ภาคผนวก ฎ

เอกสารเทียบเครื่องมือ

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Tisch Environmental,Inc.	TE-5025A 3393	Jiranatee Associates Co., Ltd.	CL-004-65	26 Jul 22	25 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1401	9 May 23	8 May 24	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1860	2 Jun 23	1 Jun 24	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1201	5 Jun 23	5 Jun 24	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM08130002	UAE Consultant Co.,Ltd.	11012023	11 Mar 23	10 Jan 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050148	UAE Consultant Co.,Ltd.	15022023	15 Feb 23	14 Feb 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050149	UAE Consultant Co.,Ltd.	09012023	9 Jan 23	8 Jan 24	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050150	UAE Consultant Co.,Ltd.	16012023	16 Jan 23	15 Jan 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 43C-65007-345	UAE Consultant Co.,Ltd.	07032023	7 Mar 23	6 Mar 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 0517512002	UAE Consultant Co.,Ltd.	04042023	4 Apr 23	3 Apr 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 0517512003	UAE Consultant Co.,Ltd.	19042023	19 Apr 23	18 Apr 24	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387061	UAE Consultant Co.,Ltd.	17012023	17 Jan 23	16 Jan 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
13	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
14	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Larson Davis	CAL150 6855	Innovative Instrument Co.,Ltd.	23-ACT-068	12 May 23	11 May 24	-
15	Sound Level Meter	$L_{Aeq\ 24\ hours}$, L_{Amax}	Larson Davis	LxT2 0005286	Sithiporn Associates Co., Ltd.	ACL22081	25 Jan 22	24 Jan 24	-
16	Sound Level Meter	$L_{Aeq\ 24\ hours}$, L_{Amax}	Larson Davis	LxT2 0005289	Sithiporn Associates Co., Ltd.	ACL22082	26 Jan 22	25 Jan 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate	Apex Instruments, USA.	XC-572-V 1701019	Envi Equipment Service Co., Ltd.	E23-04044	25 Apr 23	24 Apr 24	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide	Testo	Testo 350 60899456	Entech Industrial Sulution Co., Ltd.	G 660139	9 Mar 23	8 Mar 24	-

List of Opacity Training Certification for Opacity Mesurement

No.	Name	Training Couse	Train	Date	Remark
1	Mr.Nattawat Dangsawat	Opacity	Pollution Control Department	20 December 2006	-
2	Mr.Noppasin Thanuthammarat	Opacity	Pollution Control Department	30-31 March 2017	-

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	Horiba	LAQUA-PH210 HA0E0006	Technology Promotion Association (Thailand-Japan)	23CH99	23 Jan 23	22 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0H0003	Technology Promotion Association (Thailand-Japan)	23TW1	5 Jan 23	4 Jan 24	-
3	Conductivity Meter	Conductivity	Horiba	LAQUA-PH210 HC9L0014	Technology Promotion Association (Thailand-Japan)	23CH427	28 Mar 23	29 Mar 24	-

JIRANATEE ASSOCIATES CO.,LTD.

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

Flow measurement laboratory
Calibration services department.

Jiranatee Associates Co.,Ltd
69/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watchapra, Bangkokyai,
Bangkok 10600(Thailand)
Tel: +6628683012
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No. : CL-004-65

MEASUREMENT ITEM	: Top Load Orifice
MANUFACTURER	: Tisch Environmental, Inc.
MODEL/TYPE	: TE-5025A
SERIAL NUMBER	: 3393
ID NUMBER	: UAE.EFM.064/2560
CONDITION AS-RECEIVED	: Used Item
CUSTOMER	: United Analyst and Engineering Consultant Co.,Ltd. 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
RECEIVED DATE	: 15 Jul 2022
MEASUREMENT DATE	: 25 Jul 2022
ISSUE DATE	: 26 Jul 2022

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 24.7 °C and 52.1 %RH.

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

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/DMC/W2-dp. The WI-CL-004 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognize the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: 02211901

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.Soranet 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[illegible] IS OBTAINED IN WRITING FROM THE LABORATORY

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JIRANATEE ASSOCIATES CO.,LTD.

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH_2O	Y	Standard Flow $[Q_s]$ m^3/min
1	0.699	756.468	24.680	23.730	55.667	1.705	1.303	0.647
2	1.001	756.479	24.910	24.180	61.363	3.454	1.855	0.918
3	1.114	756.494	24.550	23.970	41.751	4.535	2.126	1.051
4	1.166	756.510	24.470	23.900	30.652	5.138	2.264	1.118
5	1.416	756.534	24.400	24.150	30.200	7.619	2.757	1.357

Slope (m): 2.04689
Intercept (b): -0.02301
Correlation coefficient (r): 0.99987
Uncertainty (z=2): 0.010 m^3/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH_2O	Y	Standard Flow $[Q_s]$ m^3/min
1	0.699	756.468	24.680	23.730	55.667	1.705	0.819	0.649
2	1.001	756.479	24.910	24.180	61.363	3.454	1.167	0.922
3	1.114	756.494	24.550	23.970	41.751	4.535	1.336	1.054
4	1.166	756.510	24.470	23.900	30.652	5.138	1.422	1.121
5	1.416	756.534	24.400	24.150	30.200	7.619	1.731	1.360

Slope (m): 1.28208
Intercept (b): -0.01449
Correlation coefficient (r): 0.99987
Uncertainty (z = 2): 0.011 m^3/min

End of Certificate of Calibration

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

Certificate of Calibration

Certificate No. : 23P1401
Page : 1 of 2

Equipment :	U-Tube Manometer
Manufacturer:	Dwyer
Model :	1221-36-W/M
Serial No.:	-
ID No.:	UAE.EFM.022/2560
Condition As-Received:	Used Item
Received Date:	26 April 2023
Calibration Date:	09 May 2023
Reference:	2304-0703WSC
Ambient Temperature:	(23 ± 2) °C
Relative Humidity:	(50 ± 15) %
Atmospheric Pressure:	1010 mbar

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

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using " DKD-R 6-1 : Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC10BP	1189	MP-0137-22	24 Aug 2023

2.This result of calibration was made on requested at the point specified by customer.
3.Scale and conversion factor is 1 kPa = 4.0146293 inH2O
4.This instrument was used clean air and oil 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 (NIMT)

Calibrated by : Suwit Aussaree
Issue Date : 11 May 2023

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

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B 0314241

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

Range : 0 inH_2O to 36 inH_2O
Scale Interval : 0.1 inH_2O(The Fifth Estimate)

Applied Pressure (inH_2O)	UUC Indication High-port side (inH_2O)	Low-port side (inH_2O)	ΔP (inH_2O)	Error (inH_2O)
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.98	1.98	-0.02
4.00	2.00	-1.98	3.98	-0.02
6.00	3.00	-2.98	5.98	-0.02
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.00	-6.00	12.00	0.00
14.00	7.00	-7.00	14.00	0.00
16.00	8.00	-8.00	16.00	0.00
18.00	9.00	-9.00	18.00	0.00
20.00	10.00	-10.00	20.00	0.00
22.00	11.00	-11.00	22.00	0.00
24.00	12.02	-12.00	24.02	0.02
26.00	13.02	-13.00	26.02	0.02
28.00	14.02	-14.00	28.02	0.02
30.00	15.04	-15.00	30.04	0.04
32.00	16.04	-16.00	32.04	0.04
34.00	17.02	-17.00	34.02	0.02
35.80	18.00	-17.96	35.96	0.16

The uncertainty of measurement was ± 0.11 inH_2O
* UUC = Unit Under Calibration
* ΔP = High-port side - Low-port side
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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Attapol P.

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a 1160340

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

Certificate of Calibration

Certificate No. : 23P1860
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.ANV.153/2550
Condition As-Received: Used Item
Received Date: 26 May 2023
Calibration Date: 02 June 2023

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.

Reference: 2305-0919WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1006 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

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

Calibrated by : Suksan Khankaew
Issue Date : 08 June 2023

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

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B 0316960

Result of calibration:- Without adjustment
Function:- Absolute Pressure Measurement
Range : 960 hPa to 1030 hPa
Scale Interval : 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	963.65	975.02	984.39	993.78	1002.66	1011.75	1020.25	1030.28
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	-3.65	-5.02	-4.39	-3.78	-2.66	-1.75	-0.25	-0.28

Decreasing Pressure

Applied Pressure (hPa)	1030.28	1020.59	1012.07	1002.79	993.81	984.44	975.05	964.28
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-0.28	-0.59	-2.07	-2.79	-3.81	-4.44	-5.05	-4.28

The uncertainty of measurement was ± 0.30 hPa
* UUC = Unit Under Calibration
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 %.

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Attapol P.
เอกสารไม่ควบคุม
a 1165503

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

Certificate of Calibration

Certificate No. : 23H1201
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.EMA2.014/2555
Condition As-Received: Used Item
Received Date: 26 May 2023
Calibration Date: 30 May 2023 to 06 June 2023

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.

Reference: 2305-0919WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23I305	15 Mar 2024

2.The certificate is valid only to the item calibrated on date and place of calibration.
3.This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Standards and Technology (NIST) , The United States of America
-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Somchai Dumwor
Issue Date : 07 June 2023

Approved Signatory :
[✓] Chakrit Waowwanjua
[ ] Pornthipa Tamsyakul
[ ] Viporn Tantiyawutti

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B 0316275

Result of Calibration:- Before Adjustment
Function: Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	55	14.9	1.6
25.0	60.0	66	6.0	1.7
25.0	80.0	78	-2.0	1.9

Result of Calibration:- After Adjustment
Function: Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	46	5.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	72	-8.0	1.9

Result of Calibration:- Without Adjustment
Function: Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.0	-0.944	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 : Jan 11,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM08130002

Standard Gas Concentration

Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 21,2024	

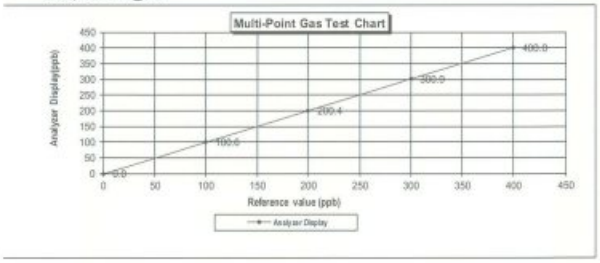
Dilutor Detail

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

Multi-point gas test data

		Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.6	0.60	0.60	0.60
Level 3	40.00%	200.0	200.4	0.40	0.20	0.20
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.22

:Acceptable Limit ± 5%



Calculate by Sirichai Gamgai 17 / 1 / 66

Approve by Peerawat W. 17 / Jan / 2023

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

MULTI-POINT GAS TEST REPORT

Test Date : Feb 15,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM19050148

Standard Gas Concentration

Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 21,2024	

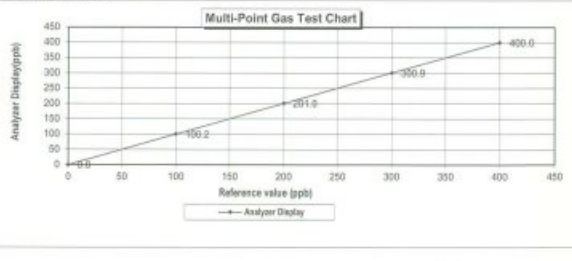
Dilutor Detail

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

Multi-point gas test data

		Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.2	0.20	0.20	0.20
Level 3	40.00%	200.0	201.0	1.00	0.50	0.50
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.20

:Acceptable Limit ± 5%



Calculate by Sirichai Gamgai 15 / 2 / 66

Approve by Peerawat W. 15 / Feb / 2023

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

MULTI-POINT GAS TEST REPORT

Test Date : Jan 9,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM19050149

Standard Gas Concentration

Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 21,2024	

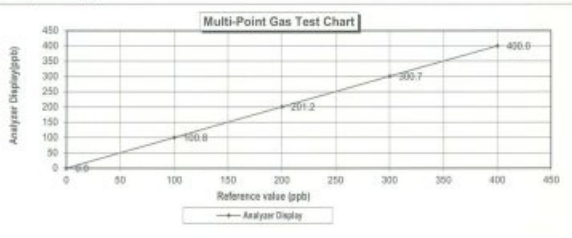
Dilutor Detail

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

Multi-point gas test data

		Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79	0.79
Level 3	40.00%	200.0	201.2	1.20	0.60	0.60
Level 4	60.00%	300.0	300.7	0.70	0.23	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.32

