☐ Replace high capacity air inlet dust filter element if installed. 1111
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ **Service not applicable**
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☒ **Service not applicable**
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☐ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☐ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ **Service not applicable**
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system. N/A
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

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

Test Results**Instrument Performance Test Results Table**

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	1500.9	2219.4	4124.9	6965.9
Mn 257.610 nm SRBR	3915.0	7492.2	13017.6	31121.6
Al 396.152 nm SBR	9.7	10.7	9.7	21.1
K 766.491 nm SBR	5.7	23.1	4.8	45.3

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	231.411 VAC	226.831 VAC
Mains Current	0.051 A	0.105 A
Instrument Temperature	22.1 °C	23.5 °C
RF Air Flow (sensor speed)	14.0 Hz	19.0 Hz
Plasma Exhaust Temperature	No measurement	63.6 °C
Water Flow Oscillator	No measurement	1.34 L/min
Water Flow Detector	0.86 L/min	0.81 L/min
Water Inlet Temperature	19.3 °C	19.3 °C
Polychromator Temperature	35.0 °C	35.0 °C
CCD Temperature	-40.1 °C	-39.6 °C
Thermal Stabilizer	35.0 °C	35.0 °C
Argon Supply Pressure	646.92 kPa	591.55 kPa
Purge Gas Supply Pressure*1	646.66 kPa	612.41 kPa
Option Gas Supply Pressure*1	— kPa	— kPa
Nebulizer Flow	No measurement	0.30 L/min
Nebulizer Back Pressure	No measurement	158.43 kPa
Plasma Gas Flow	No measurement	11.91 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1204.3 W
RF Supply Current	No measurement	3.856 A
RF Supply Voltage	No measurement	204.417 V

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	—
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	—
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	—
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	—
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	—
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	—
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	—
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	—
Z axis drive belt	5410047400	SPS 3	—
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	—

Consumed Parts Reference
(Purchased by customer, not included as part of PM)☒ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed

Signature Page

Service Engineer Comments (optional)

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

Service Verification

Service Request Number:

6003193100

Service Engineer Name:

Kanyakorn S.

Service Engineer Signature:

Kanyakorn S.

Total number of pages in this document:

14

Date Service Completed:

04 Nov 2024

Customer Name:

Aphorn Onkong

Customer Signature:

Aphorn Onkong

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	Pre Test_PM_Kanyakorn S.
Test Completed On	11/4/2024 9:19:10 AM
Result Summary	
Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Fail
Precision Test	Pass

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.98	
As (188.980 nm)	≤ 8.20	6.17	
C (193.027 nm)	≤ 11.50	8.30	
Mo (202.032 nm)	≤ 8.20	6.38	
Cr (206.158 nm)	≤ 13.40	8.98	
Zn (213.857 nm)	≤ 8.70	6.60	
Pb (220.353 nm)	≤ 9.50	7.09	
Co (228.615 nm)	≤ 17.20	11.67	
Ba (230.424 nm)	≤ 9.40	7.20	
Mn (257.610 nm)	≤ 13.30	9.43	
Mn (260.568 nm)	≤ 20.30	14.11	
Cr (267.716 nm)	≤ 11.00	8.04	
Cu (324.754 nm)	≤ 25.00	18.97	
Cu (327.395 nm)	≤ 14.20	11.23	
Sr (338.071 nm)	≤ 33.50	24.30	
Ba (455.403 nm)	≤ 44.00	33.47	
Sr (460.733 nm)	≤ 36.00	17.23	
Ba (493.408 nm)	≤ 36.00	25.37	
Ba (614.171 nm)	≤ 42.00	25.54	
Ar (675.283 nm)	≤ 74.00	56.51	
K (766.491 nm)	≤ 80.00	65.86	

