

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือตรวจวัดและวิเคราะห์

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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 <sub>10</sub> )	Thermo Scientific	G25A 158M	Tisch Environmental,Inc.	05072022	5 Jul 22	4 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1402	9 May 23	8 May 24	-
3	Air Flow Meter	Particular Matter (PM <sub>2.5</sub> )	Mesa Labs	DeltaCal DC1 159822	Innovative Instrument Co.,Ltd.	22-AFM-140	7 Sep 22	6 Sep 23	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1583	27 Jul 22	26 Jul 23	-
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	-
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050151	UAE Consultant Co.,Ltd.	15022023	15 Feb 23	16 Feb 24	-
10	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387064	UAE Consultant Co.,Ltd.	14022023	14 Feb 23	13 Feb 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									
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387065	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387066	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
14	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387067	UAE Consultant Co.,Ltd.	09022023	9 Feb 23	8 Feb 24	-
15	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
16	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201497732	UAE Consultant Co.,Ltd.	21022023	21 Feb 23	20 Feb 24	-
17	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778117	UAE Consultant Co.,Ltd.	06102022	6 Oct 22	5 Oct 23	-
18	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778117	UAE Consultant Co.,Ltd.	21022023	21 Feb 23	20 Feb 24	-
19	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778118	UAE Consultant Co.,Ltd.	06102022	6 Oct 22	5 Oct 23	-
20	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
21	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 21020224	Thai Meteorological Department	414/22	12 Jul 22	11 Jul 23	-
22	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	05103-5 19040403	Thai Meteorological Department	415/22	12 Jul 22	11 Jul 23	-
23	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0106	Scarlet Tech Ltd.	14092022	14 Sep 22	13 Sep 23	-
24	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0113	Scarlet Tech Ltd.	14092022	14 Sep 22	13 Sep 23	-

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									
25	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	SvanteK	SV35A 73249	Innovative Instrument Co.,Ltd.	22-ACT-406	1 Jul 22	30 Jun 23	-
26	Sound Level Meter	$L_{Aeq\ 24\ hr}$ $L_{Amax}$ $L_{A90}$ $L_{ACh}$ ระดับการรบกวน	Larson Davis	LxT2 0005398	Innovative Instrument Co.,Ltd.	22-ACT-035	21 Jan 22	20 Jan 24	-
27	Sound Level Meter	$L_{Aeq\ 24\ hr}$ $L_{Amax}$ $L_{A90}$ $L_{ACh}$ ระดับการรบกวน	Larson Davis	LxT2 0005400	Innovative Instrument Co.,Ltd.	22-ACT-036	21 Jan 22	20 Jan 24	-
28	Sound Level Meter	$L_{Aeq\ 24\ hr}$ $L_{Amax}$ $L_{A90}$ $L_{ACh}$ ระดับการรบกวน	Larson Davis	LxT2 0005402	Innovative Instrument Co.,Ltd.	22-ACT-103	11 Feb 22	10 Feb 24	-

List of Instruments Certification for Water Quality Analysis

Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water								
29	pH Meter	Horiba	LAQUA-PH210 HA1G0008	Technology Promotion Association (Thailand-Japan)	22CH1441	21 Oct 22	20 Oct 23	-
30	DO Meter	Horiba	LAQUA-DO210 HE1D0008	Technology Promotion Association (Thailand-Japan)	22TM232	20 Oct 22	19 Oct 23	-
31	Conductivity Meter	Horiba	LAQUA-EC210 HC0K0005	Technology Promotion Association (Thailand-Japan)	22CH1436	20 Oct 22	21 Oct 23	-



RECALIBRATION  
DUE DATE:  
July 5, 2023

# Certificate of Calibration

Calibration Certification Information			
Cal. Date:	July 5, 2022	Rootmeter S/N: 438320	Ta: 297 °K
Operator:	Jim Tisch	Pa: 750.1	mm Hg
Calibration Model #:	G25A	Calibrator S/N:	158M

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3240	3.2	2.00
2	3	4	1	0.9480	6.5	4.00
3	5	6	1	0.8480	7.9	5.00
4	7	8	1	0.8060	8.7	5.50
5	9	10	1	0.6670	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\frac{\Delta H}{P_{std}}} \left( \frac{V_{std}}{T_{std}} \right)$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\frac{\Delta H}{T_a/P_a}}$ (y-axis)
0.9860	0.7447	1.4073	0.9957	0.7521	0.8899
0.9818	1.0357	1.9902	0.9915	1.0459	1.2585
0.9798	1.1554	2.2751	0.9895	1.1668	1.4071
0.9788	1.2143	2.3337	0.9884	1.2263	1.4757
0.9735	1.4595	2.8146	0.9831	1.4739	1.7798
m= 1.96745			m= 1.23199		
b= -0.05315			b= -0.03361		
r= 0.99995			r= 0.99995		

Calculations			
Vstd=ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)		Va=ΔVol((Pa-ΔP)/Pa)	
Qstd= Vstd/ΔTime		Qa= Va/ΔTime	
For subsequent flow rate calculations:			
Qstd= 1/m ( √ΔH ( Pa / Pstd ) ( Tstd / Ta ) ) -b		Qa= 1/m ( √ΔH ( Ta / Pa ) ) -b	

Standard Conditions	
Tstd:	298.15 K
Pstd:	760 mm Hg
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootmeter manometer reading (mm Hg)	
Ta: actual absolute temperature (°K)	
Pa: actual barometric pressure (mm Hg)	
b: intercept	
m: slope	

**RECALIBRATION**  
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

Tisch Environmental, Inc.  
145 South Miami Avenue  
Village of Cleves, OH 45002

www.tisch-env.com  
TOLL FREE: (877) 263-7610  
Tel: 937-9009

เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E04N189E15A01D3	Reference Number: 122-402136167-1
Laboratory Number: E04N143252	Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC	Cylinder Pressure: 2015 PSIG
PGVP Number: B22021	Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN	Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024	

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Oxygen Calibration Standards (May 2012)" document EPA 900R-12/31, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.  
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	±1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	±1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	±1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	±0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	20081120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	±1.0%
PRM	12336	DN89026	6.91 PPM NITROGEN DIOXIDE/AIR	±2.0%
GMS	401423638102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	±2.1
NTRM	16011043	CC413277	48.02 PPM SULFUR DIOXIDE/NITROGEN	±0.8%
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	±0.8%

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

Triad Data Available Upon Request

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



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

Approved for Release



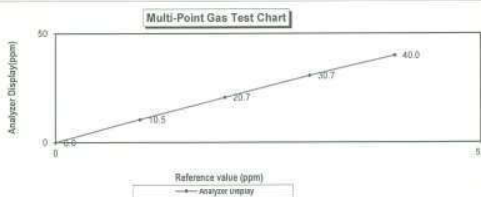
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United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260  
Tel: 0 2763 2828 Fax: 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

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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 21,2023				
Equipment : Gas Analyzer (CO)		Model : 48i		
Manufacturer : Thermo Scientific		Serial Number : 1201497732		
Standard Gas Concentration		Dilutor Detail		
Sulphur Dioxide (SO <sub>2</sub> )	44.68 PPM	Manufacturer :		Thermo Scientific
Nitric Oxide (NO)	45.94 PPM	Model :		146i
Methane (CH <sub>4</sub> )	- PPM	Serial Number :		1180540071
Carbon Monoxide (CO)	984.8 PPM			
Cylinder No. :	E00143262			
Expiration Date :	Jun 20, 2024			

Multi-point gas test data					
Reference Value (ppm)		Analyzer Display (ppm)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.0	0.0
Level 2	20.00%	10.0	10.5	0.5	4.8
Level 3	40.00%	20.0	20.7	0.7	3.4
Level 4	60.00%	30.0	30.7	0.7	2.3
Level 5	80.00%	40.0	40.0	0.0	0.0
Remark : Measuring Range		50.0 ppm	Average Difference (%) 2.08		
Acceptable Limit ± 5%					



Calculate by

91 Oct 66

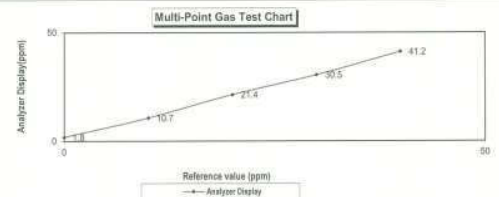
Approved by

22 Feb 2023

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MULTI-POINT GAS TEST REPORT				
Test Date : Oct 6,2022				
Equipment : Gas Analyzer (CO)		Model : 48i		
Manufacturer : Thermo Scientific		Serial Number : 1201778117		
Standard Gas Concentration		Dilutor Detail		
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model :	146i
Methane (CH <sub>4</sub> )	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8	PPM		
Cylinder No. :	EBO143262			
Expiration Date :	Jun 20,2024			