:Acceptable Limit ± 5%



Calculate by Sirichai Gamgai 9 / 1 / 66

Approve by Peerawat W. 9 / Jan / 2023

เอกสารไม่ควบคุม

Airgas

Airgas SpecGas Owens
Airgas USA, LLC
[illegible]
Durham, NC 27713
[illegible]

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	[illegible]	Batch ware Number:	122-402185187-1
Cylinder Number:	EB0143262	Cylinder Volume:	144.4 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number:	B22021	Valve Outlet:	330
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jun 21, 2021

Expiration Date: Jun 21, 2024

[illegible] Do Not Use This Cylinder Below 150 PSIG [illegible] 32 Pages Book

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.02 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	05/14/2021, 05/21/2021
NITRIC OXIDE	45.00 PPM	45.84 PPM	G1	+/- 1.4% NIST Traceable	05/14/2021, 05/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.4% NIST Traceable	05/14/2021, 05/21/2021
CARBON MONOXIDE	1005 PPM	938.6 PPM	G1	+/- 1.4% NIST Traceable	05/21/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	[illegible]	[illegible]	45.02 PPM NITROGEN MONOXIDE/NITROGEN	+/- 1.0%	Feb 08, 2024
PRM	[illegible]	[illegible]	9.07 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 27, 2020
[illegible]	[illegible]	[illegible]	4.5[illegible] PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.[illegible]	Feb [illegible], 2023
NTRM	[illegible]	[illegible]	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun [illegible], 2021
NTRM	[illegible]	[illegible]	[illegible] PPM CARBON MONOXIDE/NITROGEN	+/- 0.8%	Nov [illegible], 2023

[illegible] The EPA Protocol gas mixtures listed above are prepared gravimetrically in accordance with the EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards, May 2012, EPA-600/R-12/531. Mixtures are analyzed using a direct comparison to a NIST traceable standard reference material (SRM) or NIST traceable gas manufacturer's Primary Reference Material (PRM) following the analytical procedure G1. All components listed are certified. Uncertainties are calculated using the root mean square method. The assay procedure has been approved by the EPA. Where applicable, results of replicate analyses are listed below. Additional information may be requested and will be supplied by your Airgas representative.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 S4RU81020 CC	FTIR	Jun 03, 2021
Nicolet 6700 A 1R0801835 N2	FTIR	Jun 01, 2021
Nicolet 6700 A 1R0801825 N2	FTIR	Jun 09, 2021
Nicolet 6700 A4Ru81020 SU2	FTIR	Jun 01, 2021

Triad Data Available Upon Request

NOTES: [illegible] 4592[illegible]937

Cylinder Wt: 26.40kg

NET Wt: 4.7kg

This analytical test result reported on this certificate relates only to the cylinder number specified above. This certificate shall not be reproduced except in full, without written approval of the laboratory.

Approved for Release

ACCREDITED

CERT [illegible]

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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.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Mar 7,2023

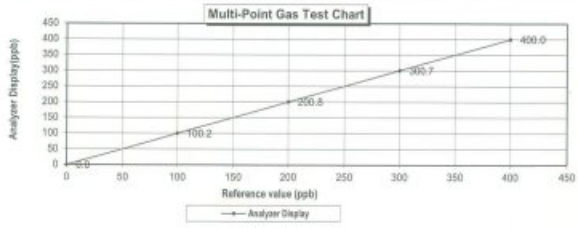
Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	CM22387062

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 24,2024			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.2	0.20	0.20	0.20
Level 3	40.00%	200.0	200.8	0.80	0.40	0.40
Level 4	60.00%	300.0	300.7	0.70	0.23	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.17

:Acceptable Limit ± 5%



Calculate by
Aphiwat K.
2 / 3 / 66

Approve by
7 / Mar / 2023

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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.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Mar 7,2023

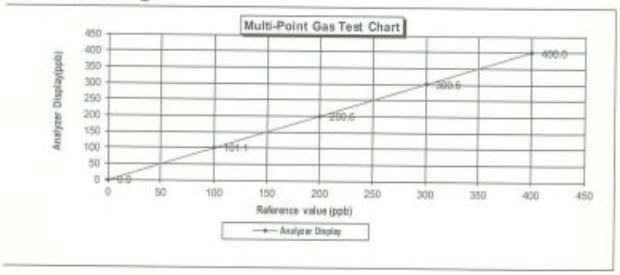
Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1200906874

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 24,2024			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.1	1.10	1.09	1.09
Level 3	40.00%	200.0	200.6	0.60	0.30	0.30
Level 4	60.00%	300.0	300.5	0.50	0.17	0.17
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.31

:Acceptable Limit ± 5%



Calculate by
Sirichai Gomgai
2 / 3 / 66

Approve by
7 / Mar / 2023

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United Analyst and Engineering Consultant Co., Ltd.
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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Apr 4,2023

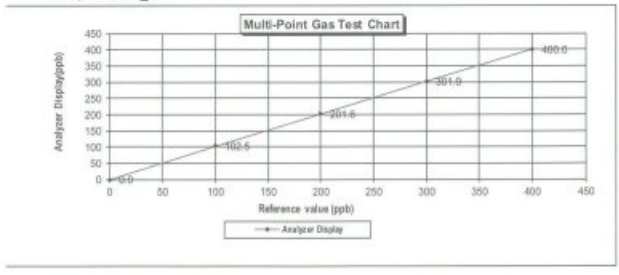
Equipment :	Gas Analyzer (SO_2)	**Model :**	43C
Manufacturer :	Thermo Electron Corporation	**Serial Number :**	0517512002

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 24,2024			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	102.5	2.50	2.44	2.44
Level 3	40.00%	200.0	201.6	1.60	0.79	0.79
Level 4	60.00%	300.0	301.9	1.90	0.63	0.63
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.77

:Acceptable Limit ± 5%



Calculate by
Aphiwat K.
4 / 4 / 66

Approve by
4 / Apr / 2023

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3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Jan 17,2023

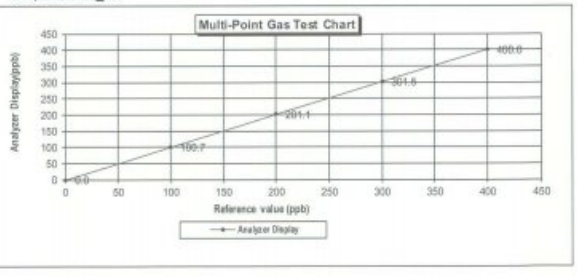
Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	CM22387061

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 24,2024			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70	0.70
Level 3	40.00%	200.0	201.1	1.10	0.55	0.55
Level 4	60.00%	300.0	301.5	1.50	0.50	0.50
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.35

:Acceptable Limit ± 5%



Calculate by
Sirichai Gomgai
17 / 1 / 66

Approve by
17 / Jan / 2023

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Airgas

Airgas Specialty Gases
Airgas USA, LLC
[illegible]
Jackson, NJ 07719
[illegible]

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	[illegible]	Reference Number:	127-402135-67-1
Cylinder Number:	EB0143252	Cylinder Volume:	144.4 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2318 PSIG
PGVP Number:	B22021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jun 21, 2021

Expiration Date: Jun 21, 2024

[illegible]

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	48.00 PPM	46.86 PPM	G1	+/- 1.48% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN DIOXIDE	48.00 PPM	46.86 PPM	G1	+/- 1.48% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN MONOXIDE	1020 PPM	994.0 PPM	G1	+/- 0.79% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	23061701	CC478026	48.32 PPM NITROGEN DIOXIDE/AIR	+/- 1.1%	Feb 15, 2025
PRM	19316	3695026	999 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 23, 2026
GMIS	4514239-101	CC473681	4,945 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 15, 2022
NTRM	[illegible]1043	CC413247	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2025
NTRM	14060710	CC514277	5011 PPM CARBON MONOXIDE/NITROGEN	+/- 0.8%	Nov 16, 2025

[illegible]

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Model 5[illegible] AHRIain 331 SO	FTIR	Jun 01, 2021
Model 4[illegible] 383 NO	FTIR	Jun 01, 2021
Model 4[illegible] 383 NO2	FTIR	Jun 08, 2021
Model 4[illegible]	FTIR	Jun 08, 2021

Triad Data Available Upon Request

NOTES:[illegible]

GROSS WT: 28.70kg

NET WT: 6.32kg

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

Approved for Release

ACCREDITED
CERT 3002.01

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5960-1 FAX: 0660-2116-7140

INNOVATIVE

ANAB ACCREDITED CALIBRATION LABORATORY AC-2961

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Certificate No : 23-ACT-068

Request No : Req-2023-0981

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

Unit Under Calibration Details

Measurement item : Acoustic Calibrator — Class : 2

Manufacturer : LARSON DAVIS — Range : 94 , 114 dB / 1000 Hz

Model : CAL150 — Instrument Status : Used

Serial Number : 6855

ID : UAE.EFM.046/2566

Calibration Environment and Details

Temperature : (23 ±2 °C)

Humidity : (50 ± 20 %RH)

Barometric Pressure : (1013 ±10.0 hPa)

Received Date : 9 May 2023

Calibration Date : 12 May 2023

Location of Calibration : LAB 1 Acoustic

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	31 May 2023
THD Multimeter	2015	1047765	NIMT	31 January 2024

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

Note

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

Calibrated By : Mr. Noppadon Luangart, Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn, Calibration Engineer Supervisor

Issue Date : 12 May 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the laboratory. [illegible]
FM-[illegible]
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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5960-1 FAX: 0660-2116-7140

Certificate No : 23-ACT-068

Request No : Req-2023-0981

Sound pressure level — **Calibration Results :** Without Adjustment

Calibration Range (dB)	Without Adjustment (dB) Measured	Without Adjustment (dB) Error	Adjustment (dB) Measured	Adjustment (dB) Error	Uncertainty (± dB)	Acceptance limit Class 2 (± dB)
94 dB / 1000 Hz	93.82	-0.18	-	-	0.13	0.40
114 dB / 1000 Hz	113.84	-0.16	-	-	0.13	0.40

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment Measured (Hz)	Without Adjustment Error (%)	Adjustment Measured (Hz)	Adjustment Error (%)	Uncertainty (± %)	Acceptance limit Class 2 (± %)
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7

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

Calibration Range (Hz)	Without Adjustment Measured (%)	Adjustment Measured (%)	Uncertainty (± %)	Acceptance limit Class 2 (± %)
94 dB / 1000 Hz	0.09	-	0.40	3.0
114 dB / 1000 Hz	0.24	-	0.40	3.0

Note :

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

End of Calibration

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the laboratory. [illegible]
FM-[illegible]
เอกสารไม่ควบคุม

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TISI-TIS 17025 CALIBRATION 0394

Cert. No. : ACL22081

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER

Manufacturer : LARSON DAVIS

Model : LxT2/ Microphone 375B02 / Preamplifier PRML x T2B

Serial No.: 0005286 / 011740 / 056087

ID No.: -

Condition As Found : GOOD

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK SUB-DISTRICT,
PHRAKHANONG DISTRICT, BANGKOK 10260
THAILAND.