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เอกสารไม่ควบคุม

Sensitivity Test			Fail		
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	104.1	793.0	50.8
Se (196.026 nm)	≥ 41.0	SRBR	87.6	862.0	79.7
Zn (213.857 nm)	≥ 1421.0	SRBR	1500.8	41823.3	749.0
Pb (220.353 nm)	≥ 46.0	SRBR	170.7	2432.0	174.9
Mn (257.610 nm)	≥ 3518.0	SRBR	3915.0	264700.2	4420.0
Al (396.152 nm)	≥ 3.4	SBR	7.7	48454.6	5563.2
Ba (493.408 nm)	≥ 34.0	SBR	45.9	1966719.7	41903.8
K (766.491 nm)	≥ 1.8	SBR	5.7	99038.2	14687.7
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	126.5	1498.8	119.0
Se (196.026 nm)	≥ 159.0	SRBR	112.0	1773.6	197.8
Zn (206.200 nm)	≥ 234.0	SRBR	466.0	6784.2	199.7
Zn (213.857 nm)	≥ 1743.0	SRBR	2217.4	95597.6	1789.7
Cd (214.439 nm)	≥ 4227.0	SRBR	1919.3	68724.6	1236.4
Pb (220.353 nm)	≥ 320.0	SRBR	332.6	7929.5	499.0
Mn (257.610 nm)	≥ 10625.0	SRBR	7492.2	991238.3	16911.7
Cr (267.716 nm)	≥ 1048.0	SRBR	2254.6	129706.6	3150.9
Cu (324.754 nm)	≥ 19.0	SBR	26.9	290746.3	10407.5
Al (396.152 nm)	≥ 6.0	SBR	10.7	211329.2	18005.0
Ba (493.408 nm)	≥ 60.0	SBR	49.3	6956460.4	138336.9
K (766.491 nm)	≥ 24.0	SBR	28.1	1395190.2	47996.2

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.73	
Se (196.026 nm)	≤ 2.60	0.95	
Zn (213.857 nm)	≤ 1.50	0.31	
Pb (220.353 nm)	≤ 2.60	0.73	
Mn (257.610 nm)	≤ 1.50	0.39	
Al (396.152 nm)	≤ 1.50	0.39	
Ba (493.408 nm)	≤ 1.50	0.87	
K (766.491 nm)	≤ 1.50	0.32	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	1.21	
Se (196.026 nm)	≤ 1.50	0.84	
Zn (206.200 nm)	≤ 1.50	0.56	
Zn (213.857 nm)	≤ 1.50	0.96	
Cd (214.439 nm)	≤ 1.50	0.26	
Pb (220.353 nm)	≤ 1.50	0.51	
Mn (257.610 nm)	≤ 1.50	0.97	
Cr (267.716 nm)	≤ 1.50	0.22	
Cu (324.754 nm)	≤ 1.50	0.24	
Al (396.152 nm)	≤ 1.50	0.33	
Ba (493.408 nm)	≤ 1.50	0.40	
K (766.491 nm)	≤ 1.50	0.65	

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เอกสารไม่ควบคุม

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
File Name	3442
Tested By	Post Test_PM_Kanyakorn S.
Test Completed On	11/4/2024 11:07:24 AM
Result Summary	
Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Fail
Precision Test	Pass
Subsystem Communications Test	Pass
Optics Test	Pass
Intensity	3184054
Wavelength	737.212
	3177175
	737.212

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เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.97	
As (188.980 nm)	≤ 8.20	6.14	
C (193.027 nm)	≤ 11.50	8.33	
Mo (202.032 nm)	≤ 8.20	6.33	
Cr (206.133 nm)	≤ 13.40	9.06	
Zn (213.637 nm)	≤ 8.70	6.70	
Pb (220.353 nm)	≤ 9.50	7.03	
Co (228.615 nm)	≤ 17.20	11.72	
Ba (230.424 nm)	≤ 9.40	7.32	
Mn (257.610 nm)	≤ 13.30	9.44	
Mn (260.568 nm)	≤ 20.30	14.21	
Cr (267.716 nm)	≤ 11.00	7.94	
Cu (324.754 nm)	≤ 25.00	18.99	
Cu (327.395 nm)	≤ 14.20	11.27	
Sr (338.071 nm)	≤ 33.50	24.40	
Ba (455.403 nm)	≤ 44.00	33.50	
Sr (460.733 nm)	≤ 36.00	17.31	
Ba (493.408 nm)	≤ 36.00	25.44	
Ba (614.171 nm)	≤ 42.00	25.16	
Ar (675.283 nm)	≤ 74.00	56.15	
K (766.491 nm)	≤ 80.00	65.56	