Multi-point gas test data						
Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	1.8	1.8	1.8	1.8
Level 2	20.00%	10.0	10.7	0.7	6.5	6.5
Level 3	40.00%	20.0	21.4	1.4	6.5	6.5
Level 4	60.00%	30.0	30.5	0.5	1.6	1.6
Level 5	80.00%	40.0	41.2	1.2	2.9	2.9
Remark : Measuring Range		50.0 ppm	Average Difference (%)			3.89
:Acceptable Limit ± 5%						



Calculate by

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Approved by

6 Oct 2022

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**MULTI-POINT GAS TEST REPORT**

Test Date : Feb 21, 2023

Equipment : Gas Analyzer (CO) Model : 48i  
Manufacturer : Thermo Scientific Serial Number : 1201778117

**Standard Gas Concentration**

Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH <sub>4</sub> )	-	PPM
Carbon Monoxide (CO)	984.8	PPM
Cylinder No. :	EB0143262	
Expiration Date :	Jun 20, 2024	

**Dilutor Detail**

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

**Multi-point gas test data**

Level	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.0	0.0
Level 2	20.00%	10.0	0.3	2.9	2.9
Level 3	40.00%	20.0	0.7	3.4	3.4
Level 4	60.00%	30.0	0.9	2.9	2.9
Level 5	80.00%	40.0	0.0	0.0	0.0

Remark : Measuring Range 50.0 ppm  
Acceptable Limit  $\pm 5\%$

**Multi-Point Gas Test Chart**

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22 Feb 2023

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**MULTI-POINT GAS TEST REPORT**

Test Date : Oct 6, 2022

Equipment : Gas Analyzer (CO) Model : 48i  
Manufacturer : Thermo Scientific Serial Number : 1201778118

**Standard Gas Concentration**

Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH <sub>4</sub> )	-	PPM
Carbon Monoxide (CO)	984.8	PPM
Cylinder No. :	EB0143262	
Expiration Date :	Jun 20, 2024	

**Dilutor Detail**

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

**Multi-point gas test data**

Level	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.9	6.9	6.9
Level 2	20.00%	10.0	0.5	4.8	4.8
Level 3	40.00%	20.0	0.8	3.8	3.8
Level 4	60.00%	30.0	0.6	1.6	1.6
Level 5	80.00%	40.0	0.9	2.2	2.2

Remark : Measuring Range 50.0 ppm  
Acceptable Limit  $\pm 5\%$

**Multi-Point Gas Test Chart**

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Approved by : [Signature]  
6 Oct 2022

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**CERTIFICATE OF ANALYSIS**  
Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3 Reference Number: 122-402135167-1  
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG  
PGVP Number: B22021 Valve Outlet: 650  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 800R-12531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	$\pm 1.0\%$ NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CCT08068	49.82 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 02, 2025
PRM	12368	D899026	9.81 PPM NITROGEN DIOXIDE/AIR	$\pm 2.0\%$	Feb 20, 2025
GMS	40142383102	CC050581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1$	Feb 18, 2023
NTRM	16011043	CC473277	49.82 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Jun 17, 2022
NTRM	14600119	CC434277	980.9 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.6\%$	Nov 15, 2023

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

Triad Data Available Upon Request

NOTES: PO #5221002607

GROSS WT: 28.40kg

NET WT: 4.73kg



CERT 3082.01  
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The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

Approved for Release

**THAI METEOROLOGICAL DEPARTMENT**

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

**Calibration Certificate**

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 12 April, 2021

Certification No. : 206/21

Page : 1 of 7

Object : เครื่องวัดความเร็วลมและทิศทาง

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Thermometers: DMA875 Barometer: DQA 601

Mfg Code : Data Logger 21020224 wind speed and wind direction: 20010221

Thermometers: 19100290 Barometer: 20030007

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakhong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1014.6 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

Serial Number 110130029 (sensor 120629286)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: testo, testo 645 Serial No. 0284057 : ThermoSchneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. 1200015

Barometer Vaisala Type PTB330 No. K1330001

Calibrated by : [Signature]

Mr. Watcharaporn Subwat

Mechanical Engineer

for the Chief  
Substandard Instrument  
เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Wind Speed And Wind Direction Certification No. 206/21

12 April, 2021 Model DNAS21 S/N 20010221 Page : 2 of 7

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Pressure	Velocity	Correction
Ultrasonic Anemometer	inches	inches	hPa	m/sec	m/sec
1.00	-	-	-	1.1	-0.10
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.5	0.52
11.02	-	-	-	10.8	0.22
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

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

Calibrated by:

Mr. Watchapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 206/21

12 April, 2021 Page : 3 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.77	1011.0	-0.23
1008.67	1008.9	-0.23
1010.49	1010.8	-0.31
1010.67	1011.0	-0.33
1010.78	1011.1	-0.32
1011.09	1011.5	-0.41
1011.21	1011.7	-0.49
1011.06	1011.5	-0.44
1010.80	1011.1	-0.30
1010.82	1011.0	-0.38
1010.45	1010.8	-0.35
1009.93	1010.3	-0.37
1009.78	1010.2	-0.42
1009.43	1009.8	-0.37
1009.29	1008.9	-0.61
1008.93	1009.4	-0.47
1008.66	1009.0	-0.34
1008.33	1008.7	-0.37
1008.15	1008.5	-0.35
1007.28	1007.6	-0.32

Average

Calibrated by:

Mr. Watchapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 206/21

12 April, 2021 Page : 4 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
758.14	758.3	-0.17
756.56	756.7	-0.17
757.93	758.2	-0.23
758.06	758.3	-0.25
756.15	756.4	-0.24
758.38	758.7	-0.31
758.47	758.8	-0.37
758.36	758.7	-0.33
758.16	756.4	-0.23
758.03	758.3	-0.29
757.90	758.2	-0.26
757.51	757.8	-0.28
757.40	757.7	-0.32
757.13	757.4	-0.28
757.03	757.5	-0.46
756.76	757.1	-0.35
756.56	756.8	-0.26
756.31	756.6	-0.26
756.17	756.4	-0.26
755.52	755.8	-0.24

Average

Calibrated by:

Mr. Watchapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Thermistors Model DMA 875 s/n 19100206

Certification No. 206/21

12 April, 2021 Page : 5 of 7

Standard	Temperature Sensor Reading	
	Reading	Correction
Temp. °C	°C	°C
45.24	45.31	-0.07
30.38	30.46	-0.10
15.12	15.19	-0.07

Calibrated by:

Mr. Watchapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารไม่ควบคุม





## THAI METEOROLOGICAL DEPARTMENT

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

### The Result of Calibration

Thermohygrometer Model DMA 875 s/n 19100298

Certification No. 206/21

12 April, 2021

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor - Reading	
	Reading % R.H.	Correction % R.H.
64.25	62.3	1.95
62.14	62.0	0.14
41.32	42.3	-0.98

Calibrated by:

Mr. Watchapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



Date of Issue 12 April, 2021

Certification No.206/21

Page : 7 of 7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET ขนาด 324 cm<sup>2</sup> Model DQA 230.1 Serial 20020189 ทำการสอบเทียบกับแก้วคั่นแบบ แก้วควม GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ ( 0.2 mm/TIP)



ลงชื่อ  
(นายวีรพล ทรัพย์วัฒน์)  
วิศวกรชำนาญการ

เอกสารไม่ควบคุม



## Certificate of Calibration

### WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (st-wl-21) and is within manufacturer's specification at the time when the calibration is done.

Client: Envir Service Co., Ltd.

Serial No.: 2205DT0106

Calibration Date: 2022/9/14

Calibration Expiry Date: 2023/9/13

#### The Result of Calibration

Measured Value(m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	1.0	0.0	0.9-1.1	Pass
1.9	2.0	0.1	1.8-2.2	Pass
5.0	5.0	0.0	4.5-5.5	Pass
7.1	7.0	0.1	6.0-8.0	Pass
10.1	10.0	0.1	9.5-10.5	Pass
19.6	20.0	0.4	19.0-21.0	Pass

#### Wind Direction

Measured Value	Actual Value	Deviation	Tolerance	Result
45°	45°	0	42-48	Pass
136°	135°	1	132-138	Pass
225°	225°	0	222-228	Pass
316°	315°	1	312-318	Pass
359°	0°	1	357-3	Pass

Inspection Room Temp	Actual Value	Deviation	Tolerance	Result
22.4°C	22.5°C	0.3	21.5-23.5	Pass

Atmospheric Pressure Inspection	Actual Value	Deviation	Tolerance	Result
1005	1005	0	1003-1019	Pass

Environment conditions :

Air temperature: 22 °C  
Relative humidity: 55 %  
Static pressure: 1013.2 hPa

Performed by:



This certificate may not be published or reproduced, except in full, unless obtaining permission in writing form from Scarlet Tech Ltd.  
4F-3, No. 347, 2nd Sec., Heping E. Rd., Daan Dist. Taipei City 106, Taiwan

เอกสารไม่ควบคุม



## Certificate of Calibration

### WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (st-wl-21) and is within manufacturer's specification at the time when the calibration is done.

Client: Envir Service Co., Ltd.