Location : -

Ambient Temperature : (23.0 ± 3) °C

Pressure : (101.3 ± 3) kPa

Relative Humidity : (50.0 ± 20) %

Received Date : 18 JANUARY 2022

Calibration Date : 26 JANUARY 2022

Date of Issue : 28 JANUARY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : (Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

เอกสารไม่ควบคุม

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

เอกสารไม่ควบคุม

SITHIPORN associates SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	✓	-	0.3	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

เอกสารไม่ควบคุม

SITHIPORN associates SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.96)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
31.0

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	30.8
C - weight	30.6
Flat	36.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	0.1	0.0	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	3.1	3.2	3.2	±5.0

เอกสารไม่ควบคุม

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CALIBRATION LABORATORY

Continuation of Calibration Certificate

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0
16000	-0.1	0.0	0.1	±5.0-(-∞)

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

เอกสารไม่ควบคุม

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.1	0.1	± 1.1
132.0	132.1	0.1	± 1.1
131.0	131.1	0.1	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.1	0.1	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.1	0.1	± 1.1
44.0	44.2	0.2	± 1.1
39.0	39.6	0.6	± 1.1

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
140	94.0	94.0	0.0	±0.5

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.8	-0.2	1.5 ; -5.0
	2	8	117.0	116.7	-0.3	1.0 ; -2.5
	200	800	134.0	133.9	-0.1	±1.0
Slow	2	8	108.0	107.8	-0.2	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	N/A	N/A	N/A	1.5 ; -5.0
	2	8	N/A	N/A	N/A	1.0 ; -2.5
	200	800	N/A	N/A	N/A	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.7	-0.7	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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Continuation of Calibration Certificate

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.2	89.4	0.2	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

End of Calibration Certificate

เอกสารไม่ควบคุม

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TISI-TIS 17025 CALIBRATION 0394

Calibration Certificate

Equipment :	SOUND LEVEL METER
Manufacturer :	LARSON DAVIS
Model :	LxT2/ Microphone 375B02 / Preamplifier PRML x T2B
Serial No.:	0005289 / 011732 / 056076
ID No.:	-
Condition As Found :	GOOD
Customer :	UNITED ANALYST AND ENGINEERING CONSULTANT (UAE) 81 SOI UDOMSUK 41, SUKHUMVIT ROAD, BANGCHAK SUB-DISTRICT, PHRAKHANONG DISTRICT, BANGKOK 10260 THAILAND.
Location :	-
Ambient Temperature :	(23.0 ± 3) °C
Pressure :	(101.3 ± 3) kPa
Relative Humidity :	(50.0 ± 20) %
Received Date :	18 JANUARY 2022
Calibration Date :	26 JANUARY 2022
Date of Issue :	28 JANUARY 2022
Calibrated by :	Nathakorn Pisutpaisan
Approved by :	(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

เอกสารไม่ควบคุม

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

เอกสารไม่ควบคุม

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Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	✓	-	0.3	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

เอกสารไม่ควบคุม

QF-TS12-04-04-020664

SITHIPORN associates SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.96)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
29.6

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	29.4
C - weight	29.1
Flat	34.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	0.2	0.2	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	2.6	2.6	2.6	±5.0

เอกสารไม่ควบคุม

QF-TS12-04-04-020664

SITHIPORN associates SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	-0.1	0.0	±3.0
8000	0.0	0.1	0.0	±5.0
16000	-0.1	0.1	0.1	±5.0-(-∞)

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

เอกสารไม่ควบคุม

QF-TS12-04-04-020664

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1

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Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
140	94.0	94.0	0.0	±0.5

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.8	-0.2	1.5 ; -5.0
	2	8	117.0	116.7	-0.3	1.0 ; -2.5
	200	800	134.0	133.9	-0.1	±1.0
Slow	2	8	108.0	107.8	-0.2	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	N/A	N/A	N/A	1.5 ; -5.0
	2	8	N/A	N/A	N/A	1.0 ; -2.5
	200	800	N/A	N/A	N/A	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.4	0.0	±2.0
Negative half cycle	135.4	135.4	0.0	±2.0

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CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.2	89.4	0.2	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

End of Calibration Certificate

เอกสารไม่ควบคุม

EES

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

Certificate No. : E23-04044
Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer	:	United Analyst and Engineering Consultant Co., Ltd.
Address	:	81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment	:	Console meter
Manufacturer	:	Apex Instrument
Model Number	:	XC-572-V
Serial Number	:	1701019
ID./Control No.	:	-
Environment Conditions	:	Temperature (25 ± 2) °C
	:	Humidity (50 ± 15) % RH
Cal. Date	:	25/04/2023
Issue Date	:	25/04/2023

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

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

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

Calibrated by : Mr. Sanya Sangnil

Approved by :
(Mr. Mana Fuekhud)
Technical Manger

เอกสารไม่ควบคุม

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

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701019
DGM Model Number	SK25EX
DGM Serial Number	00002028

Calibration Conditions			
Date	Time	25/04/2023	10:00 AM
Calibration Reference No.		SER23-04016	
Barometric Pressure		757.49	mmHg
Calibration Meter Gamma		0.999	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K_1	0.386	
Console Leak Check	PASS	

Calibration Data

Run Time	Metering Console					Calibration Meter			
Elapsed	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(Q)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})	(Vwi)	(Vwf)	(t_{wi})	(t_{wf})
min	mm H_2O	m^3	m^3	°C	°C	m^3	m^3	°C	°C
12.17	13.0	2094.611	2094.751	34	34	136.89522	137.03608	30	30
12.15	13.0	2094.751	2094.891	34	34	137.03608	137.17600	30	30
8.50	26.0	2094.897	2095.037	35	35	137.18408	137.32456	29	29
8.47	26.0	2095.037	2095.177	35	35	137.32456	137.46414	29	29
13.80	40.0	2095.183	2095.463	36	36	137.47002	137.74746	29	29
13.72	40.0	2095.463	2095.743	36	36	137.74746	138.02270	29	29
10.32	70.0	2095.752	2096.032	36	36	138.03154	138.30536	28	28
10.30	70.0	2096.032	2096.312	37	37	138.30536	138.57884	28	28
9.00	90.0	2096.324	2096.604	37	37	138.58928	138.86564	28	28
8.98	90.0	2096.604	2096.884	37	37	138.86564	139.14072	27	27

เอกสารไม่ควบคุม

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

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701019
DGM Model Number	SK25EX
DGM Serial Number	00002028

Calibration Conditions			
Date	Time	25/04/2023	10:00 AM
Calibration Reference No.		SER23-04016	
Barometric Pressure		757.49	mmHg
Calibration Meter Gamma		0.999	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K_1	0.386	
Console Leak Check	PASS	

Calibration Data

Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate		
Dry Gas Meter		Calibration Meter		Value	Variation	Std & Corr	.0212 m^3/min	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vw_{(std)}$)	($Qw_{(std)}$)	(Y)	(△Y)	($Q_{m(std)corr}$)	(△$H_@$)	(△$H_@$)
m^3	m^3/min	m^3	m^3/min			m^3/min	mm H_2O	
0.135	0.011	0.136	0.011	1.004	0.019	0.011	45.580	-0.318
0.135	0.011	0.135	0.011	0.997	0.012	0.011	46.068	0.170
0.136	0.016	0.136	0.016	1.000	0.015	0.016	44.700	-1.199
0.136	0.016	0.135	0.016	0.993	0.009	0.016	44.924	-0.975
0.272	0.020	0.268	0.019	0.986	0.001	0.019	46.600	0.701
0.272	0.020	0.266	0.019	0.978	-0.007	0.019	46.777	0.879
0.274	0.027	0.265	0.026	0.970	-0.015	0.026	46.906	1.007
0.274	0.027	0.265	0.026	0.969	-0.016	0.026	46.870	0.972
0.274	0.030	0.268	0.030	0.977	-0.007	0.030	45.230	-0.669
0.275	0.031	0.268	0.030	0.973	-0.012	0.030	45.332	-0.567
				0.985	Y Average		45.899	△H@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For △$H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H_2O.

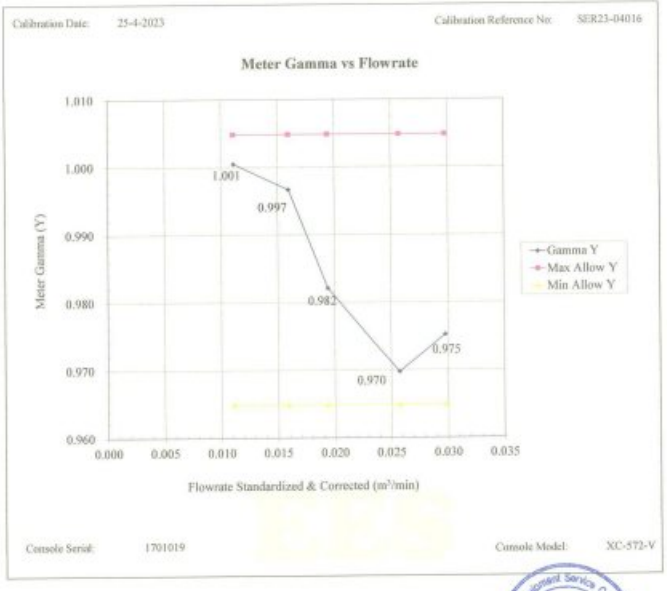
เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701019
DGM Model Number	SK25EX
DGM Serial Number	00002028

Calibration Conditions			
Date	Time	25/04/2023	10:00 AM
Calibration Reference No.		SER23-04016	
Barometric Pressure		757.49	mmHg
Calibration Meter Gamma		0.999	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K_1	0.386	
Console Leak Check	PASS	

Calibration Date: 25-4-2023 Calibration Reference No: SER23-04016



Console Serial: 1701019 Console Model: XC-572-V

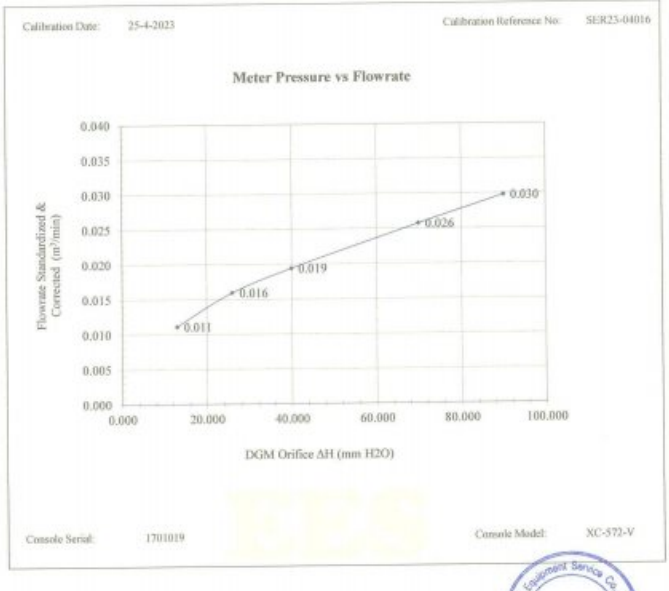
เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701019
DGM Model Number	SK25EX
DGM Serial Number	00002028

Calibration Conditions			
Date	Time	25/04/2023	10:00 AM
Calibration Reference No.		SER23-04016	
Barometric Pressure		757.49	mmHg
Calibration Meter Gamma		0.999	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K_1	0.386	
Console Leak Check	PASS	

Calibration Date: 25-4-2023 Calibration Reference No: SER23-04016



Console Serial: 1701019 Console Model: XC-572-V

เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	1701019
DGM Model Number	SK25EX
DGM Serial Number	00002028
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 19031

Calibration Conditions		
Date	Time	25/04/2023 12:00 PM
Calibration Reference No.		SER23-04016
Reference Thermometer		DIGICON
Serial Number		183169105

Results

Console Thermocouple Simulator

Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-19.0	23.0	36.0	92.0	149.0	259.0	373.0	484.0	596.0	820.0	1044.0
Aux	-19.0	23.0	36.0	92.0	149.0						
Probe	-19.0	23.0	36.0	92.0	149.0						
Filter	-18.0	23.0	36.0	93.0	149.0						
Oven	-19.0	23.0	36.0	93.0	149.0						
Exit	-18.0	23.0	36.0								

Tolerance Range

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

EES Environmental Service Co., Ltd.