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เอกสารไม่ควบคุม

Sensitivity Test			Fail		
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	130.6	977.1	50.4
Se (196.026 nm)	≥ 41.0	SRBR	106.0	958.7	70.2
Zn (213.857 nm)	≥ 1421.0	SRBR	4124.8	44037.7	113.4
Pb (220.353 nm)	≥ 46.0	SRBR	207.2	2554.7	136.2
Mn (257.610 nm)	≥ 3518.0	SRBR	13017.8	271846.6	434.7
Al (396.152 nm)	≥ 3.4	SBR	9.7	50615.5	4717.0
Ba (493.408 nm)	≥ 34.0	SBR	133.7	2069203.0	15359.3
K (766.491 nm)	≥ 1.6	SBR	4.8	100199.5	17235.5
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	174.9	1566.7	73.0
Se (196.026 nm)	≥ 159.0	SRBR	167.0	1863.4	110.2
Zn (206.200 nm)	≥ 234.0	SRBR	740.9	6836.0	83.1
Zn (213.857 nm)	≥ 1743.0	SRBR	6965.9	101568.1	211.7
Cd (214.439 nm)	≥ 4227.0	SRBR	5781.0	72852.9	158.1
Pb (220.353 nm)	≥ 320.0	SRBR	501.0	8464.3	267.7
Mn (257.610 nm)	≥ 10625.0	SRBR	31121.6	1006637.8	1044.0
Cr (267.716 nm)	≥ 1048.0	SRBR	4424.8	132202.9	880.8
Cu (324.754 nm)	≥ 19.0	SBR	68.7	302907.8	4345.6
Al (396.152 nm)	≥ 6.0	SBR	21.1	218771.0	9892.3
Ba (493.408 nm)	≥ 60.0	SBR	250.6	7137380.9	28367.3
K (766.491 nm)	≥ 24.0	SBR	45.3	1435050.6	31025.0

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.81	
Se (196.026 nm)	≤ 2.60	0.98	
Zn (213.857 nm)	≤ 1.50	0.22	
Pb (220.353 nm)	≤ 2.60	0.37	
Mn (257.610 nm)	≤ 1.50	0.27	
Al (396.152 nm)	≤ 1.50	0.25	
Ba (493.408 nm)	≤ 1.50	0.53	
K (766.491 nm)	≤ 1.50	0.15	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.81	
Se (196.026 nm)	≤ 1.50	0.65	
Zn (206.200 nm)	≤ 1.50	0.79	
Zn (213.857 nm)	≤ 1.50	0.81	
Cd (214.439 nm)	≤ 1.50	0.35	
Pb (220.353 nm)	≤ 1.50	0.33	
Mn (257.610 nm)	≤ 1.50	1.02	
Cr (267.716 nm)	≤ 1.50	0.32	
Cu (324.754 nm)	≤ 1.50	0.51	
Al (396.152 nm)	≤ 1.50	0.37	
Ba (493.408 nm)	≤ 1.50	0.68	
K (766.491 nm)	≤ 1.50	0.74	

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เอกสารไม่ควบคุม

Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9507	
Firmware Version	3442	
Tested By	Post Test_PM_Kanyakorn S.	
Test Completed On	11/4/2024 11:30:15 AM	
Result Summary		
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
Water Flow Test	Pass	
Gas Flows Test	Pass	
RF Generator Test	Pass	
Camera Test	Pass	
Optics Test	Skipped	
Advanced Valve System Test	Skipped	
Resolution Test	Skipped	
Sensitivity Test	Skipped	
Precision Test	Skipped	
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
30% Air Flow (relative speed)	75% Air Flow (relative speed)	
15.00	19.00	
Water Flow Test	Pass	
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.30	0.81	20.55

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เอกสารไม่ควบคุม

Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	154.65	2.00	2.00	110.92
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	115.38	18.00	17.97	21.48
RF Generator Test			Pass		
RF Power Supply Test	Passed				
RF Power Supply (V)	128.554				
RF Oscillator Test	Passed				
RF Oscillator Frequency (MHz)	25.834				
Work Coil Current (A)	44.660				
RF Power Supply Current (A)	1.999				
Camera Test			Pass		
	Integration Time (ms)	Standard Deviation	Status		
Electronic Offset Test	1000	5.228	Passed		
Dark Current Test	6000	1.168	Passed		
Array Test	5	0.024	Passed		
Linearity Test		0.118	Passed		

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เอกสารไม่ควบคุม

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	change mirror
Test Completed On	11/6/2024 10:35:26 AM
Result Summary	
Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