Serial No.: 2205DT0113

Calibration Date: 2022/9/14

Calibration Expiry Date: 2023/9/13

#### The Result of Calibration

Measured Value(m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	1.0	0.0	0.9-1.1	Pass
2.1	2.0	0.1	1.8-2.2	Pass
5.1	5.0	0.1	4.5-5.5	Pass
7.0	7.0	0.0	6.0-8.0	Pass
10.2	10.0	0.2	9.5-10.5	Pass
19.8	20.0	0.2	19.0-21.0	Pass

#### Wind Direction

Measured Value	Actual Value	Deviation	Tolerance	Result
45°	45°	0	42-48	Pass
136°	135°	1	132-138	Pass
227°	225°	2	222-228	Pass
316°	315°	1	312-318	Pass
358°	0°	2	357-3	Pass

Inspection Room Temp	Actual Value	Deviation	Tolerance	Result
22.5°C	22.5°C	0.0	21.5-23.5	Pass

Atmospheric Pressure Inspection	Actual Value	Deviation	Tolerance	Result
1005	1005	0	1003-1019	Pass

Environment conditions :

Air temperature: 22 °C  
Relative humidity: 55 %  
Static pressure: 1013.2 hPa

Performed by:



This certificate may not be published or reproduced, except in full, unless obtaining permission in writing form from Scarlet Tech Ltd.  
4F-3, No. 347, 2nd Sec., Heping E. Rd., Daan Dist. Taipei City 106, Taiwan

เอกสารไม่ควบคุม

### Certificate of Calibration

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

**Certificate No :** 22-ACT-406  
**Request No :** Req-2022-1080

#### Unit Under Calibration Details

Measurement item : Acoustic Calibrator  
Manufacturer : SVANTEK  
Model : SV 35A  
Serial Number : 73249  
ID : UAE.EFM.105/2561

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

#### Calibration Environment and Details

Temperature : ( 23 ±2 °C )  
Humidity : ( 50 ± 20 %RH )  
Barometric Pressure : (1013 ±10.0 hPa )  
Received Date : 15 June 2022  
Calibration Date : 1 July 2022  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2023
THD Multimeter	2015	1047765	NIMT	2 February 2023

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

#### Note

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

**Calibrated By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 1 July 2022

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

เอกสารไม่ควบคุม

**Certificate No :** 22-ACT-406  
**Request No :** Req-2022-1080

#### Sound pressure level

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty ( ± dB)	Acceptance limit Class 1 ( ± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.82	-0.18	-	-	0.11	0.25
114 dB / 1000 Hz	113.81	-0.19	-	-	0.11	0.25

#### Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (%)		Measured (%)			
94 dB / 1000 Hz	0.17		-	-	0.40	2.5
114 dB / 1000 Hz	0.04		-	-	0.40	2.5

#### 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 Innovative Instrument Co., Ltd.

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### Certificate of Calibration

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

**Certificate No :** 22-ACT-035  
**Request No :** Req-2022-0094

#### Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LX72  
Serial Number : 0003394  
ID : UAE.EFM.035/2564  
Resolution : 0.1 dB

Microphone Class : 2  
Microphone Model : 375A04  
Microphone S/N : 326675  
Preamplifier Model : PRMLX7C  
Preamplifier S/N : 073793  
Instrument Status : Used

#### Calibration Environment and Details


Temperature : 23 °C ±2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 14 January 2022  
Calibrated Date : 21 January 2022  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic


#### Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	(18273)	15 September 2022	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	14 June 2022	TST
Audio Generator	Sytek	SVan401	131	18 October 2022	WK Electric

#### Note

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

**Calibrated By :**   
Mr. Noppadon Luangart  
Calibration Officer

**Approved By :**   
Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 21 January 2022

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

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**Certificate No :** 22-ACT-035  
**Request No :** Req-2022-0094

#### 1. Indication at the calibration check frequency

UUC Setting FAST / A / 37-139 Calibrator Setting 1000 Hz 114.00 dB	Nominal Level (dB)	Before Adjust		Adjust		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
		UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)		
	113.85	114.0	-0.15	113.9	0.05	0.20	0.3

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

#### 2. Self-generated noise, Microphone installed

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

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

UUC Setting FAST / 37-139 UUC Weighting A	Measured (dB)	UNCERTAINTY ( ± dB)
	27.9	0.10
C	27.3	0.10
Z	31.9	0.10

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

UUC Setting FAST / 37-139 STD Setting 125 Hz 1000 Hz 4000 Hz 8000 Hz	Deviation from various Frequency Weighting Response curve (dB)			UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
	A	C	Z		
	0.0	0.0	0.0	0.50	2.0
	0.0	0.0	0.0	0.60	1.0
	0.4	0.3	0.3	0.60	3.0
	-0.1	-0.2	-0.1	0.70	3.0

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

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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

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

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

6. Frequency and time weightings at 1kHz

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

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

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovate Co., Ltd.  
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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

7. Long Term Stability

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

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY	Acceptance
FAST / A / 37-139	REF	UUC	ERR	( $\pm$ dB)	Limit
STD dB	(dB)	(dB)	(dB)	( $\pm$ dB)	( $\pm$ dB)
139.00	139	139.0	0.0	0.3	1.3
134.00	134	134.0	0.0		1.3
129.00	129	129.0	0.0		1.3
124.00	124	124.0	0.0		1.3
119.00	119	119.0	0.0		1.3
114.00	114	114.0	0.0		1.3
109.00	109	109.0	0.0		1.3
104.00	104	104.0	0.0		1.3
99.00	99	99.0	0.0		1.3
94.00	94	93.8	-0.1		1.3
89.00	89	88.9	-0.1		1.3
84.00	84	83.9	-0.1		1.3
79.00	79	78.9	-0.1		1.3
74.00	74	73.9	-0.1		1.3
69.00	69	69.0	0.0		1.3
64.00	64	63.9	-0.1		1.3
59.00	59	59.0	0.0		1.3
54.00	54	54.0	0.0		1.3
49.00	49	49.0	0.0		0.6
44.00	44	44.1	0.1		1.3
39.00	39	39.3	0.3		1.3
34.00	34	34.3	0.3		1.3
29.00	29	29.3	0.3		1.3

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovate Co., Ltd.  
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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	( $\pm$ dB)	Limit
UUC Range	(dB)	(dB)	(dB)	( $\pm$ dB)	( $\pm$ dB)
37-139	43.2	43.4	0.2	0.3	1.3
	114	114.0	0.0		1.3

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance
A / 37-139	Touchstart	Ref	UUC	ERR	( $\pm$ dB)	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	( $\pm$ dB)	( $\pm$ dB)
Fast	200	135.0	135.0	0.0	0.3	1
	2	118.0	117.9	-0.1		+1.0, -2.5
	0.25	109.0	108.7	-0.3		+1.5, -5.0
Slow	200	128.6	128.5	-0.1		1
	2	109.0	108.9	-0.1		+1.0, -5.0
	200	129.0	129.0	0.0		1
SPL	2	109.0	109.1	+0.1		+1.0, -2.5
	0.25	100.0	99.9	-0.1		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	( $\pm$ dB)	Limit
STD Setting	(dB)	(dB)	(dB)	( $\pm$ dB)	( $\pm$ dB)
Complete cycle	137.4	136.8	-0.60	0.2	3.0
Positive half cycle	136.4	136.1	-0.30		2.0
Negative half cycle	136.4	136.1	-0.30		2.0

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovate Co., Ltd.  
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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC	( $\pm$ dB)	Limit
STD Setting	(dB)	( $\pm$ dB)	( $\pm$ dB)
Positive one-half cycle	142.3		
Negative one-half cycle	142.0		
Deviated	0.3	0.2	1.5

13. High Level Stability

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

End of Certificate

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



# Certificate of Calibration

**Customer**  
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udonrak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 22-ACT-036  
Request No : Req-2022-0095

## Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : L872  
Serial Number : 0005-400  
ID : UAE.FFM.017/2564  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : 375A04  
Microphone S/N : 328676  
Preamplifier Model : PRM.LX12C  
Preamplifier S/N : 073603  
Instrument Status : Used

## Calibration Environment and Details

Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 14 January 2022  
Calibrated Date : 21 January 2022  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic

## Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	189273	15 September 2022	GRAS
Multi-frequency Calibrator	Quest	Quest-cal	EFA000234	14 June 2022	TSI
Audio Generator	Svanvik	Svan401	121	18 October 2022	WK Electric

## Note

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

Calibrated By :  
Mr. Noppadol Luangrat  
Calibration Officer

Approved By :  
Mr. Pachi Mathayon  
Calibration Engineer Supervisor  
Issue Date : 21 January 2022

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing body.  
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Page: 1/6

Certificate No : 22-ACT-036  
Request No : Req-2022-0095

## 1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	1000	(dB)	(dB)	(dB)	(dB)
1000 Hz (114.00 dB)	113.85	113.9	-0.05	113.9	0.05

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

## 2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	29.0	0.10

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

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.8	0.10
C	28.2	0.10
Z	32.9	0.10