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Calibration Certificate

Certificate No: G 660139
Date of issue : 14-Mar-23

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 60899456
ID no. or control no. : UAE.EFM.005/2560
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Customer address : 81 SOI UDOMSUK41,SUKHUMVIT ROAD,BANGCHAK PRAKANONG BANGKOK 10260

Total pages of certificate : 3 Pages
Receiving no. : L-230460
Receiving date. : 07-Mar-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurment ware caried out the stabilized labotary
Temperature : 23 ±5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration work instration no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.
This calibration certificate documents are traceblity to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 09-Mar-23

Mr. Sedtawut Nuesthong
Calibration Engineer

Mrs. Nongluck Wongsettee
Technical Manager

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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Calibration Certificate

Certificate No.: G 660139

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	45513	Linde	09-Aug-24
Nitrogen Dioxide (NO2) 30.34 ppm	2703/22	Nimt	22-Aug-24
Nitrogen Dioxide (NO2) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO2) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide (NO) 30.08 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions
Temperature : 21.7 °C Humidity : 59.1 %RH Pressure : 1012.3 mbar

Calibration conditions
Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1021.3 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.55	0.052	0.20
O2 (%Vol)	10.00	10.12	0.08	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.9	315	5.1	6.0
CO (ppm)	1003	1019	16	12
NO2 (ppm)	30.34	26.8	-3.54	8.0
NO2 (ppm)	80.96	68.5	-12.46	8.0
NO2 (ppm)	202.2	178.4	-23.8	12
NO (ppm)	30.08	29	-1.08	8.0
NO (ppm)	150.9	152	1.1	8.0
NO (ppm)	320.6	316	-4.6	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	604	2.9	13

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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ENTECH Where Solutions Begin

Calibration Certificate

Certificate No.: G 660139

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.55	0.052	0.20
O2 (%Vol)	10.04	10.12	0.08	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1001	-2	12
NO2 (ppm)	30.34	29.3	-1.04	8.0
NO2 (ppm)	80.96	80.5	-0.46	8.0
NO2 (ppm)	202.2	204.1	1.9	12
NO (ppm)	30.08	29	-1.08	8.0
NO (ppm)	150.9	152	1.1	8.0
NO (ppm)	320.6	316	-4.6	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	604	2.9	13

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

End of Report

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
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เอกสารไม่ควบคุม

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
384 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000 FAX 0-2719-9494

Cert.No.: 23CH99
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Horiba
Model :	AQUA-PH220
Serial No. :	HAGE0005
ID No. :	UAE.EFM.070/3584(EFM.pH.23/64)
Condition As-Received:	Used Item
Received Date :	20 January 2023
Calibration Date :	23 January 2023
Reference :	2301-068TWSC-2
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature :	(25 ± 2.0) °C
Relative Humidity :	(50 ± 10) %
Calibration Procedure :	In - house method - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference materials (CRM) CP-CH3 by comparison with standard thermometer
Calibrated by :	Waraporn Lerngaghakul
Approved by :	Approved Signatory

(✓) Malee Bulkulea
( ) Saithip Mesangmai
( ) Waraporn Lerngaghakul

Issue Date : 25 January 2023

The Uncertainties are for a confidence probability of approximately 95%

เอกสารไม่ควบคุม
A 0050218

Condition of this calibration result

1. Reference Standard Instrument :

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	540300140	18IR0118	22C2769	24 Aug 2023
2) Rel. Standard Thermometer	4382054	14RD044	22I1305	27 Oct 2023

The certificates is traceable to the International System of Units (SI) through
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chemicals
ANSI-ASQ National Accreditation Board, Accredited No. AT-1356

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826589	29 July 2024
pH 6.987	CPA chem	826589	29 July 2024
pH 10.008	CPA chem	826589	29 July 2024

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 Fluke at pH (4,7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.00	177.46	177.0	4.01	0.059	2.00
S/N : H40E0036	7.00	0.00	0.1	7.00	0.056	2.00
	7.00	0.00	0.1	7.00	0.056	2.00
	10.00	-177.46	-177.4	10.01	0.058	2.00

เอกสารไม่ควบคุม
a 1144767

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	4.008	4.01	180.5	0.0021	2.07
S/N : 991L0035	6.987	7.00	-11.8	0.011	2.00
	6.987	7.00	-12.0	0.011	2.00
	10.008	12.01	-198.8	0.010	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : 9060
- Serial No. : 991L0035

Dimension of probe:

- Length : 112 mm.
- Diameter : 16 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	25.002	25.01	-0.002	0.15	2.00
30.0	30.003	30.0	-0.003	0.15	2.00
35.0	35.002	35.0	-0.002	0.13	2.00

Remark : * UUC = Unit Under Calibration

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

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เอกสารไม่ควบคุม
a 1144766

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
384/1 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000 FAX 0-2719-9494

Cert.No.: 23TW074
Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	Pro 20i
Serial No. :	18H110486
ID No. :	UAE.EFM.2002561(ENV.DO.04/61)
Received Date :	25 July 2023
Test Date :	26 July 2023
Reference :	2307-078WSC-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 Winkler Titration Method with Azide Modification Method
Tested by :	Wallalak Srilleam
Approved by :	Approved Signatory

( ) Malee Bulkulea
(✓) Saithip Mesangmai
( ) Waraporn Lerngaghakul

Issue Date : 27 July 2023

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B 0320266

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) Buret,1e	-	1300110	23001172	22 Mar 2024
2) Balance	1125143764	14NR0004	22MM50	20 Sep 2023

2. Standard Materia :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AB1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 18H120123

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.18	0.0045

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

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a 1173159

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
TEL.

Cert. No.: 23LM122
Page.: 1 of 2

Certificate of Calibration

Equipment :	DO Meter with Sensor
Manufacturer :	YSI
Model :	Pro 20i
Serial No. :	18H110495
ID No. :	LAE.EFM.200/2563(ENV.DO.04/61)
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 :	25 July 2023
Calibrated Date :	27 July 2023
Ambient Temperature :	(25 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Preecha Hlahh
Approved by :	Approved Signatory

( ) Parnnippa Tanreyakul
( ) Melee Bulkuea
(✓) Suwit Imjai

Issue Date : 4 August 2023

The Uncertainties are for a confidence probability of approximately 95%

เอกสารไม่ควบคุม
A 0056826

Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0736WSC-2

Procedure Used :-
Calibration were conducted using in-house calibration procedure CP-DT01 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	2180080	2211295	TPA	21 Oct 2023

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.: 18H120129

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.009	24.5	-0.209	0.16	2.00
30.0	100	30.010	29.5	-0.210	0.16	2.00
35.0	100	35.009	34.7	-0.309	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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เอกสารไม่ควบคุม
a 1173064

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
TEL.

Cert.No.: 23CH427
Page.: 1 of 3

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Horiba
Model :	LAQUA-EC210
Serial No. :	KCBL0014
ID No. :	LAE.EFM.007/2564(EHM.SCT.0163)
Condition As-Received:	Used item
Received Date :	28 March 2023
Calibration Date :	29 March 2023
Reference :	2303-0[illegible]WSC-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-CH0 by direct measurement with certified reference material (CRM) - CP-CH6 by comparison with standard thermometer
Calibrated by :	Wakkak Sritheen
Approved by :	Approved Signatory

(✓) Malee Bulkuea
( ) Sakhip Meangmai
( ) Wanakorn Lamgagnaku

Issue Date : 31 March 2023

The Uncertainties are for a confidence probability of approximately 95%

เอกสารไม่ควบคุม
A 0052411

Condition of this result of calibration

1. Reference Standard Instrument :

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	15IRC033	2214/1	17 Apr 2023
2) Ref. Std. Thermometer	4982054	11IRC044	2213305	27 Oct 2023

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

- Traceable to National Institute of Metrology (Thailand) NIMT

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-1639

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 µS/cm	CPA Chem	826595	29 July 2023
12,880 mS/cm	CPA Chem	823329	26 June 2023

- 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 1413.0 µS/cm

Conductivity Electrode Serial No.: 9B8F0054

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.0 µS/cm	1408 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12,880 mS/cm	12.48 mS/cm	12.76 mS/cm	0.066 mS/cm	2.00

Remark - UUC* = Unit Under Calibration

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Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 3383
- Serial No. : 9B8F0054

Dimension of probe;

- Length : 110 mm
- Diameter : 15 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	25.001	25.0	-0.001	0.13	2.00
30.0	29.999	30.0	0.001	0.13	2.00
35.0	34.999	35.0	0.001	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 %.

-end-

เอกสารไม่ควบคุม

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละออง ฝุ่นละอองรวม (TSP)	Mettler-Toledo	AB204-S/FACT / B108115858	Technology Promotion Association (Thailand-Japan)	23MM332	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.001 mg)	นละอองขนาดไม่เกิน 10 ไมครอน (PM 10)	Mettler-Toledo	XP6 / B322373893	Technology Promotion Association (Thailand-Japan)	23MM333	7 Apr 23	5 Apr 24	-
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ									
3	pH Meter	ค่าความเป็นกรด-ด่าง	Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
4	pH Meter		Mettler-Toledo	SevenCompact S220/ C113432421	National Food Institute, Ministry of Industry, Thailand	2303560-001-01	26 Jun 23	24 Jun 24	-
5	Analytical Balance (Readability 0.01 mg)	ปริมาณของแข็งแขวนลอย (Suspended Solids) ปริมาณสารที่ละลายได้ทั้งหมด	Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	24 Apr 24	-
6	Hot Air Oven	ปริมาณสารแขวนลอยทั้งหมด	Memmert	UF55 / B216.1666	National Food Institute, Ministry of Industry, Thailand	2400141-001-01	11 Oct 23	9 Oct 24	-
7	Analytical Balance (Readability 0.1 mg)	น้ำมันและไขมันบนผิวน้ำ (Floatable Oil & Grease)	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-
8	BOD Incubator	บีโอดี	Arco	UC4-1320 / (UAE.WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
9	DO Meter		YSI	5100 / 11B101863	Harikul Science	HSU012C	1 Mar 23	28 Feb 24	-
10	UV-VIS Spectrophotometer	ปริมาณฟอสฟอรัสทั้งหมด, ปริมาณไนโตรเจนทั้งหมด ไนเตรท, ฟอสเฟต	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
11	Atomic Absorption Spectrophotometer (AAS)	ปรอท, ตะกั่ว, แคดเมียม, โครเมียม	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute of Scientific and Technological Research(TISTR)	MTC. ACL. No. 387/66	2 Feb 23	1 Feb 24	-
12	Cold Vapor Atomic Fluorescence Spectrometer (CVAFS)	ปรอทรวม -น้ำทะเล	Analytik Jena	mercur DUO plus / K170A0153	Analytik Jena FarEast Thailand Ltd.	Maintenance Protocol	2 Feb 23	1 Feb 24	-

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

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.: 23MM332
Page.: 1 of 3

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	AB204-S /FACT
Serial No. :	B108115858
ID No. :	UAE.AIR.016/2555
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Location :	Balance Room 2
Received order :	07 April 2023
Calibration Date :	07 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 90 %
Calibrated by :	Suwit Imjai
Approved by :	Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

Cert.No.: 23MM332
Page: 2 of 3

Procedure used :-
Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.
4. This certificate is not certified for any commercial transaction.
5. This certification is traceable to the International System of Unit.

Result of calibration ( ) Without Adjustment (*) After Adjustment by Internal Calibration
Range capacity : 0 g to 220 g **Resolution** 0.0001 g
Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	100.0002	-0.0002	0.21	2.06
200	200.0003	-0.0003	0.29	2.00

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

Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00009
200	0.00007

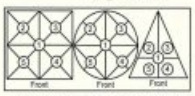
เอกสารไม่ควบคุม

Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

Cert.No.: 23MM332
Page: 3 of 3

Result of calibration

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



Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002	0.0005

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.0000	0.0000	0.18	2.17
0.1	0.0999	+0.0001	0.18	2.17
1	0.9998	+0.0002	0.18	2.17
5	5.0000	0.0000	0.18	2.17
10	10.0000	0.0000	0.18	2.17
20	20.0000	0.0000	0.18	2.15
50	50.0001	-0.0001	0.19	2.11
70	70.0001	-0.0001	0.20	2.07
100	100.0002	-0.0002	0.21	2.06
150	150.0004	-0.0004	0.29	2.00
200	200.0005	-0.0005	0.29	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 %.