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เอกสารไม่ควบคุม

Resolution Test		
Pass		
Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.79
As (188.980 nm)	≤ 8.20	5.80
C (193.027 nm)	≤ 11.50	8.15
Mo (202.032 nm)	≤ 8.20	5.90
Cr (206.158 nm)	≤ 13.40	8.85
Zn (213.857 nm)	≤ 8.70	6.77
Pb (220.353 nm)	≤ 9.50	6.61
Co (228.615 nm)	≤ 17.20	11.79
Ba (230.424 nm)	≤ 9.40	7.25
Mn (257.610 nm)	≤ 13.30	9.47
Mn (260.568 nm)	≤ 20.30	14.50
Cr (267.716 nm)	≤ 11.00	7.91
Cu (324.754 nm)	≤ 25.00	18.72
Cu (327.395 nm)	≤ 14.20	11.09
Sr (338.071 nm)	≤ 33.50	25.39
Ba (455.403 nm)	≤ 44.00	33.09
Sr (460.793 nm)	≤ 36.00	18.54
Ba (493.408 nm)	≤ 36.00	25.74
Ba (614.171 nm)	≤ 42.00	25.23
Ar (675.283 nm)	≤ 74.00	58.92
K (766.491 nm)	≤ 80.00	63.16

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เอกสารไม่ควบคุม

Sensitivity Test					
Pass					
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	110.5	868.9	54.3
Se (196.026 nm)	≥ 41.0	SRBR	88.3	934.7	91.3
Zn (213.857 nm)	≥ 1421.0	SRBR	3535.4	44017.7	153.9
Pb (220.353 nm)	≥ 46.0	SRBR	184.5	2492.3	159.8
Mn (257.610 nm)	≥ 3518.0	SRBR	11099.6	249595.3	503.6
Al (396.152 nm)	≥ 3.4	SBR	8.7	50274.4	5172.0
Ba (493.408 nm)	≥ 34.0	SBR	124.5	1903164.1	15166.0
K (766.491 nm)	≥ 1.8	SBR	6.9	110041.4	13991.2
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	253.3	3744.3	196.3
Se (196.026 nm)	≥ 159.0	SRBR	206.7	4199.7	347.2
Zn (206.200 nm)	≥ 234.0	SRBR	923.0	12282.3	172.1
Zn (213.857 nm)	≥ 1743.0	SRBR	6398.3	157551.5	601.7
Cd (214.439 nm)	≥ 4227.0	SRBR	5069.2	99873.7	385.2
Pb (220.353 nm)	≥ 320.0	SRBR	389.0	10641.1	658.6
Mn (257.610 nm)	≥ 10625.0	SRBR	21190.4	985528.7	2153.6
Cr (267.716 nm)	≥ 1048.0	SRBR	3054.1	131797.6	1811.5
Cu (324.754 nm)	≥ 19.0	SBR	36.3	301401.4	8082.9
Al (396.152 nm)	≥ 6.0	SBR	10.8	228359.5	19280.5
Ba (493.408 nm)	≥ 60.0	SBR	106.5	6460421.5	60122.8
K (766.491 nm)	≥ 24.0	SBR	30.2	1639840.6	52562.1

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	1.56	
Se (196.026 nm)	≤ 2.60	1.16	
Zn (213.857 nm)	≤ 1.50	0.50	
Pb (220.353 nm)	≤ 2.60	0.74	
Mn (257.610 nm)	≤ 1.50	0.63	
Al (396.152 nm)	≤ 1.50	0.54	
Ba (493.408 nm)	≤ 1.50	0.78	
K (766.491 nm)	≤ 1.50	0.44	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.82	
Se (196.026 nm)	≤ 1.50	0.82	
Zn (206.200 nm)	≤ 1.50	0.35	
Zn (213.857 nm)	≤ 1.50	0.34	
Cd (214.439 nm)	≤ 1.50	0.44	
Pb (220.353 nm)	≤ 1.50	0.48	
Mn (257.610 nm)	≤ 1.50	0.83	
Cr (267.716 nm)	≤ 1.50	0.53	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.56	
Ba (493.408 nm)	≤ 1.50	1.29	
K (766.491 nm)	≤ 1.50	0.74	

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เอกสารไม่ควบคุม

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



CERTIFICATE OF CALIBRATION

Certificate No. : SP24-028

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : HITACHI

Model : U-5100

Serial No. : 23A4-008


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
Received Date : 10 September 2024

Calibration Date : 10 September 2024

Issue Date : 13 September 2024

Condition Instrument : Good

Calibrated by : 
(Mr.Tanawut Rittidach)
Technical Manager


Approved by : 
(Ms.Chonthicha 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 unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

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REPORT OF CALIBRATION

Certificate No. : SP24-028

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 : 5.0 nm.