## 4. Acoustic signal test of frequency weightings

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance Limit
FAST / 37-139	A	C	Z
STD Setting	(dB)	(dB)	(dB)
125 Hz	-0.1	0.1	0.0
1000 Hz	0.0	0.0	0.0
4000 Hz	0.5	0.5	0.6
8000 Hz	0.6	0.6	0.70

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เอกสารไม่ควรถูก  
Page: 3/6

Certificate No : 22-ACT-036  
Request No : Req-2022-0095

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

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance Limit
FAST / 37-139	A	C	Z
STD Setting	(dB)	(dB)	(dB)
63 Hz	-0.2	-0.1	0.0
125 Hz	-0.1	0.0	0.0
250 Hz	-0.1	0.0	0.0
300 Hz	-0.1	0.0	0.0
1000 Hz	0.0	0.0	0.0
2000 Hz	0.0	0.0	0.0
4000 Hz	0.0	0.0	0.0
8000 Hz	-0.1	0.0	0.0
16000 Hz	-0.1	-0.1	0.0

## 6. Frequency and time weightings at 1kHz

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

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

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing body.  
เอกสารไม่ควรถูก  
Page: 4/6

Certificate No : 22-ACT-036  
Request No : Req-2022-0095

## 7. Long Term Stability

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

## 8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	REF	UUC	ERR	
STD dB	(dB)	(dB)	(dB)	(± dB)
139.00	139	139.0	0.0	1.1
134.00	134	134.0	0.0	1.1
129.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	99.0	0.0	1.1
94.00	94	93.8	-0.1	1.1
89.00	89	88.9	-0.1	1.1
84.00	84	83.9	-0.1	1.1
79.00	79	78.9	-0.1	1.1
74.00	74	73.9	-0.1	1.1
69.00	69	69.0	0.0	1.1
64.00	64	63.9	-0.1	1.1
59.00	59	59.0	0.0	1.1
54.00	54	54.0	0.0	1.1
49.00	49	49.0	0.0	1.1
44.00	44	44.1	0.1	1.1
39.00	39	38.3	-0.3	1.1
34.00	34	34.3	0.3	1.1
29.00	29	29.5	0.5	1.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing body.  
เอกสารไม่ควรถูก  
Page: 5/6

Certificate No : 22-ACT-036  
Request No : Req-2022-0095

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(± dB)
37-139	-42.9	43.2	0.3	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance
A / 37-139	Timeburst	Ref	UUC	ERR		Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)	(+ dB)
Fast	200	135.0	135.0	0.0	0.3	1
	2	118.0	117.8	-0.2		+1.0, -2.5
	0.25	109.0	108.8	-0.2		+1.5, -5.0
200	128.6	128.5	-0.1	1		
Slow	2	109.0	108.8	-0.2		+1.0, -5.0
	200	129.0	129.0	0.0		1
	SEL	2	109.0	109.0	0.0	+1.0, -2.5
0.25		100.0	99.9	-0.1	+1.5, -5.0	

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	137.4	136.9	-0.50	-3.0
Positive half cycle	136.4	136.2	-0.20	-2.0
Negative half cycle	136.4	136.2	-0.20	-2.0

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

Certificate No : 22-ACT-036  
Request No : Req-2022-0095

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC	Limit	Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	142.1		
Negative one-half cycle	141.9		
Deviated	0.2	0.2	1.5

13. High Level Stability

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

End of Certificate

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

Customer  
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address : 81 Soi Udonnuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 22-ACT-103  
Request No : Req-2022-0230

Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LxT2  
Serial Number : 0005402  
ID : UAEF0352564  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : 375A04  
Microphone S/N : 328668  
Preamplifier Model : PRMLxT2C  
Preamplifier S/N : 071340  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 31 January 2022  
Calibrated Date : 11 February 2022  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	15 September 2022	GRAS
Multi-frequency Calibrator	Quest	Quest-cal	EFA000234	14 June 2022	TSL
Audio Generator	Svante	Svan401	131	18 October 2022	WK Electric

Note

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

Calibrated By :  
Mr. Noppadon Luangart  
Calibration Officer

Approved By :  
Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 11 February 2022

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.  
PM-700-SLM-01 Rev.0 Issue date 01/07/21  
เอกสารไม่ควบคุม

Certificate No : 22-ACT-103  
Request No : Req-2022-0230

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114.00 dB	113.85	114.0	+0.15	113.9	0.05
				0.20	0.3

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

2. Self-generated noise, Microphone installed

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

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

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting	(dB)	(± dB)
A	28.1	0.10
C	27.9	0.10
Z	34.4	0.10

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

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance
FAST / 37-139	A C Z	(± dB)	(± dB)
STD Setting	(dB) (dB) (dB)	(± dB)	(± dB)
125 Hz	0.0 0.1 0.1	0.50	2.0
1000 Hz	0.0 0.0 0.0	0.60	1.0
4000 Hz	0.9 0.9 1.0	0.60	3.0
8000 Hz	0.7 0.7 0.8	0.70	-5.0

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PM-700-SLM-01 Rev.0 Issue date 01/07/21  
เอกสารไม่ควบคุม



Certificate No : 22-ACT-103  
Request No : Req-2022-0230

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

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

6. Frequency and time weightings at 1kHz

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

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

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FM-708-SLM-01 Rev.0 Issue date 01/07/21

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Certificate No : 22-ACT-103  
Request No : Req-2022-0230

7. Long Term Stability

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

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139	REF	UUC	ERR		
STD dB	(dB)	(dB)	(dB)	0.3	
139.00	139	139.0	0.0		
134.00	134	134.0	0.0		
129.00	129	129.0	0.0		
124.00	124	124.0	0.0		
119.00	119	119.0	0.0		
114.00	114	114.0	0.0		
109.00	109	109.0	0.0		
104.00	104	104.0	0.0		
99.00	99	99.0	0.0		
94.00	94	94.0	0.0		
89.00	89	89.0	0.0		
84.00	84	84.0	0.0		
79.00	79	79.0	0.0		
74.00	74	74.0	0.0		
69.00	69	69.0	0.0		
64.00	64	64.0	0.0		
59.00	59	59.0	0.0		
54.00	54	54.0	0.0		
49.00	49	49.0	0.0		
44.00	44	44.0	0.0		
39.00	39	39.3	0.3		
34.00	34	34.3	0.3		

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FM-708-SLM-01 Rev.0 Issue date 01/07/21

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Certificate No : 22-ACT-103  
Request No : Req-2022-0230

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR		Limit
UUC Range	(dB)	(dB)	(dB)	( $\pm$ dB)	( $\pm$ dB)
37-139	43.2	42.9	-0.3	0.3	1.1
	114	114.0	0.0		1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
A/37-139	Touchburst	Ref	UUC (dB)	ERR (dB)		
UUC Time Response	(ms)	(dB)				
Fast	200	135.0	135.0	0.0	0.3	1.0
	2	118.0	117.7	-0.3		+1.0, -2.5
	0.25	109.0	108.7	-0.3		+1.5, -5.0
Slow	200	128.6	128.5	-0.1		1.0
	2	109.0	108.9	-0.1		+1.0, -5.0
SEL	200	129.0	129.0	0.0	1.0	
	2	109.0	109.0	0.0	+1.0, -2.5	
	0.25	100.0	99.9	-0.1	+1.5, -5.0	

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / C / 95-142	REF	UUC	ERR		
STD Setting	(dB)	(dB)	(dB)		
Complete cycle	137.4	136.7	-0.70	0.2	3.0
Positive half cycle	136.4	136.1	-0.30		2.0
Negative half cycle	136.4	136.2	-0.20		2.0

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FM-708-SLM-01 Rev.0 Issue date 01/07/21

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Certificate No : 22-ACT-103  
Request No : Req-2022-0230

12. Overload indication

UUC Setting	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139	UUC		
STD Setting	(dB)	0.2	1.5
Positive one-half cycle	142.2		
Negative one-half cycle	142.3		
Deviated	-0.1	0.2	1.5

13. High Level Stability

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

End of Certificate

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

FM-708-SLM-01 Rev.0 Issue date 01/07/21

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-23 FAX: 0-2719-9484




ISO-17025:2017  
CALIBRATION 0009

Cert.No.: 22CH1441  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** pH Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-PH210  
**Serial No. :** HA1G0008  
**ID No. :** UAE.EFM.201/2564(EFM.pH.09/64)  
**Condition As-Received:** Used Item  
**Received Date :** 20 October 2022  
**Calibration Date :** 21 October 2022  
**Reference :** 2210-0694WSC-2  
**Submitted by :** United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
Phrakhanong, Bangkok 10260

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

**Calibrated by :** Walalak Sirirthean

**Approved by :**   
Approved Signatory

( / ) Malee Butkrusa  
( ) Saitthip Meangmai  
( ) Warakorn Lemgagtrakul

**Issue Date :** 26 October 2022

**Condition of this calibration result**

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	788995	01 Jan 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	823323	20 June 2023