-oOo-

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.: 23MM333
Page.: 1 of 3

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	XP6
Serial No. :	B322373893
ID No. :	UAE.AIR.019/2556
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Location :	Balance Room 2
Received order :	07 April 2023
Calibration Date :	07 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 90 %
Calibrated by :	Suwit Imjai
Approved by :	Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-3
Cert.No.: 23MM333
Page: 2 of 3

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.
4. This certificate is not certified for any commercial transaction.
5. This certification is traceable to the International System of Unit.

Result of calibration ( ) Without Adjustment (*) After Adjustment by Internal Calibration
Range capacity : 0 g to 6.1 g **Resolution** 0.000001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
3	2.999987	+0.000013	0.026	2.00
6	6.000003	-0.000003	0.036	2.00

After Adjustment :

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

Applied Weight (g)	Standard Deviation of Reading (g)
3	0.0000027
6	0.0000030

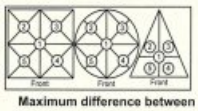
เอกสารไม่ควบคุม

Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-3
Cert.No.: 23MM333
Page: 3 of 3

Result of calibration

2. **Effect of off center loading**

A mass of 2 g was placed to various position on the pan.
The weighing machine reading error obtained is given in the table



Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
-0.000006	-0.000007	-0.000007	-0.000010	-0.000002	0.000004

3. **Departure from nominal value**

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.000000	0.000000	0.0060	2.37
0.01	0.009998	+0.000002	0.0060	2.13
0.05	0.050003	-0.000003	0.0070	2.05
0.1	0.100007	-0.000007	0.0090	2.03
0.15	0.150000	0.000000	0.011	2.00
0.17	0.169998	+0.000002	0.014	2.00
0.2	0.200002	-0.000002	0.014	2.00
1.5	1.500001	-0.000001	0.020	2.00
3	2.999990	+0.000010	0.026	2.00
4.5	4.499994	+0.000006	0.036	2.00
6	5.999982	+0.000018	0.036	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 %.

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

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NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2302181-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, Bangkok 10260

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Order No.: 2302181
Operation No.: 2302181-001
Date of Receipt: 14 March 2023
Date of Calibration: 24 March 2023

Calibrated by Mr.Pheraphat Tuanjit, Scientist
Approved by (Mr.Nuttapol Niyomchart), Specialist, Division of Calibration Laboratory, Responsible for the Technical Management Team
Date of Issue: 24 March 2023

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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2008 Soi 35, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel. +66(0) 2422 8688 Fax. +66(0) 2422 8545
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Foundation for Industrial Development National Food Institute
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NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01
Equipment: pH Meter
Resolution: 0.01 pH : 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
Type: Bench top
ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023
Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: **Ambient Temperature:** (23.4 ± 1.5) °C **Relative Humidity:** (52 ± 3) %
Condition of Equipment: Good Condition

Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650555-01	21 September 2023

Certified Reference Material	Lot. No.	Manufacturer	Ref N	Expire Date
2.4 pH buffer 4.006 (Primary pH buffer Solution)	573608	CPAchem	PH216.L5	16 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	573609	CPAchem	PH217.L5	16 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	573611	CPAchem	PH220.L5	16 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	573612	CPAchem	PH107.L5	16 February 2024

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

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter.The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7	traceable to	BIM RefN HI-13 LotN 25.05.2022; BIM RefN HI-16 LotN 02.06.2022; BIM RefN HI-13 LotN 25.05.2022; BIM RefN HI-16 LotN 02.06.2022, the Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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.

2008 ซอยอรุณอมรินทร์ 35 ถนนอรุณอมรินทร์ แขวงบางยี่เรือ เขตบางพลัด กรุงเทพมหานคร 10700
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เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2302181-001-01

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

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

Serial No.: 1230525212 **Type:** Bench top

ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023

Calibration Results:

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.120	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.156	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

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

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

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

Serial No.: 1156883 **ID.No.** N/A

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

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	187	-	0.0071	2.00
6.865	6.86	22	97.86	0.0075	2.00
10.010	10.01	-160	97.66	0.0086	2.00
6.865	6.99	14	-	0.0093	2.00

เอกสารไม่ควบคุม

สุดสาหกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการสุดสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

Serial No.: 1230525212 ID No.: UAE.WAS.003/2553

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature 25 °C ± 1 °C

Relative Humidity 55 % ± 5 %

Condition of this results of Calibration:

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

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1521	A85997	TE 660039-01	10-Dec-23	NATIONAL FOOD INSTITUTE
Platinum Resistance Thermometer (PRT)	385	509201			

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

3. This certificate is traceable to International System of Units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.
6. Condition of Calibrated item : Good
7. Result of Calibration : [X] Without adjustment [ ] After adjustment

เอกสารไม่ควบคุม

สุดสาหกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการสุดสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

Serial No.: 1230525212 ID No.: UAE.WAS.003/2553

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Calibration point: 15.0, 25.0 and 30.0 °C

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A S/N : N/A

Dimension of probe : Diameter 3 mm., Length 120 mm.,

Sheath material : N/A

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.2	14.999	- 0.2	0.12
25.2	24.999	- 0.2	0.12
30.2	29.999	- 0.2	0.12

Note

- UUC* : Unit Under Calibration

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

---------- End ----------

เอกสารไม่ควบคุม

สุดสาหกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการสุดสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2303560-001-01

Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, Bangkok 10260

Equipment: pH Meter

Manufacturer: Mettler Toledo

Model: Seven Compact S220

Serial No.: C113432421

ID No.: UAE.WAT.009/2564

Order No.: 2303560

Operation No.: 2303560-001

Date of Receipt: 23 June 2023

Date of Calibration: 26 June 2023

Calibrated by Mr.Worapob Sooktong, Scientist

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

Date of Issue: 27 June 2023 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.

เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2303560-001-01

Equipment: pH Meter — **Resolution:** 0.01 pH : 1 mV
Manufacturer: Mettler Toledo — **Model:** Seven Compact S220
Serial No.: C113432421 — **Type:** Bench top
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: **Ambient Temperature:** (24.3 ± 1.5) °C **Relative Humidity:** (49 ± 3) %
Condition of Equipment: Good Condition
Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	23E2003	14 June 2024
2.2 Digital Thermometer	2709007	Fluke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650655-01	21 September 2023
Certified Reference Material	**Lot. No.**	**Manufacturer**	**Ref N**	**Expire Date**
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873808	CPAchem	PH216.L5	16 February 2025
2.5 pH buffer 7.00 (Standard pH buffer Solution)	873812	CPAchem	PH107.L5	16 February 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873811	CPAchem	PH220.L5	16 February 2024
2.7 pH buffer 6.865 (Primary pH buffer Solution)	873809	CPAchem	PH217.L5	16 February 2025

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

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0008
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0061
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter.The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7	traceable to	BIM RefN HI-13 LotN 25.05.2022; BIM RefN HI-16 LotN 02.06.2022; BIM RefN HI-13 LotN 25.05.2022; BIM RefN HI-16 LotN 02.06.2022, the Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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.

J. Jeenghanlit
27 June 2023

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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2303560-001-01

Equipment: pH Meter — **Resolution:** 0.01 pH : 1 mV
Manufacturer: Mettler Toledo — **Model:** Seven Compact S220
Serial No.: C113432421 — **Type:** Bench top
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023

Calibration Results:

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.121	414	0.00	0.58	2.00
2	295.814	295	2.00	0.58	2.00
4	177.464	177	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.461	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.118	-414	14.00	0.58	2.00

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

Equipment: pH Electrode — **Type:** Combined Electrode
Manufacturer: Mettler Toledo — **Model:** InLab Expert Pro-ISM
Serial No.: 3114136 — **ID.No.** N/A
Performance of Electrode system (Three-Point Calibration at pH 4, pH 7 and pH 10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	177	-	0.0071	2.00
6.865	6.90	9	98.26	0.0074	2.00
10.01	10.01	-168	96.20	0.0065	2.00
6.986	7.02	3	-	0.0093	2.00

J. Jeenghanlit
27 June 2023

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2008 ซอยอรุณอมรินทร์ 36 ถนนอรุณอมรินทร์ แขวงบางยี่ขัน เขตบางพลัด กรุงเทพมหานคร 10700
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel +66(0) 2422 6666 Fax +66(0) 2422 8545
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สุดสาครรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2303560-001-01

Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C — **Model:** Seven Compact S220
Serial No.: C113432421 — **ID No.:** UAE.WAT.009/2564
Manufacturer: Mettler Toledo

Date of Calibration: 26 June 2023

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature (24.4 ± 1.0) °C
Relative Humidity (54 ± 2) %

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2933097	PSL-T 1282/65	03-Nov-23	TISTR
Platinum Resistance Thermometer (PRT)	5627A	923972			

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

3. This certificate is traceable to International System of Units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.
6. Condition of Calibrated Item : Good
7. Result of Calibration : [X] Without adjustment [ ] After adjustment

J. Jeenghanlit
27 June 2023

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2008 ซอยอรุณอมรินทร์ 36 ถนนอรุณอมรินทร์ แขวงบางยี่ขัน เขตบางพลัด กรุงเทพมหานคร 10700
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2303560-001-01

Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C — **Model:** Seven Compact S220
Serial No.: C113432421 — **ID No.:** UAE.WAT.009/2564
Manufacturer: Mettler Toledo

Date of Calibration: 26 June 2023

Calibration point: 15.0, 25.0 and 35.0 °C
Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.
- Description of probe, model : HI1310 S/N : 078743
Dimension of probe : Diameter 12 mm., Length 175 mm.,
Sheath material : Plastic

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.0	15.003	0.0	0.099
24.9	25.005	0.1	0.099
34.9	35.005	0.1	0.099

Note - UUC* : Unit Under Calibration

J. Jeenghanlit
27 June 2023

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 --------

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2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	AB204-S
Serial No. :	1128312528
ID No. :	UAE.AIR.019/2550
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Location :	Balance Room 2
Received order :	07 April 2023
Calibration Date :	07 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 80 %
Calibrated by :	Suwit Imjai
Approved by :	Approved Signatory ( ) Pornthippa Tameyakul (/) Malee Butkruea
Issue Date :	10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.
4. This certificate is not certified for any commercial transaction.
5. This certification is traceable to the International System of Unit.

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

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

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	99.9999	+0.0001	0.19	2.03
200	200.0001	-0.0001	0.29	2.00

After Adjustment :

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

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

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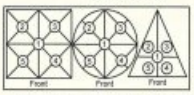
Result of calibration

2. Effect of off center loading

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



Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006	0.0005

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.0000	0.0000	0.15	2.13
0.1	0.0999	+0.0001	0.15	2.13
1	0.9999	+0.0001	0.15	2.13
5	4.9999	+0.0001	0.15	2.13
10	9.9999	+0.0001	0.15	2.11
20	20.0000	0.0000	0.15	2.11
50	50.0000	0.0000	0.16	2.06
70	69.9999	+0.0001	0.18	2.04
100	99.9999	+0.0001	0.19	2.03
150	150.0003	-0.0003	0.29	2.00
200	200.0005	-0.0005	0.29	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 %.