Scan Speed of UUC : 40


Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.

Wavelength 0.1 nm.

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REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

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

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REPORT OF CALIBRATION

Certificate No. : SP24-028Page 4 of 5

Photometric Accuracy :

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

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REPORT OF CALIBRATION

Certificate No. : SP24-028Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration
- N/A = Not Available
- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%
- End of Certificate -

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FM-708-02 R01 1/11/2021

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

CERTIFICATE OF CALIBRATION

Certificate No. : SP25-001Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration : Laboratory 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009

ID No. : UAE.WAT.051/2564

Received Date : 3 January 2025

Calibration Date : 3 January 2025

Issue Date : 8 January 2025

Condition Instrument : Good

Calibrated by :

Mr.Tanawat Rittidach

Technical Manager

Approved by :

Ms.Chonthicha Sangnern

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.
The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written consent of DQE Services Co.,Ltd.เอกสารไม่ควบคุม
FM-708-02 R01 1/11/2021

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REPORT OF CALIBRATION

Certificate No. : SP25-001Page 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 : 200 nm/min

Scan Interval of UUC : 0.1 nm.


Resolution of UUC : Photometric 0.001 Abs.
Wavelength 0.1 nm.

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FM-708-02 R01 1/11/2021

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REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

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


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FM-708-02 R01 1/11/2021

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REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 4 of 5

Photometric Accuracy :

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


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FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.

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

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 ISO 9001:2015
 CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k ,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- End of Certificate -

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FM-708-02 R01 1/11/2021

Technology



Service Report

TO	FOR
Company: United Analyst and Engineering Consultant Co., Ltd. _ Bangkok-HQ Address: 700/2 หมู่ที่ 1 Phrakhanong District, Bangkok, 10260	Work Order Number: WO-00704079 Contact: Kamphong Boonpuang Email: kamphong.b@uaeconsultant.co.th Tel: +66 2763 2828 (7021), +66 8 6347 7390

WORK ORDER INFORMATION			
Top-Level		Order Type	Preventive Maintenance
Installed Product ID	IB-00105024	Billing Type	Chargeable
Product	SKALAR 2SAN59000 SAN++ Classic CFA 230V 2SAN59000	PO No.	HPO-250400209
Serial No.	182688	Warranty No.	
		Contract No.	

PRODUCTS SERVICED		
Installed Product Id	Serial Number	Product
IB-00105024	182688	SKALAR 2SAN59000 SAN++ Classic CFA 230V 2SAN59000

PROBLEM DESCRIPTION	
PM 1 ครั้ง/ปี **ใบเสนอราคาเลขที่ Q-120095	

Line Number	Engineer	Start Date And Time	End Date And Time	Billable Labor Hour	Billable Travel Hour	Travel KM
WL-00342192	Yongyuth Chanphong	05/23/2025 9:30 AM	05/23/2025 6:00 PM	8.5		
Total				8.5	0	0

! Reach us at DKSH Service-Hotline : +66 2 639 7000
2533 Sukhumvit Road, Bangkok, 10260, Phrakhanong, Bangkok, Thailand
Phone +66 2 639 7000 Fax +66 2 333 1026

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Page 1 of 2



Line Number	Work Description		
WL-00342192	- ฟ้า PM เสร็จแล้ว, เครื่องพร้อมใช้งาน		
PARTS CONSUMED			
Part No	Part Description		Quantity
EXPENSES			
Part No	Expense Type	Description	Line Quantity
RECOMMENDED PARTS			
อะไหล่สำรองที่ควรสั่งซื้อทั้งหมด 7 รายการ คือ Pump tube 3 รายการ (SA3028, SA3032 และ SA3034), หลอดไฟ Halogen 6V/10W (90020012) 1 รายการ จำนวน 2 หลอด, Tubing polyethylene 3 รายการ (SA3142, SA5141 และ SA5142)			
REMARKS			

Travel Time Disclaimer:
Please note that the travel time in this report only includes time taken to reach the installed equipment location. It does not include our engineer's return travel time.