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 Fluhe at pH (4.7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
			mV	pH		
pH Meter S/N: HA1G0008	4.00	177.48	-177.5	4.01	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00

The Uncertainties are for a confidence probability of approximately 95%  
This certificate may not be reproduced without prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

**เอกสารไม่ควบคุม**  
a 0046602



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 FAX: 0-2719-9484


Cert.No.: 22CH1441  
Page.: 2 of 3

## Certificate of Calibration

**Equipment :** pH Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-PH210  
**Serial No. :** HA1G0008  
**ID No. :** UAE.EFM.201/2564(EFM.pH.09/64)  
**Condition As-Received:** Used Item  
**Received Date :** 20 October 2022  
**Calibration Date :** 21 October 2022  
**Reference :** 2210-0694WSC-2  
**Submitted by :** United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
Phrakhanong, Bangkok 10260

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

**Calibrated by :** Walalak Sirirthean

**Approved by :**   
Approved Signatory

( / ) Malee Butkrusa  
( ) Saitthip Meangmai  
( ) Warakorn Lemgagtrakul

**Issue Date :** 26 October 2022

**Condition of this calibration result**

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	788995	01 Jan 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	823323	20 June 2023


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 Fluhe at pH (4.7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
			mV	pH		
pH Meter S/N: HA1G0008	4.00	177.48	-177.5	4.01	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00

The Uncertainties are for a confidence probability of approximately 95%  
This certificate may not be reproduced without prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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a 1132040



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 FAX: 0-2719-9484

Cert.No.: 22CH1441  
Page.: 3 of 3

## Certificate of Calibration

**Calibration Results**  
**Function : pH Measurement**  
**Performing three buffers standard curve by using buffer nominal pH (4.7)(7,10)**

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( ± )	Coverage factor k
pH Electrode S/N: 991F0169	4.008	4.01	144.6	0.0085	2.05
	6.987	6.99	-26.3	0.011	2.00
	6.987	7.00	-26.7	0.011	2.00
	10.008	10.01	-203.3	0.0085	2.00

**Function : Temperature Measurement**  
(\*) Without adjustment  
This equipment was connected with Temperature Probe;  
- Model : 9652  
- Serial No. : 991F0169  
Dimension of probe;  
- Length : 103 mm.  
- Diameter : 10 mm.  
- Immersion Depth : 90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( ± °C)	Coverage factor k
25.0	25.000	24.9	-0.100	0.13	2.00
30.0	30.001	29.9	-0.101	0.13	2.00
35.0	34.999	34.9	-0.099	0.13	2.00

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

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

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**Condition of this calibration result**

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	788995	01 Jan 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	823323	20 June 2023

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 Fluhe at pH (4.7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
			mV	pH		
pH Meter S/N: HA1G0008	4.00	177.48	-177.5	4.01	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00

The Uncertainties are for a confidence probability of approximately 95%  
This certificate may not be reproduced without prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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a 1132039



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 FAX: 0-2719-9484

Cert.No.: 22TW232  
Page.: 1 of 2

## Certificate of Testing

**Equipment :** DO Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-DO210  
**Serial No. :** HE1D0008  
**ID No. :** UAE.EFM.207/2564(EFM.DO.09/64)  
**Received Date :** 20 October 2022  
**Test Date :** 20 October 2022  
**Reference :** 2210-0694WSC-9  
**Submitted by :** United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260

**Laboratory Condition :** Temperature ( 25 ± 5 ) °C  
Humidity ( 50 ± 20 ) %  
**Test Procedure :** In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method

**Tested by :** Warakorn Lemgagtrakul

**Approved by :**   
Approved Signatory

( / ) Malee Butkrusa  
( ) Saitthip Meangmai  
( ) Warakorn Lemgagtrakul

**Issue Date :** 2 November 2022

**Condition of this calibration result**

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	788995	01 Jan 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	823323	20 June 2023

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 Fluhe at pH (4.7)(7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ± mV )	Coverage factor k
			mV	pH		
pH Meter S/N: HA1G0008	4.00	177.48	-177.5	4.01	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00

The Uncertainties are for a confidence probability of approximately 95%  
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Cert.No.: 22TW232  
Page.: 2 of 2

**Condition of this result of calibration**

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %  
Dissolved Oxygen Probe No.: 9K1B0020

Titration Method (Azide Modification Method)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.027

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


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เอกสารไม่ควบคุม

a 1133325

Cert.No.: 22LM150  
Page.: 1 of 2

## Certificate of Calibration

**Equipment :** DO Meter with Sensor  
**Manufacturer :** Horiba  
**Model :** LAQUA-DO210  
**Serial No. :** HE1D0008  
**ID No. :** UAE.EFM.207/2564(EFM.DO.09/64)  
**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 :** 20 October 2022  
**Calibrated Date :** 31 October 2022  
**Ambient Temperature :** (26 ± 10) °C  
**Relative Humidity :** (50 ± 30) %  
**AC Line Voltage :** (220 ± 22) V  
**Calibrated by :** Preecha Hiahb  
**Approved by :**   
Approved Signatory  
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
**Issue Date :** 1 November 2022

The Uncertainties are for a confidence probability of approximately 95%  
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A 0046814

Cert.No.: 22LM150  
Page.: 2 of 2

**Equipment :** DO Meter with Sensor  
**Condition As-Received :** Used Item  
**Reference :** 2210-0694WSC-10  
**Procedure Used :-**  
Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.  
The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	3240076	221249	02 Mar 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 :** Temperature measurement  
This instrument was connected with temperature sensor, S/N: 9K1B0020

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.000	24.8	-0.200	0.10	2.00
30.0	100	30.005	29.8	-0.205	0.16	2.00
35.0	100	35.001	34.8	-0.201	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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a 1133168

Cert.No.: 22CH1436  
Page.: 1 of 3


## Certificate of Calibration

**Equipment :** Conductivity Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-EC210  
**Serial No. :** HC0K0005  
**ID No. :** UAE.EFM.204/2564(EFM.SCT.09/64)  
**Condition As-Received :** Used Item  
**Received Date :** 20 October 2022  
**Calibration Date :** 20 October 2022  
**Reference :** 2210-0694WSC-5  
**Submitted by :** United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
**Ambient Temperature :** (26 ± 2.5) °C  
**Relative Humidity :** (50 ± 15) %  
**Calibration Procedure :** In -house method ;  
- CP-CH6 by direct measurement  
with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer  
**Calibrated by :** Warakorn Lemragtrakul  
**Approved by :**   
Approved Signatory  
(✓) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lemragtrakul  
**Issue Date :** 26 October 2022

The Uncertainties are for a confidence probability of approximately 95%  
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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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A 0046605



Cert.No.: 22CH1436  
Page.: 2 of 3

**Condition of this result of calibration**

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	2211140	12 Sep 2023
2) Ref. Std. Thermometer	4982054	110RC044	2111201	26 Oct 2022

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-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 µS/cm	CPA Chem	823328	20 June 2023
12.880 mS/cm	CPA Chem	823329	20 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.: 980M0068

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.0 µS/cm	1323 µS/cm	1412 µS/cm	9.2 µS/cm	2.00
12.880 mS/cm	11.75 mS/cm	12.60 mS/cm	0.086 mS/cm	2.00

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

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a 1132034



Cert.No.: 22CH1436  
Page.: 3 of 3

**Calibration Results**  
**Function : Temperature Measurement**  
**(\*) Without adjustment**  
This equipment was connected with Temperature Probe;  
- Model : 9383  
- Serial No. : 980M0068  
Dimension of probe;  
- Length : 113 mm.  
- Diameter : 10 mm.  
- Immersion Depth : 90 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	30.001	30.0	-0.001	0.13	2.00
35.0	35.003	35.0	-0.003	0.13	2.00

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

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

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a 1132033



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.: 23P1402  
Page: 1 of 2

Equipment : U Tube Manometer  
Manufacturer: Dwyer  
Model : 1221-36-WIM  
Serial No.: -  
ID No.: UAE.EFM.1802561  
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

Submitted by: United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10280

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.