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สุดสาหกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Calibration Certificate

Certificate No.:	2400141-001-01
Client name:	UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address:	3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, Bangkok 10260

Equipment:	CHAMBER (Hot Air Oven)
Manufacturer:	MEMMERT
Model:	UF 55
Serial No.:	B216.1666
ID No.:	UAE.WAO.027/2559
Order No.:	2400141
Operation No.:	2400141-001
Date of Receipt:	11 October 2023
Date of Calibration:	11 October 2023

Calibrated by Mr.Worapob Sooktong, Scientist

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

Date of Issue: 16 October 2023

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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Calibration Report

Certificate No.: 2400141-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF 55 Serial No.: B216.1666

Resolution: 0.1 °C ID No.: UAE.WAO.027/2559

Manufacturer: MEMMERT

Date of Calibration: 11 October 2023

Location: Laboratory, Floor 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Environment Condition: Ambient Temperature (28 ± 1) °C

Relative Humidity (63 ± 2) %

Line Voltage (228 ± 1) Volt

Condition of this results of Calibration:

1. 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	MY49016894	TE 660380-01	22 April 2024	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

   [-] Not Available
7. Result of Calibration : [X] Without adjustment [ ] After adjustment

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

เอกสารไม่ควบคุม

สุดสาคกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2400141-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF 55 Serial No.: B216.1666

Resolution: 0.1 °C ID No.: UAE.WAO.027/2559

Manufacturer: MEMMERT

Date of Calibration: 11 October 2023

Calibration point: 104.0, 140.0 and 180.0 °C

Calibration result:

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
MIN	28.2	61.4	227.4
MAX	28.3	65.1	229.3

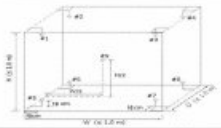

Table1 : Reporting of Temperature

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	104.05	103.98	104.02	104.08	104.00	104.05	103.99	104.17	104.00	0.53
140.0	140.09	139.99	139.91	140.05	139.99	139.91	139.97	140.26	139.97	0.73
180.0	180.46	180.33	180.25	180.28	180.33	179.96	180.31	180.64	180.16	0.90

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	MIN	MAX	Average			
104.0	104.0	104.0	104.0	0.090	0.18	0.38
140.0	140.0	140.1	140.0	0.075	0.28	0.47
180.0	180.0	180.1	180.0	0.13	0.48	0.88

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 througout 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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สุดสาคกรรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2302827-001-01

Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR204

Serial No.: C117635043

ID No.: UAE.WAS.012/2564

Order No.: 2302827

Operation No.: 2302827-001

Date of Receipt: 10 May 2023

Date of Calibration: 10 May 2023

Calibrated by Mr.Manas Somsak
Specialist

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

Date of Issue: 18 May 2023

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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ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302827-001-01

Equipment: Electronic Balance **Manufacturer:** METTLER TOLEDO

Model: XSR204 **Resolution:** 0.0001 g

Serial No.: C117635043 **ID No.:** UAE.WAS.012/2564

Capacity: 220 g

Date of Calibration: 10 May 2023

Environment Condition: Ambient Temperature 21.4 ± 0.2 °C Relative Humidity: 43.4 ± 0.9 %

Place of Calibration: Balance room (Water Analysis Unit), 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	M230405335	8 April 2024
Instrument	**Model**	**Serial No.**	**Calibrated By**	**Certificate No.**	**Due Date**
Thermo-Hygro Meter	608-H1	NFI.BTH 016/23	Quality Reborn	QR23-0489	21 February 2024

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

Calibration Results:

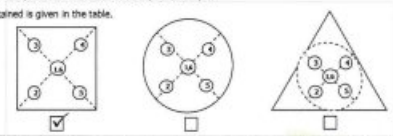
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.000032
200	0.000032

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)
100.0002	100.0002	100.0002	100.0002	100.0003	100.0002	0.0001

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

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สถาบันพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Calibration Report

Certificate No.: 2302827-001-01

Equipment: Electronic Balance | **Manufacturer:** METTLER TOLEDO
Model: XSR204 | **Resolution:** 0.0001 g
Serial No.: C117635043 | **ID No.:** UAE.WAS.012/2564
Capacity: 220 g

Date of Calibration: 10 May 2023

Calibration Results: (Continued)
Calibration Range: 0 - 200 g
Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Unload	0.00000	0.0000	0.0000	0.000085	2.00
0.01	0.01000	0.0100	0.0000	0.000085	2.00
0.02	0.02001	0.0200	0.0000	0.000085	2.00
0.05	0.05000	0.0500	0.0000	0.000085	2.00
0.1	0.10001	0.1000	0.0000	0.000085	2.00
0.2	0.20001	0.2000	0.0000	0.000085	2.00
0.5	0.50002	0.5000	0.0000	0.000085	2.00
1	1.00000	1.0000	0.0000	0.000086	2.00
2	2.00002	2.0000	0.0000	0.000086	2.00
3	3.00003	3.0000	0.0000	0.000087	2.00
5	5.00002	5.0000	0.0000	0.000087	2.00
10	10.00001	10.0000	0.0000	0.000088	2.00
20	20.00003	20.0000	0.0000	0.000092	2.00
30	30.00004	30.0000	0.0000	0.000098	2.00
40	40.00007	40.0000	0.0000	0.00011	2.00
45	45.00009	45.0001	0.0000	0.00013	2.00

เอกสารไม่ควบคุม

สถาบันพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Calibration Report

Certificate No.: 2302827-001-01

Equipment: Electronic Balance | **Manufacturer:** METTLER TOLEDO
Model: XSR204 | **Resolution:** 0.0001 g
Serial No.: C117635043 | **ID No.:** UAE.WAS.012/2564
Capacity: 220 g

Date of Calibration: 10 May 2023

Calibration Results: (Continued)
Calibration Range: 0 - 200 g
Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
50	50.00003	50.0000	0.0000	0.00011	2.00
55	55.00005	55.0000	0.0000	0.00012	2.00
60	60.00004	60.0000	0.0000	0.00012	2.00
65	65.00005	65.0000	0.0000	0.00013	2.00
70	70.00006	70.0001	-0.0001	0.00013	2.00
75	75.00008	75.0002	-0.0001	0.00013	2.00
80	80.00007	80.0002	-0.0001	0.00014	2.00
85	85.00009	85.0002	-0.0001	0.00014	2.00
90	90.00010	90.0002	-0.0001	0.00015	2.00
100	100.00006	100.0002	-0.0001	0.00016	2.00
120	120.00009	120.0002	-0.0001	0.00018	2.00
150	150.00009	150.0002	-0.0001	0.00021	2.00
200	200.00016	200.0003	-0.0001	0.00028	2.00

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

---------- End ----------

เอกสารไม่ควบคุม

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URC4S013201
ID No. : UAE.WAO.015/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib
Approved by : Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม

A 0051476

Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2302-0297OC-1
Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 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

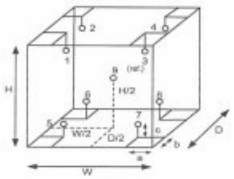
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Environment during calibration	Beginning	Finished
Temp. (°C)	29	31
REL.Humid. (%)	63	67
AC Supply (Volt)	220	220



Probe Installation Details :

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

Dimension of Chamber :

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

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9

เอกสารไม่ควบคุม

Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2302-0297OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 23TM249
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor k
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2

Calibration Point	Measured Temperature (°C) Position								
(°C)	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

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 %.

-o0o-

เอกสารไม่ควบคุม

a 1149512

HARIKUL SCIENCE

Harikul Science Co.,Ltd.
694 Soi Ratchadanivet 24 , Pracharatbamphen,
Samsaennok , Huaikhwang, Bangkok 10310
Tel: 0-2274-2456 Fax: 0-2274-2443
Email:info@harikul.com www.harikul.com

Certificate of Calibration

CERT.No.: HS-U012C

Calibration Date : 1 Mar 23
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok.(Head office)

Avg Room Temp : 20 °C
Avg Water Temp : 20 °C
Air Pressure : 760.00 mmHg
Salinity : 0 ppt

Model : YSI 5100
S/N : 11B101863
Probe : YSI 5010
S/N : 22B100125
ID NO. : -
Air Temp ref : S/N. E00522
Barometric ref : S/N. E00522
Water Temp ref : S/N. 11431

Technician : Kittipong M.

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)		(status)
Measurement 1 (mg/l)	9.09	(PASS)	-	-
Measurement 2 (mg/l)	9.09	(PASS)	-	-
Measurement 3 (mg/l)	9.09	(PASS)	-	-
Measurement 4 (mg/l)	9.09	(PASS)	-	-
Measurement 5 (mg/l)	9.09	(PASS)	-	-
Measurement 6 (mg/l)	9.09	(PASS)	-	-
Measurement 7 (mg/l)	9.08	(PASS)	-	-
Measurement 8 (mg/l)	9.09	(PASS)	-	-
Measurement 9 (mg/l)	9.08	(PASS)		-
Measurement 10 (mg/l)	9.09	(PASS)	-	-
Mean Measurement	9.09	mg/l	-	-
Inaccuracy	0.00	mg/l	-	-
Overall Status	(PASS)			

Manufacturer Specification
Accuracy = +/- 0.02 mg/l

1) This certificate is issued based on the result that are found as shown on date and place of test only.
2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
3) This result shall not be used for advertising purpose.

Technician Signature
(Kittipong Maekwong)

Laboratory Manager
(Supreecha Sumaritam)

เอกสารไม่ควบคุม

DQE Services

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

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021 Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,
Bangkok 10260

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated by : (Mr.Tanawut Rittidach)
Technical Manager

Approved by : (Ms. Chonthicha Sangngern)
Quality Manager

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

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

FM-708-02 R01 1/11/2021

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DQE Services

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32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230
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REPORT OF CALIBRATION

Certificate No. : SP23-021 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
Absobance Standard set	25760	95935	22 October 2023
Absobance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.
Wavelength 0.1 nm.

FM-708-02 R01 1/11/2021

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DQE Services Co.,Ltd.
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REPORT OF CALIBRATION

Certificate No. : SP23-021

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.5742	0.0045	0.0031	2.00
	1.0490	1.0423	0.0067	0.0029	2.00
	2.1900	2.1847	0.0053	0.0075	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5607	0.5577	0.0030	0.0034	2.00
	1.0247	1.0234	0.0013	0.0035	2.00
	2.1229	2.1171	0.0058	0.0088	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5236	0.5184	0.0052	0.0029	2.00
	0.9634	0.9607	0.0027	0.0029	2.00
	1.9763	1.9715	0.0048	0.0081	2.00
546.1	0.0000	-0.0001	0.0001	0.0028	2.00
	0.5191	0.5159	0.0032	0.0031	2.00
	1.0003	0.9980	0.0023	0.0033	2.00
	1.9987	1.9917	0.0070	0.0087	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5523	0.5501	0.0022	0.0030	2.00
	1.0809	1.0808	0.0001	0.0030	2.00
	2.0391	2.0336	0.0055	0.0081	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5601	0.5585	0.0016	0.0031	2.00
	1.0512	1.0485	0.0027	0.0030	2.00
	1.9294	1.9317	-0.0023	0.0083	2.00

เอกสารไม่ควบคุม

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REPORT OF CALIBRATION

Certificate No. : SP23-021

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7478	0.7436	0.0042	0.0058	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8686	0.8648	0.0038	0.0064	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2912	0.2908	0.0004	0.0052	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6448	0.6398	0.0050	0.0058	2.00

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	0.31	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.3	0.63	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.3	0.64	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.4	0.19	0.18	2.00
637.98	638.3	-0.32	0.18	2.00
431.38	431.0	0.38	0.18	2.00
472.50	472.5	0.00	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	529.0	-0.12	0.18	2.00
573.17	573.0	0.17	0.18	2.00
585.35	585.0	0.35	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	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available
- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor *k*, which for a normal distribution corresponds to a coverage probability of approximately 95%
- * Indicates non TISI accredited

- End of Certificate -

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Request No. 25-66 / 0323 MTC. ACL.No. 387 / 66

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies" Model AA240FS, Serial No. MY13160001
2. Working standard solution "Inorganic Ventures" Multi Analyte Custom Grade Solution, Lot No. 52-MEB708640

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer (WI-500-02-30)
2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

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

CALIBRATION DATE : 2 February 2023

REFERENCE MATERIAL : Traceable to NIST "Carlo Erba", "PanReac AppliChem"
Cadmium Lot No. 1152457, Chromium Lot No. 1793249, Copper Batch No. T117098A, Iron Batch No. T126087A, Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated by 1. ..... (Mr. Danai Srithongkum)

2. ..... (Mr. Atipat Ratana)