Customer Signature: _____

Technician: Yongyuth Chanphong
Job Title: Service Manager
Email: yongyuth.yc@dksh.com

Customer Signature _____

Date: 06/06/2025



Item	Characteristic	Before	After	Remark
14	Base Line Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A	
15	Detector Signal Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A	

Summary of checked

- ☐ The instrument can work normally and efficiently. (เครื่องมือวัดสามารถทำงานได้ปกติและมีประสิทธิภาพ)
- ☐ The instrument can work but it's requiring to maintenance. (เครื่องมือวัดสามารถทำงานได้แต่ต้องบำรุงรักษา)
- ☐ The instrument could not work it's requiring to repair. (เครื่องมือวัดไม่สามารถทำงานได้ต้องทำการซ่อมบำรุง)

Remark : _____

* Pump tube, Tubing polyethylene และ Air tube เป็นอะไหล่ที่ควรสั่งซื้อทั้งหมด 7 รายการ ดังนี้

1. อะไหล่ สารเคมีของ Ammonia จำนวน 3 รายการ (SA3032, SA5141 และ 90020012)
2. อะไหล่ สารเคมีของ Phenol และ Cyanide จำนวน 6 รายการ (SA3028, SA3034, SA3142, SA5142 และ 90020012)

Equipment	Equipment I.D.
Digital multi meter	S/N 57600592 Due date : 19-Jun-2025
Thermo hygrometer	S/N 39520444/904 Due date : 27-Dec-2025

Test By : _____ Approved by : _____

(Mr. Yongyuth Chanphong) (Mr. Eknasong Wankiang)

Position : _____ Supervisor, Technical Service Position : _____ Manager, Technical Services



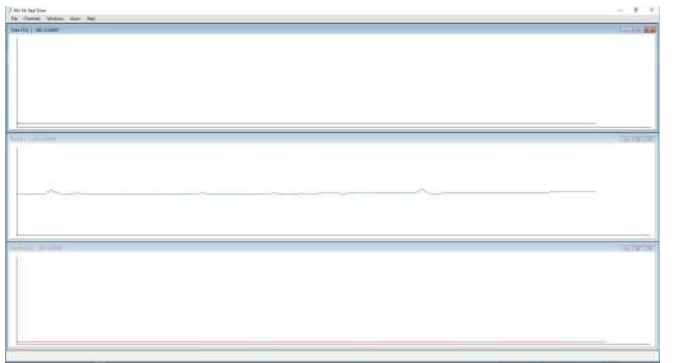
Job No. WO-00074079			
Test Report			
Customers	United Analyst and Engineering Consultant Co., Ltd.		
Equipment	Continuous Flow Analyzer	Manufacturer	SKALAR
Controller Mdel	SA5000	Auto Sample Model	SA1052
Controller Serial No.	182688	Auto Sample Serial No.	181729
Date of test	23-May-2025	Period	12 Month
Environment temperature	24.3 °C	Humidity	54.4 %RH

Instrument Checked		Results					
Item	Characteristic	Before		After		Remark	
1	Visual inspect	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
2	Power supply (210 - 240 VAC)	220	VAC	220	VAC		
3	Computer	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
4	Program	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
5	Auto sampler	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
6	Module holder						
	- Motor pump	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
	- Pump tube	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	*	
	- Air-injection	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	*	
	- Chemistry manifolds, Switching valve, Coil, Membrane	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
7	Detector						
	- Filter	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
	- Flow cell	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
	- Lamp	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
8	Interface	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail		
9	Rinsing valves	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
10	Temperature / Reactor	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
11	Flame photometer	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
12	UPS / Stabilizer	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A

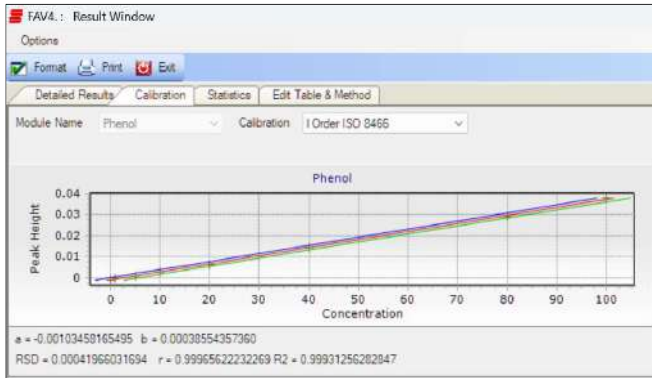
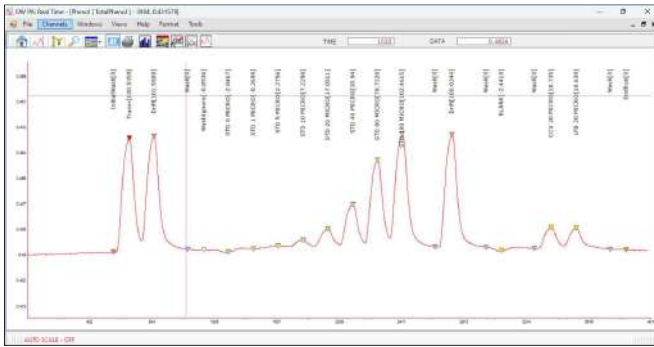
Warning and Error Checked		Before	After
Item	Event	<input type="checkbox"/> None <input type="checkbox"/> Appear : _____	<input type="checkbox"/> None <input type="checkbox"/> Appear : _____
13	Error list		