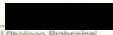
**Condition of this result of calibration**

1. Reference standards instruments :


Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0137-22	24 Aug 2023

2. This result of calibration was made on request at the point specified by customer.  
3. Scale and conversion factor is 1 kPa = 4.0146293 inHgO  
4. This instrument was used clean air as pressure media.  
5. This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.  
6. This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.  
7. The certificate is valid only to the item calibrated on date and place of calibration.  
8. This Certification is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussamee  
Issue Date : 11 May 2023

Approved Signatory :   
Prasinee Pratsupphaj  
Sura Suwanmasri  
Atitapol Panurach

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B 0314242



Cert.No.: 23P1402  
Page: 2 of 2

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

Range : 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O  
Scale Interval: 0.1 inH<sub>2</sub>O (The Fifth Estimate )

Applied Pressure (inH <sub>2</sub> O)	UUC Indication		AP (inH <sub>2</sub> O)	Error (inH <sub>2</sub> O)
	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)		
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-1.00	2.00	0.00
4.00	2.00	-2.00	4.00	0.00
6.00	3.00	-3.00	6.00	0.00
8.00	4.00	-4.00	8.00	0.00
10.00	5.00	-5.00	10.00	0.00
12.00	6.00	-6.00	12.00	0.00
14.00	7.00	-7.02	14.02	0.02
16.00	8.00	-8.02	16.02	0.02
18.00	9.02	-9.04	18.06	0.06
20.00	10.02	-10.04	20.06	0.06
22.00	11.00	-11.04	22.04	0.04
24.00	12.02	-12.06	24.08	0.08
26.00	13.02	-13.06	26.08	0.08
28.00	14.02	-14.04	28.06	0.06
30.00	15.02	-15.02	30.04	0.04
32.00	16.00	-16.02	32.02	0.02
34.00	17.00	-17.00	34.00	0.00
35.80	17.96	-17.98	35.94	0.14

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O  
\* UUC = Unit Under Calibration  
\* AP = 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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a 1160343

Certificate of Calibration

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

Certificate No : 22-AFM-140  
Request No : Req-2022-1607

Unit Under Calibration Details

Measurement Item : Air Flow meter  
Manufacturer : BGI  
Model : Delta Cal DC1  
Serial Number : 159822  
ID : UAE.EFM.039/2561  
Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 22 August 2022  
Calibration Date : 7 September 2022  
Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 High Flow	18501012012	Sensidyne	15 June 2023


Traceability :

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

Note :

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

Calibrated By :   
Mr. Noppadon Luangrat  
Service Calibration Engineer

Approved By :   
Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 7 September 2022

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

FM-708-AFM-01 Rev 00 Issue date 01/07/29

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Certificate No : 22-AFM-140

Request No : Req-2022-1607

Result of Calibration :

Flow Setting :	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
(LPM)	(LPM)	(LPM)	(LPM)	(LPM)
14.5	14.50	14.57	-0.07	0.21
15.0	15.00	15.09	-0.09	0.22
15.5	15.50	15.58	-0.08	0.23
16.5	16.60	16.67	-0.07	0.24
18.3	18.30	18.40	-0.10	0.26

Note

STD : Standard

UUC : Unit Under Calibration

Calibration media : Air

\* Indicates non accredited

End of Certificate

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

FM-708-AFM-01 Rev 00 Issue date 01/07/29

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Certificate of Calibration

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

Certificate No : 22-TPM-379  
Request No : Req-2022-1607  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Air Flow meter  
Manufacturer : BGI  
Model : Delta Cal DC1  
Serial Number : 159822  
Resolution : 0.1 °C  
ID Number : UAE.EFM.039/2561  
Range Calibration : 20 °C to 45 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 3  
Calibration Position (mm) : 45  
Instrument Status : Used

Calibration Environment and Details

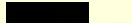
Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 22 August 2022  
Calibrated Date : 7 September 2022  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11 / RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 10 March 2022, Calibration Certificate No.: QR22-0578

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note :

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

Approved By :   
Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 7 September 2022

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

FM-708-TPM-01 Rev 01 Issue date 13/02/20

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Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 22-TPM-379


Request No : Req-2022-1607

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
Ta	20.004	20.0	0.0	0.14
	25.003	24.9	+0.1	0.14
	30.001	30.0	0.0	0.14
	35.002	34.9	+0.1	0.14
	40.002	39.9	+0.2	0.14
Tt	45.005	45.0	0.0	0.14
	20.004	20.1	-0.1	0.14
	25.003	24.9	+0.1	0.14
	30.001	29.9	+0.1	0.14
	35.002	34.9	+0.1	0.14
Tt	40.002	39.9	+0.1	0.14
	45.005	45.2	-0.2	0.14

End of Certificate

Calibrated By :   
Mr. Noppadon Luangrat

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

FM-708-TPM-01 Rev 01 Issue date 13/02/20

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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. 0-2719-8484

**Certificate of Calibration** Certificate No.: 22P2722  
Page: 1 of 2

Equipment: Aneroid Barometer  
Manufacturer: Barigo  
Model: -  
Serial No.: -  
ID No.: UAE.ANV.013/2547  
Condition As-Received: Used Item  
Received Date: 20 July 2022  
Calibration Date: 22 July 2022

Reference: 2207-0584WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1010 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	DP1142	1422505046	MP-0076-22	02 May 2023

2. This instrument was installed in vertical orientation and center of the dial was used as the reference level.  
3. This result of calibration was made on requested at the point specified by customer.  
4. Scale and conversion factor is 1 kPa = 7.50062 mmHg  
5. This result of calibration instrument was in absolute pressure.  
6. This instrument was used clean air as pressure media.  
7. The certificate is valid only to the item calibrated on date and place of calibration.  
8. This Certification is traceable to the International System of Unit maintained at:-  
National Institute of Metrology Thailand (NIMT)

Calibrated by: Suwit Aussarree  
Issue Date: 25 July 2022

Approved Signatory: [Signature]  
[Signature]  
[Signature]

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Cert. No.: 22P2722  
Page: 2 of 2

Result of calibration: Without adjustment  
Function: Absolute Pressure Measurement  
Range: 720 mmHg to 780 mmHg  
Scale Interval: 1 mmHg ( The Fifth Estimate )

Increasing Pressure

Applied Pressure (mmHg)	719.40	729.33	739.03	750.22	760.90	772.01	780.00
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.54	0.67	0.15	-0.22	-0.80	-2.01	-5.89

Decreasing Pressure

Applied Pressure (mmHg)	785.90	771.99	760.85	750.17	739.00	729.57	718.62
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-5.90	-1.98	-0.85	-0.17	0.10	0.43	1.38

The uncertainty of measurement was ± 0.24 mmHg  
\* UUC = Unit Under Calibration  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 %.

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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. 0-2719-8484

**Certificate of Calibration** Certificate No.: 22H1583  
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer  
Manufacturer: Barigo  
Model: -  
Serial No.: -  
ID No.: UAE.ANV.016/2547  
Condition As-Received: Used Item  
Received Date: 20 July 2022  
Calibration Date: 22 July 2022  
Reference: 2207-0584WSC  
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) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

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 at:-  
National Institute of Standards and Technology (NIST) , The United States of America  
National Institute of Metrology Thailand (NIMT)

Calibrated by: Somchai Dunwor  
Issue Date: 03 August 2022

Approved Signatory: [Signature]  
[Signature]  
[Signature]

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Cert. No.: 22H1583  
Page: 2 of 2

Result of Calibration: Without Adjustment  
Function: Humidity measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	42	1.9	1.6
25.0	60.0	63	3.0	1.8
25.0	80.0	78	-2.0	2.0

Result of Calibration: Without Adjustment  
Function: Temperature measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
20.00	20.0	0.00	0.72
30.01	30.0	-0.01	0.72
35.04	35.0	-0.04	0.72
39.99	40.0	0.02	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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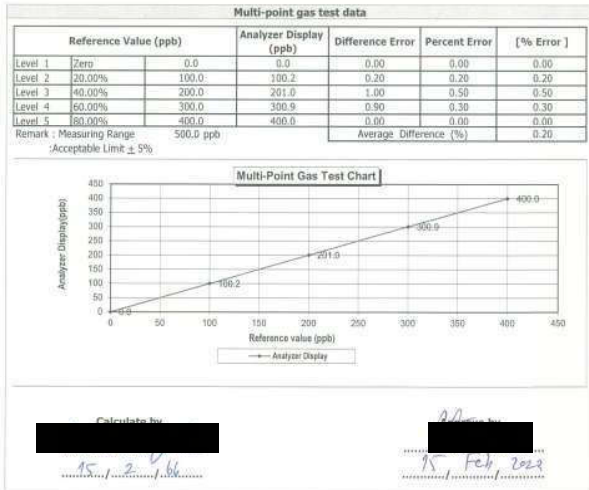
**MULTI-POINT GAS TEST REPORT**

Test Date : Feb 15, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM19050148

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071



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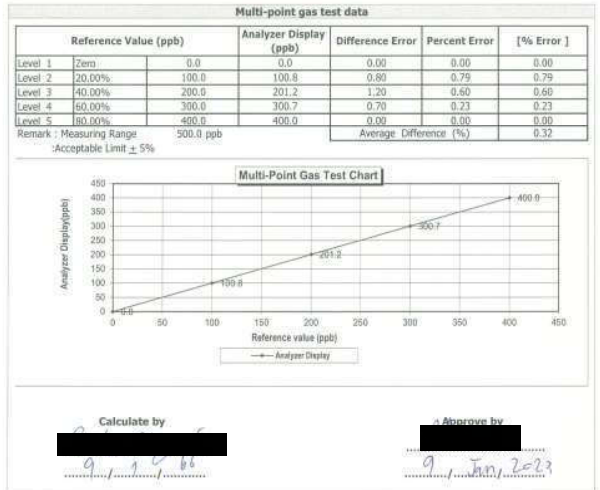
**MULTI-POINT GAS TEST REPORT**