Approved by ..... (Miss Sulaidda Deawtong)
Senior Technical Officer
Acting Director of Analytical Chemistry Laboratory
Ref. 20152660126003660001
Issued Date : 15 February 2023

The results relate only to the items tested/calibrated or value assigned.
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CALIBRATION DATA

1. Noise Level

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
Absorbance	0.0020	0.0000	0.0008	0.0000	-0.0009	0.0021	-0.0016	-0.0022
	0.0015	0.0006	0.0005	-0.0009	-0.0014	0.0018	0.0002	-0.0023
	0.0014	0.0006	0.0010	-0.0009	0.0015	0.0008	-0.0004	-0.0015
	0.0021	-0.0008	0.0013	-0.0010	0.0005	0.0005	-0.0008	-0.0004
	0.0020	-0.0012	0.0004	0.0003	-0.0004	0.0001	-0.0024	-0.001
	0.0021	-0.0011	0.0011	0.0003	0.0006	0.0009	-0.0002	-0.0013
	0.0017	-0.0009	0.0001	-0.0015	0.0010	0.0007	0.0001	-0.0016
	0.0024	-0.0012	0.0004	-0.0002	0.0008	-0.0005	-0.0012	-0.0019
	0.0011	-0.0002	0.0015	-0.0004	0.0004	0.0008	-0.0003	-0.0017
	0.0017	0.0000	0.0009	0.0004	0.0001	0.0015	-0.0009	-0.0024
	0.0019	-0.0004	0.0004	0.0000	0.0006	0.0010	-0.0005	-0.0016
	0.0016	-0.0025	0.0003	0.0005	0.0009	-0.0004	-0.0013	-0.0016
	0.0018	-0.0014	0.001	-0.0009	-0.0006	0.0010	-0.0004	-0.0017
	0.0019	-0.0006	0.0011	-0.0008	0.0011	0.0004	-0.0003	-0.0005
	0.0024	0.0003	0.0005	-0.0012	-0.0002	0.0012	-0.0006	-0.0011
	0.0023	-0.0012	0.0006	-0.0007	0.0002	0.0014	-0.0012	-0.0013
	0.0020	-0.0014	0.0009	-0.0018	0.0003	0.0012	-0.0012	-0.0013
	0.0010	-0.0015	0.0002	0.0004	0.0017	0.0011	-0.0018	-0.0013
	0.0016	-0.0011	0.0013	0.0003	0.0007	0.0026	-0.0006	-0.0006
	0.0001	-0.0007	0.0009	-0.0003	0.0008	0.0008	0.0000	-0.0001
Average Absorbance	0.002	-0.001	0.001	0.000	0.000	0.001	-0.001	-0.001

Continue 2 / 5

The results relate only to the items tested/calibrated or value assigned.
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2. Precision

Element	Conc. (mg/l)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0085	0.0084	0.0090	0.0089	0.0089	0.0090	0.0086	0.0092	0.0090	0.0089	0.009	0.0003	2.88
	0.30	0.0993	0.1001	0.1007	0.1004	0.1004	0.0995	0.0997	0.0998	0.0999	0.0996	0.100	0.0005	0.45
	0.70	0.2238	0.2229	0.2244	0.2249	0.2243	0.2233	0.2235	0.2231	0.2251	0.2240	0.224	0.0007	0.33
Cr	0.10	0.0088	0.0087	0.0094	0.0086	0.0086	0.0091	0.0099	0.0095	0.0076	0.0085	0.009	0.0006	7.25
	0.30	0.0257	0.0265	0.0255	0.0270	0.0266	0.0258	0.0261	0.0262	0.0274	0.0262	0.026	0.0006	2.25
	0.70	0.0573	0.0590	0.0580	0.0576	0.0578	0.0579	0.0593	0.0599	0.0586	0.0594	0.058	0.0009	1.51
Cu	0.05	0.0083	0.0084	0.0084	0.0075	0.0086	0.0086	0.0081	0.0080	0.0087	0.0092	0.008	0.0005	5.45
	0.30	0.0430	0.0444	0.0426	0.0429	0.0435	0.0432	0.0428	0.0441	0.0427	0.0436	0.043	0.0006	1.41
	0.70	0.0981	0.0992	0.0990	0.0997	0.0977	0.0986	0.0990	0.0982	0.0988	0.0980	0.099	0.0006	0.63
Fe	0.10	0.0109	0.0104	0.0087	0.0100	0.0087	0.0094	0.0102	0.0092	0.0094	0.0100	0.010	0.0007	7.53
	0.50	0.0456	0.0442	0.0450	0.0444	0.0450	0.0455	0.0455	0.0441	0.0446	0.0444	0.045	0.0006	1.27
	1.00	0.0904	0.0901	0.0891	0.0876	0.0873	0.0901	0.0876	0.0886	0.0879	0.0901	0.089	0.0012	1.38
Pb	0.20	0.0093	0.0099	0.0104	0.0102	0.0104	0.0109	0.0102	0.0103	0.0115	0.0117	0.010	0.0007	6.85
	0.70	0.0344	0.0336	0.0336	0.0328	0.0338	0.0346	0.0336	0.0331	0.0343	0.0350	0.034	0.0007	2.02
	1.50	0.0709	0.0718	0.0706	0.0713	0.0698	0.0718	0.0712	0.0713	0.0715	0.0719	0.071	0.0006	0.90
Mn	0.05	0.0115	0.0130	0.0131	0.0127	0.0135	0.0136	0.0124	0.0133	0.0124	0.0130	0.013	0.0006	4.88
	0.30	0.0709	0.0700	0.0714	0.0704	0.0700	0.0705	0.0714	0.0698	0.0694	0.0700	0.070	0.0007	0.96
	0.70	0.1619	0.1633	0.1646	0.1638	0.1646	0.1614	0.1632	0.1614	0.1636	0.1652	0.163	0.0014	0.83
Ni	0.10	0.0113	0.0105	0.0113	0.0114	0.0110	0.0113	0.0117	0.0112	0.0107	0.0117	0.011	0.0004	3.45
	0.50	0.0509	0.0517	0.0508	0.0502	0.0517	0.0516	0.0516	0.0523	0.0518	0.0503	0.051	0.0007	1.36
	1.00	0.0997	0.1006	0.1006	0.1006	0.0996	0.0998	0.1007	0.1000	0.1013	0.0999	0.100	0.0006	0.55
Zn	0.05	0.0315	0.0309	0.0322	0.0304	0.0329	0.0312	0.0313	0.0319	0.0308	0.0311	0.031	0.0007	2.35
	0.30	0.1705	0.1728	0.1688	0.1693	0.1711	0.1704	0.1704	0.1707	0.1708	0.1688	0.170	0.0012	0.70
	0.70	0.3559	0.3572	0.3548	0.3560	0.3559	0.3550	0.3579	0.3552	0.3574	0.3573	0.356	0.0011	0.31

Continue 3 / 5

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เอกสารไม่ควบคุม

3. Trueness

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cd	0.02002	0.021	0.001	4.90	± 0.005
	0.30030	0.298	-0.002	0.77	± 0.005
	0.70070	0.675	-0.026	3.67	± 0.008

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cr	0.1001	0.101	0.001	0.90	± 0.009
	0.3003	0.293	-0.007	2.43	± 0.012
	0.7007	0.648	-0.053	7.52	± 0.023

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cu	0.050	0.046	-0.004	8.00	± 0.003
	0.300	0.289	-0.011	3.67	± 0.009
	0.700	0.674	-0.026	3.71	± 0.020

Continue 4 / 5

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เอกสารไม่ควบคุม

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Fe	0.100	0.095	-0.005	5.00	± 0.014
	0.500	0.474	-0.026	5.20	± 0.016
	1.000	0.950	-0.050	5.00	± 0.029

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Pb	0.200	0.207	0.007	3.50	± 0.014
	0.700	0.673	-0.027	3.86	± 0.030
	1.500	1.417	-0.083	5.53	± 0.061

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Mn	0.04995	0.046	-0.004	7.91	± 0.005
	0.29970	0.294	-0.0057	1.90	± 0.007
	0.69930	0.694	-0.0053	0.76	± 0.014

Continue 5 / 5

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เอกสารไม่ควบคุม

Request No. 25-66 / 0323 5 / 5 MTC. ACL. No. 387 / 66

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Ni	0.1001	0.103	0.003	2.90	± 0.013
	0.5005	0.501	0.001	0.10	± 0.018
	1.0010	0.987	-0.014	1.40	± 0.032

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

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Zn	0.050	0.046	-0.004	8.00	± 0.013
	0.300	0.311	0.011	3.67	± 0.013
	0.700	0.665	-0.035	5.00	± 0.019

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

Calibrated by 1. (Mr. Danai Srithongkum)

2. Atipat (Mr. Atipat Ratana)

Approved by. (Miss Sutadda Deawtong)
Senior Technical Officer
Acting Director of
Analytical Chemistry Laboratory
Issued Date : 15 February 2023

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE
End of Certificate

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FM.BL.MTC.002 Rev.4

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เอกสารไม่ควบคุม

analytikjena

Maintenance Protocol

Atomic Fluorescence Spectrometer

mercur DUO / mercur DUO plus

เอกสารไม่ควบคุม

analytikjena

Serial-No.: K170A0153 Customer-No.:

Date: 2 February 2023 Carried out by: Mr. Srichai Fak-On

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

Company	บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริ่งคอนซัลแตนท์ จำกัด
User	คุณเฌอร์ลิน สุจริต
Department	ห้องปฏิบัติการ (Mercur Analysis)
Street	3 ซอยอุดมสุข 44 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง
Zip Code, City	กรุงเทพมหานคร 10260
Country	ประเทศไทย
Phone	
Fax	
E-mail	

เอกสารไม่ควบคุม

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

Maintenance works Autosampler	Serial No.: N/A
lubricate the dosing-winding (Teflon-grease-spray)	☐
clean the dosing cylinder, if necessary exchange it	☐
lubricate the winding system of the height drive with some drops of oil	☐
check the toothed belt	☐
check the position of the mechanical stopper (height: 13mm)	☐
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	☐
check the pump rate of washing cup	☐
check the electrical hose connections for good contact	☐
check the connectors of the magnetic valves	☐
check the dosing hose for buckling, if necessary exchange it	☐

Maintenance Protocol mercur DUO/ mercur DUO plus | update 27.06.2016 Version 2.1 Kaes
Analytik Jena AG | Konrad-Zuse-Str. 1 | 07745 Jena/ Germany 3/5

เอกสารไม่ควบคุม

Device parameter		nominal value	actual value
visual check general tightness inside the Mercur		o.k.: ☑	changed: ☐
visual check Goldtraps		o.k.: ☑	changed: ☐
visual check spectrometer			
Fluorescence cell		o.k.: ☑	changed: ☐
Absorption cell, incl. window		o.k.: ☑	changed: ☐
lens		o.k.: ☑	changed: ☐
Swivel drive (SEV)		o.k.: ☑	changed: ☐
check pump hoses		o.k.: ☑	changed: ☐
check hoses and hose connectors		o.k.: ☑	changed: ☐
check and clean reactor		o.k.: ☑	changed: ☐
check drying hose output Gas-liquid-seperator		o.k.: ☑	changed: ☐
check bubble-sensor		o.k.: ☑	not o.k.: ☐
Check gasflow			
Argon pressure valve 4		1.2 – 1.5 bar	1.5 bar
Valve 1		10 Nl/h or 0.166 NL/min	0.167 NL/min
Valve 2		50 Nl/h or 0.833 NL/min	0.833 NL/min
Valve 3		5 Nl/h or 0.083 NL/min	0.084 NL/min
Valve 4		10 Nl/h or 0.166 NL/min	0.166 NL/min
Check liquidflow			
Acid		2.5ml/min ± 1 ml	2.5 ml/min
Red.-agent		2.5ml/min ± 1 ml	2.5 ml/min
Sample		10ml/min ± 2 ml	10 ml/min
Adventitious light - values	**(V)**	**from file**	
	100	0	0
	200	0	0
	300	0	0
	350	0	0
	400	1	1
	450	3	3
	500	8	8
	550	18	18
	575	26	26
	600	37	35