Base Line Test : Reagent_Baseline_CN_Phenol_NH3



Detector Signal Test : Phenol



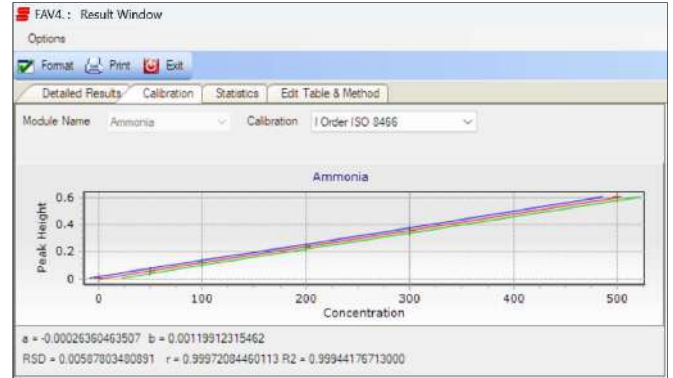
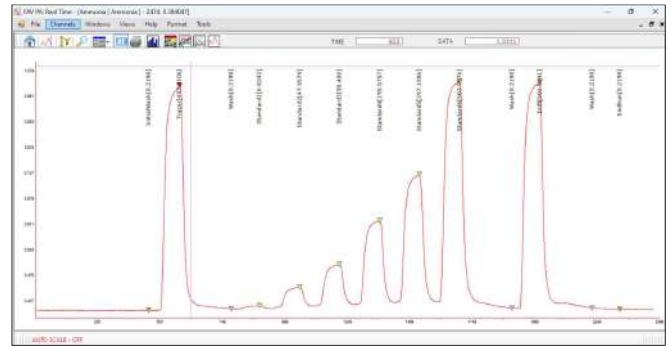
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Detector Signal Test : NH3



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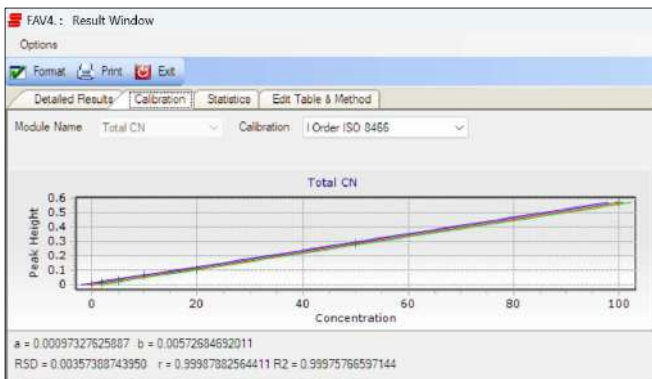
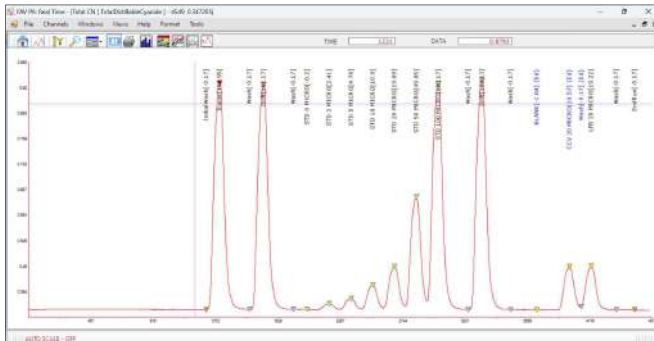
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Technology



Detector Signal Test : CN



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