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM19050149

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071



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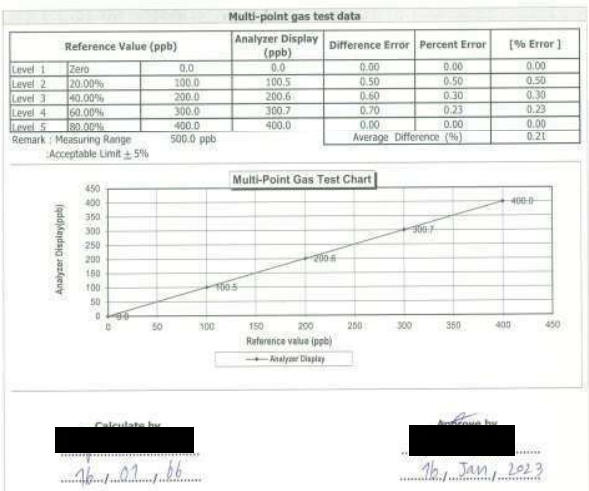
**MULTI-POINT GAS TEST REPORT**

Test Date : Jan 16, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM19050150

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071



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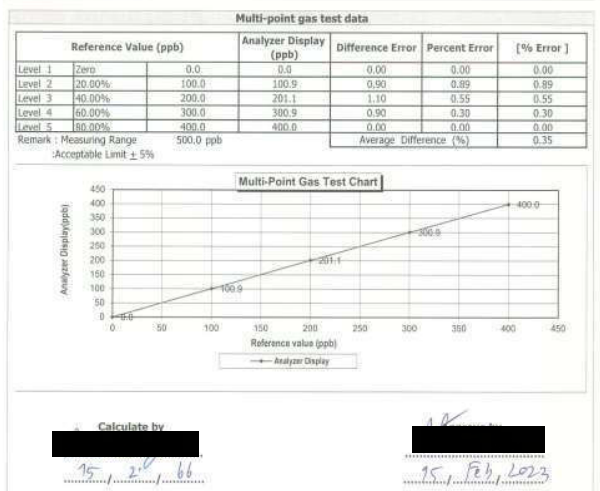
**MULTI-POINT GAS TEST REPORT**

Test Date : Feb 15, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM19050151

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071



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## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1  
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG  
PGVP Number: B22021 Valve Outlet: 560  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gas Calibration Standards (May 2012)" document EPA 500R-12/511, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.58 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CCT08068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12388	D869026	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 02, 2025
GMS	40142383102	C505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	15011043	CC413277	48.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	980.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.8%	Nov 15, 2025

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

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

Triad Data Available Upon Request

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



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

Approved for Release

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## MULTI-POINT GAS TEST REPORT

Test Date : Feb 14, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43i  
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387054

### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

### Dilutor Detail

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

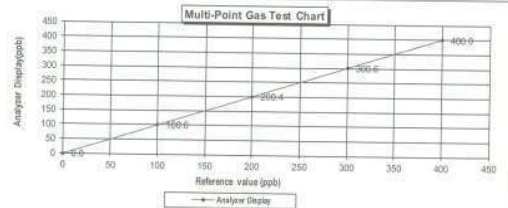
### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.6	0.60	0.60
Level 3	40.00%	200.0	200.4	0.40	0.20
Level 4	60.00%	300.0	300.6	0.60	0.20
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb

Acceptable Limit  $\pm 5\%$

### Multi-Point Gas Test Chart



Calculate by

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Approved by

14, Feb, 2023

Page 1 of 1

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## MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43i  
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387065

### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

### Dilutor Detail

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

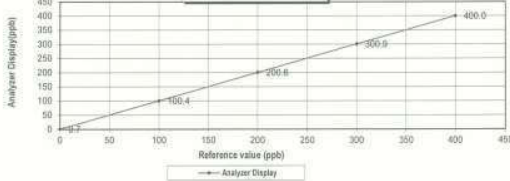
### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.7	0.70	0.70
Level 2	20.00%	100.0	100.4	0.40	0.40
Level 3	40.00%	200.0	200.6	0.30	0.30
Level 4	60.00%	300.0	300.9	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb

Acceptable Limit  $\pm 5\%$

### Multi-Point Gas Test Chart



9, 1 66

10, Jan, 2023

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เอกสารไม่ควบคุม

## MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43i  
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387066

### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

### Dilutor Detail

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

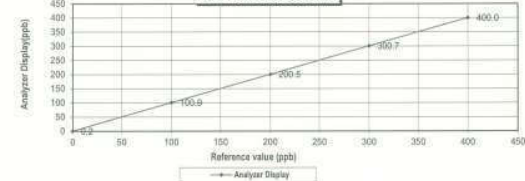
### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.2	0.20	0.20
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	200.5	0.50	0.25
Level 4	60.00%	300.0	300.7	0.70	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb

Acceptable Limit  $\pm 5\%$

### Multi-Point Gas Test Chart



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Approved by

10, Jan, 2023

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# MULTI-POINT GAS TEST REPORT

Test Date : Feb 9, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43  
 Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387067

## Standard Gas Concentration

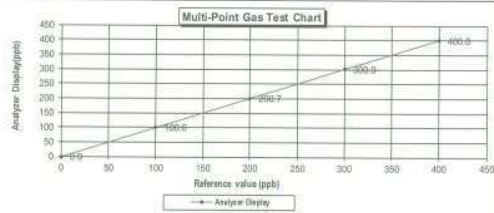
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
 Nitric Oxide (NO) : 45.94 PPM  
 Methane (CH<sub>4</sub>) : -  
 Carbon Monoxide (CO) : 984.8 PPM  
 Cylinder No. : EB0143262  
 Expiration Date : Jun 24, 2024

## 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	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.25



Calculate by

9, 2, 2023

9, Feb, 2023

List Certificate of Instrument for Air Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Instrument for Ambient Air Quality Analysis.									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน (PM <sub>10</sub> )	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)		Mettler-Toledo	AB204-S/FACT / B108115858	Mettler-Toledo (Thailand) Ltd.	23MM332	7 Apr 23	5 Apr 24	-
3	Analytical Balance (Readability 0.001 mg)	ฝุ่นละอองขนาดเล็กไม่เกิน 2.5 ไมครอน (PM <sub>2.5</sub> )	Mettler-Toledo	XP6 / B322373893	Mettler-Toledo (Thailand) Ltd.	23MM333	7 Apr 23	5 Apr 24	-
4	UV-VIS Spectrophotometer	ออกไซด์ของไนโตรเจน (NO <sub>x</sub> ) ก๊าซไนโตรเจนไดออกไซด์ (NO <sub>2</sub> )	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP23-008	44932	5 Jan 24	3 Jan 25	-
5	UV-VIS Spectrophotometer		Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 Jan 24	-

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

List Certificate of Instrument for Water Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Instrument for Water, Wastewater, Sea, Soil, Sediment Quality Analysis.									
1	pH Meter	ค่าความเป็นกรด-ด่าง (pH) อุณหภูมิ	Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
2	pH Meter		Mettler-Toledo	SevenCompact S220/ C113432421	National Food Institute, Ministry of Industry, Thailand	2203527-001-01	5 Jul 22	4 Jul 23	-
3	Conductivity Meter	ความเค็ม	SI Analytics	Lab955 / 16300356	DKSH Technology Limited	C24230059	16 Mar 23	14 Mar 24	-
4	Analytical Balance (Readability 0.01 mg)	ทองแข็งแขวนลอย ทองแข็งละลายน้ำทั้งหมด	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	23MM112	26 Apr 23	24 Apr 24	-
5	Analytical Balance (Readability 0.01 mg)		Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	24 Apr 24	-
6	Hot Air Oven		Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23	-
7	Hot Air Oven		Memmert	UF55 / B212.0411	Technology Promotion Association (Thailand-Japan)	23TM373	11 Apr 23	9 Apr 24	-
8	Analytical Balance (Readability 0.1 mg)	น้ำมันและไขมัน ปิโตรเลียมไฮโดรคาร์บอน	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-
9	BOD Incubator	บีโอดี (BOD)	Arco	UC4-1320 / (UAE:WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
10	BOD Incubator		Arco	UR-1320 / (UAE:WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	23TM375	12 Apr 23	10 Apr 24	-
11	UV-VIS Spectrophotometer	ไนเตรท-ไนโตรเจน ฟอสเฟต-ฟอสฟอรัส	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
12	UV-VIS Spectrophotometer	แอมโมเนียรวม โครเมียมเฮกซะวาเลนต์	Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	5 Jan 23	4 Jan 24	-