เอกสารไม่ควบคุม

analytikjena

Device parameter		nominal value	actual value
Analytical parameters Fluorescence cell			
Conditions.: max.conc.: 10µg/L PMT-voltage: 453 V			
Blank-solution			Int 0.0007
without enrichment / FBR 30 ng/L		Int > 0.0015 RSD < 3 %	Int_1 0.0031 RSD 1.13 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 444 V			
Blank-solution			Int 0.0012
with enrichment / FBR 30 ng/L		Int > 0.008 RSD < 3 %	Int_2 0.0117 RSD 2.90 %
Fok.- factor (Int_2 / Int_1)		> 3.5	3.77
Analytical parameters Absorption cell			
Blank-solution			Ext 0.00168
without enrichment / FBR 100 ng/L		Ext. > 0.0012 RSD < 5 %	Ext 0.00500 RSD 1.39 %
Comments			
# Sensitivity check (Without enrichment / FBR / 100 ng/L)			
Int. Blank = 0.000811			
Int. 100 ng/L = 0.009981			

Mr. Srichai Fak-on.
Signature Technician

3 February 2023
Place, Date (DD/MM/YYYY)

Signature Customer

3 February 2023
Place, Date (DD/MM/YYYY)

เอกสารไม่ควบคุม

Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_019
Program version: 4.7.9.0 Printed on: 8/02/2023 10:16
Recording started on 8/02/2023 10:07 GMT+7.0
Operator:
Laboratory:
Code:

Remarks:

Method parameters Hg

Method: Without Enrichment / FBR / 30 µg/L_PM_3-02-2023
Created on: 8/02/2023 Time: 10:06
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

เอกสารไม่ควบคุม

QC parameters

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

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	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 Hg

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: **0.000774**	**0.000038**	**4.995**
					A: 0.01847	0.000554	3.002
2	Cal-Std1	(--)	##	30.000	H: **0.003169**	**0.000036**	**1.137**
					A: 0.05036	0.000069	0.138

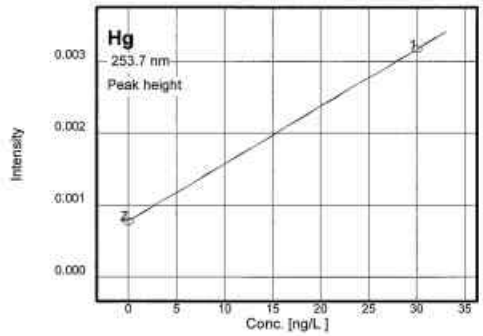
เอกสารไม่ควบคุม

Calibration function 1 **8/02/2023 10:16 Calibration (Peak height)**

Ints=k1+k2*conc

k1=0.000775 k2=0.000080 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	—

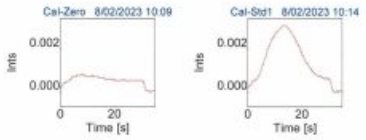


Measurements and events (sorted by time)

Hg	Without Enrichment / FBR / 30 µg/L_PM_3-02-2023				8/02/2023	10:07
ID	**Conc.**	**Ints**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.000816				PkH	10:09
		0.000765					10:10
		0.000741					10:11
	0ng/L	0.000774		0.000038680	4.995		10:11
Cal-Std1		0.003130				PkH	10:14
		0.003177					10:15
		0.003201					10:16
	30.00ng/L	0.003169		0.000036050	1.137		10:16
Calibration	Calibration function: 01						10:16

เอกสารไม่ควบคุม

Peak plots Hg



เอกสารไม่ควบคุม

Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_017

Program version: 4.7.9.0 Printed on: 3/02/2023 14:44

Recording started on 3/02/2023 14:25 GMT+7.0

Operator:

Laboratory:

Code:

Remarks:

Method parameters Hg

Method Enrichment / FBR /30 µg/L_PM 3-02-2023

Created on 3/02/2023 Time 13:41

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	8/5
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	10 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	10 NL/h
Purge time3	10 s	Gas wash time3	10 NL/h
Heat.time coil.1	20 s	Cool. time coil.1	30 s

เอกสารไม่ควบคุม

QC parameters

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

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	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	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards Hg

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: **0.001256**	**0.000060**	**4.833**
					A: 0.003771	0.000252	6.708
2	Cal-Std1	(--)	##	30.000	H: **0.01174**	**0.000341**	**2.909**
					A: 0.03281	0.000721	2.200

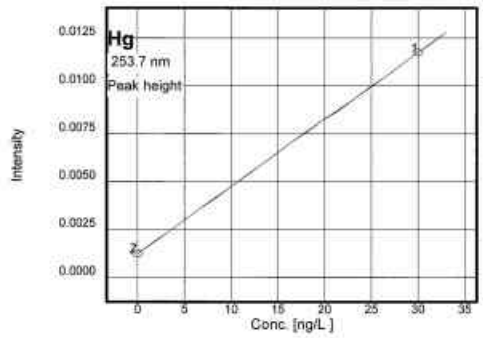
เอกสารไม่ควบคุม

Calibration function 1 **3/02/2023 14:38 Calibration (Peak height)**

Ints=k1+k2*conc

k1=0.001256 k2=0.000349 Recal. factor: ---

Slope	0.00035 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	---

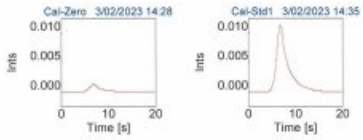


Measurements and events (sorted by time)

Hg	Enrichment / FBR /30 µg/L_PM 3-02-2023				3/02/2023	14:25
ID	**Conc.**	**Ints**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.001263				PkH	14:28
		0.001313					14:30
		0.001192					14:31
	0ng/L	0.001256		0.000060700	4.833		14:31
Cal-Std1		0.01135				PkH	14:35
		0.01189					14:36
		0.01198					14:38
	30.00ng/L	0.01174		0.0003415	2.909		14:38
Calibration	Calibration function: 01						14:38

เอกสารไม่ควบคุม

Peak plots Hg



เอกสารไม่ควบคุม

Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_025

Program version: 4.7.9.0 Printed on: 8/02/2023 11:44

Recording started on 8/02/2023 11:31 GMT+7.0

Operator:

Laboratory:

Code:

Remarks:

Method parameters Hg

Method Without enrichment / FBR 100 ng/L PM_3-02-2023

Created on 3/02/2023 Time 11:53

Program ---

Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	238 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		

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

QC parameters

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

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Calibration settings

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

Sample statistics

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

Calibration standards Hg

No	Name	State	Pos	Conc./ ng/L	Abs	SD	RSD/%
1	Cal-Zero	(--)	##	0.00	H: **0.000383**	**0.000070**	**18.47**
					A: 0.009152	0.002492	27.24
2	Cal-Std1	(--)	##	100.00	H: **0.002931**	**0.000034**	**1.163**
					A: 0.040877	0.002788	6.855

Calibration function 1 **8/02/2023 11:43 Calibration (Peak height)**

Abs=k1+k2*conc

k1=0.000383 k2=0.000025 Recal. factor: ---

Slope	0.00003 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	171.082 (ng/L)/1%I
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

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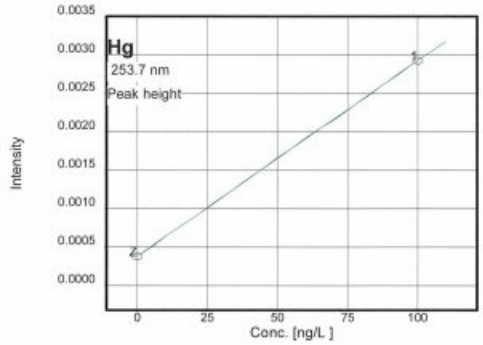
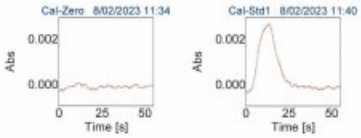


Measurements and events (sorted by time)

Hg	Without enrichment / FBR 100 ng/L PM_3-02-2023					8/02/2023	11:31
ID	**Conc.**	**Abs**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.000363				PkH	11:34
		0.000324					11:35
		0.000461					11:37
	0ng/L	0.000383		0.000070827	18.47		11:37
Cal-Std1		0.002954				PkH	11:40
		0.002948					11:41
		0.002892					11:43
	100.ng/L	0.002931		0.000034104	1.163		11:43
Calibration	Calibration function: 01						11:43

Peak plots Hg



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Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_024
Program version: 4.7.9.0 Printed on: 8/02/2023 11:22
Recording started on 8/02/2023 11:13 GMT+7.0
Operator:
Laboratory:
Code:

Remarks:

Method parameters Hg

Method: Without Enrichment / FBR / 100 µg/L_PM_3-02-2023
Created on: 8/02/2023 Time 10:56
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

เอกสารไม่ควบคุม

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(100.000 ng/L)	QC std.2 no.	3(0.100 ng/L)
QC std.1 limit	± 20.00%	QC std.2 limit	± 20.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	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 Hg

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: **0.000811**	**0.000020**	**2.545**
					A: 0.01927	0.000649	3.371
2	Cal-Std1	(--)	##	100.000	H: **0.009981**	**0.000073**	**0.739**
					A: 0.1406	0.001352	0.961

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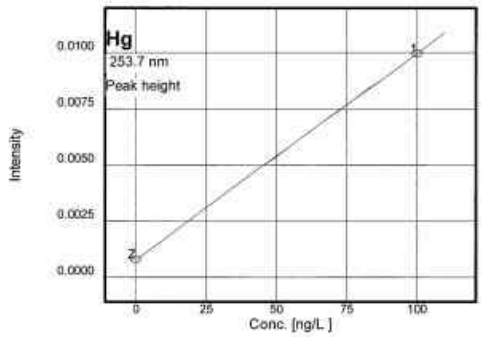
Calibration function 1 **8/02/2023 11:22 Calibration (Peak height)**

Ints=k1+k2*conc
k1=0.000812 k2=0.000092 Recal. factor: ---

Slope	0.00009 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg	Without Enrichment / FBR / 100 µg/L_PM_3-02-2023					8/02/2023	11:13
ID	**Conc.**	**Ints**	**BG**	**SD**	**RSD/%**	**Int. type**	**Time**
Cal-Zero		0.000796				PkH	11:15
		0.000803					11:16
		0.000835					11:17
	0ng/L	0.000811		0.000020660	2.545		11:17
Cal-Std1		0.009957				PkH	11:20
		0.009821					11:21
		0.01006					11:21
	100.0ng/L	0.009981		0.000073720	0.739		11:21
Calibration	Calibration function: 01						11:22

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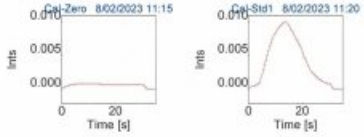
Peak plots Hg



Mercur

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Service Report

Customer's address :	Customer's Ref. No.	DISTRIBUTOR AJ-TH.	
E-mail :	Phone :	Fax :	
Job No. 230155 PM	User :	Service Engineer :	Date : 2/2/2023 Page : 1/1
Instrument model : Mercur Duo	Serial No. 21904 01153		Software Version No. 4.7.9.0

☐ Repair (RE) ☑ Maintenance (PM) ☐ Installation (IN) ☐ Warranty ☐ Application (AP) ☐ Site Prep.(SP) ☐ Visit(VI)

Fault / Claim : Preventive Maintenance (PM 2/6) ☐☐☐ Error Code

Action taken : – Maintenance Mak Basic Unit
– Check Device parameter
– Check gas flow
– Check liquid flow
– Check Adsorptivous light - valves

Test run Analytical parameter Fluorescence cell
Test run Analytical parameter Absorption cell

[redacted]

Action Pending / Recommendation :

☐ Spare Part ☐ Instrument Configuration

Item No.	Name	Quantity	Unit Price
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Herewith 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 Sherlyn Sajiwat 3/2/2023	Date / Signature of Service Engineer 3/2/2023	Work completed? ☑ Yes ☐ No

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