List Certificate of Instrument for Water Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Instrument for Water, Wastewater, Sea, Soil, Sediment Quality Analysis.									
13	UVA-VIS Spectrophotometer	ซีไอดี	Hitachi	U-2900 / 21E22-009	DOE Services Co.,Ltd.	SP23-008	6 Jan 23	5 Jan 24	-
14	Atomic Absorption Spectrophotometer (AAS)	แคดเมียม, โครเมียมเฮกซะวาเลนท์, ตะกั่ว, ทองแดง, แมงกานีส, สังกะสี, เหล็ก, ปรอท, สารหนู, แคดเมียม	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30 Jan 23	29 Jan 24	-
15	Atomic Absorption Spectrophotometer (AAS)		Perkin Elmer	PinAAcle 900F / PFBS20031902	Perkin Elmer Co.,Ltd.	PM Service No. WO-01710010	20 Jul 22	19 Jul 23	-
16	Inductively Coupled Plasma (ICP)		Agilent Technologies	System ID:G8015A G8015AA / MY18030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30 Nov 22	29 Nov 23	-
17	Cold Vapor Atomic Spectrometer (CVAAS)	ปรอท (น้ำทะเล)	Analytik Jena	mercur DUO plus / K170A0153	Analytik Jena FarEast Thailand Ltd.	Maintenance Protocol	2 Feb 23	1 Feb 24	-
18	Cold Vapor Atomic Absorption (CVAAS)	ปรอท (ดิน,ภาคตะกอน)	Milestone	DMA-80 / 11030982	Sithiporn Associates Co.,Ltd.	Service Protocol Report	18 Nov 22	17 Nov 23	-
19	Distillation Unit (Kjeldahl Method)	ฟอสเฟต	FOSS TECATOR	KT8100/ 91889052	FOSS South East Asia	6623	25 Jul 22	24 Jul 23	-
20	Distillation Unit (Kjeldahl Method)		Velp	DKL20 / 213517	National Food Institute, Ministry of Industry, Thailand	2203368-001-01	23 Jun 22	22 Jun 23	-
21	Digestor Unit		FOSS TECATOR	2520auto / 91794469	National Food Institute, Ministry of Industry, Thailand	2302413-001-01	30 Mar 23	28 Mar 24	-
22	Incubator	แบคทีเรียกลุ่มฟีคอลโคลิฟอร์มทั้งหมด	Binder	KB400 / 20200000015535	Technology Promotion Association (Thailand-Japan)	23TM726	27 Apr 23	25 Apr 24	-
23	Incubator	โคลิฟอร์มแบคทีเรียทั้งหมด	Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	23TM728	27 Apr 23	25 Apr 24	-

List Certificate of Instrument for Water Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Instrument for Water, Wastewater, Sea, Soil, Sediment Quality Analysis.									
24	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	23TM194	15 Feb 23	14 Feb 24	-
25	Water Bath		Memmert	WNE 14 / L414.1407	Technology Promotion Association (Thailand-Japan)	23TM374	11 Apr 23	9 Apr 24	-
26	Auto Clave		ALP	CL-40L / 807298	Technology Promotion Association (Thailand-Japan)	22TM1121	11 Jul 22	10 Jul 23	-
27	Auto Clave		ALP	CL-40L / 808763	Technology Promotion Association (Thailand-Japan)	23TM763	27 Apr 23	25 Apr 24	-
28	Analytical Balance		OHAUS	PX623 / C236754745	DKSH (Thailand) Ltd.	C01223732	9 Dec 22	8 Dec 23	-

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SIUANLUANG, SIUANLUANG BANGKOK 10250  
TEL. 0-2717-3003-29 FAX. 0-2719-9484



Cert.No.: 23MM331  
Page.: 1 of 3

## 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 90 %  
**Calibrated by :** Suwit Imjai  
**Approved by :**   
( ) 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 & Equipment Calibration and Testing Services.

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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-0015OC-1  
**Procedure used :-**

Cert.No.: 23MM331  
Page: 2 of 3

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

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- 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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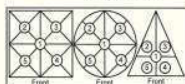
**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-0015OC-1

Cert.No.: 23MM331  
Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

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



Maximum difference between  
off-center and central loading  
( g )  
0.0005

Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006

#### 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 %.

-00-

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analytikjena  
No Endorsement Company

## Maintenance Protocol

Atomic Fluorescence Spectrometer

mercur DUO /  
mercur DUO plus

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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 แอนาไลติกส์ แอนด์ เฮนจิเนียริ่งคอนซัลแตนท์ จำกัด
User	คุณเนอริณ สุจิวิต
Department	ห้องปฏิบัติการ (Mercur Analysis)
Street	3 ซอยอุดมสุข 44 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง
Zip Code, City	กรุงเทพมหานคร 10260
Country	ประเทศไทย
Phone	
Fax	
E-mail	

**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

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.:	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.:	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.:	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.:	changed: <input type="checkbox"/>
lens	o.k.:	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.:	changed: <input type="checkbox"/>
check pump hoses	o.k.:	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.:	changed: <input type="checkbox"/>
check and clean reactor	o.k.:	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.:	changed: <input type="checkbox"/>
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

Device parameter	nominal value	actual value
<b>Analytical parameters Fluorescence cell</b>		
Conditions.: max conc.: 10µg/L PMT-voltage: 453 V		
Blank-solution	Int > 0.0015	Int. 0.0007
without enrichment / FBR 30 ng/L	RSD < 3 %	Int., 0.0031 RSD 1.13 %
Conditions.: max conc.: 1.7µg/L PMT-voltage: 444 V		
Blank-solution	Int > 0.008	Int. 0.0012
with enrichment / FBR 30 ng/L	RSD < 3 %	Int., 0.0117 RSD 2.90 %
Fok.-factor (Int <sub>2</sub> / Int <sub>1</sub> )	> 3.5	3.77
<b>Analytical parameters Absorption cell</b>		
Blank-solution	Ext. > 0.0012	Ext. 0.00168
without enrichment / FBR 100 ng/L	RSD < 5 %	Ext. 0.00500 RSD 1.39 %
<b>Comments</b>		
# Sensitivity check (Without enrichment / FBR / 100 ng/L)		
Int. Blank = 0.000811		
Int. 100 ng/L = 0.009981		

Signature Technician

3 February 2023

Place, Date (DD/MM/YYYY)

Signature Customer

3 February 2023

Place, Date (DD/MM/YYYY)



**Mercur**

Report file: C:\WinAAS\TMP\2023\Result\WVO\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**

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

**Hg**

Mercur

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**QC parameters**

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

**Calibration settings**

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

**Sample statistics**

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

**Calibration standards**

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

**Hg**

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**Calibration function 1**

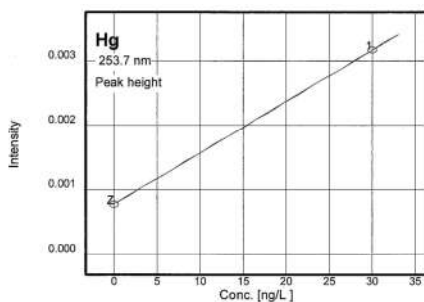
8/02/2023 10:16 Calibration (Peak height)

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
Cal-Zero		0.000816	
		0.000765	
		0.000741	
	0ng/L	0.000774	0.000038690 4.995
Cal-Std1		0.003130	
		0.003177	
		0.003201	
	30.00ng/L	0.003169	0.000036050 1.137
Calibration	Calibration function: 01		

Mercur

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**Peak plots****Hg**

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**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**

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 coll.1	20 s	Cool. time coll.1	30 s

**Hg**

Mercur

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**QC parameters**

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

**Calibration settings**

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

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.001256 A: 0.003771	0.000060 0.000252	4.833 6.708
2	Cal-Std1	(--)	##	30.000	H: 0.01174 A: 0.03261	0.000341 0.000721	2.909 2.200

**Hg**

Mercur

เอกสารไม่ควบคุม

**Calibration function 1**

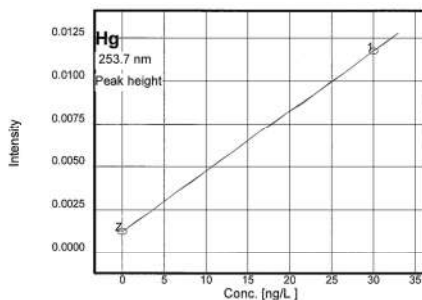
3/02/2023 14:38 Calibration (Peak height)

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
Cal-Zero		0.001263	
		0.001313	
		0.001162	
	0ng/L	0.001256	0.000060700 4.833
Cal-Std1		0.01135	
		0.01189	
		0.01198	
	30.00ng/L	0.01174	0.0003415 2.909
Calibration	Calibration function: 01		14:38

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**Peak plots****Hg**

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**Mercur**

Report file: C:\WinAAS\TMP\2023\Result\WOIPro\_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**

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-IP		
Integr. mode	Peak height	Integr. time	55 s
PMT	238 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Acid
FBR technique	off	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Purge time1	40 s		

**QC parameters**

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

No	Name	State	Poc	Conc./ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000383 A: 0.009152	0.000070 0.002492	18.47 27.24
2	Cal-Std1	(-)	##	100.00	H: 0.002931 A: 0.040677	0.000034 0.002788	1.163 6.855

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

Abs=K1+K2\*Conc

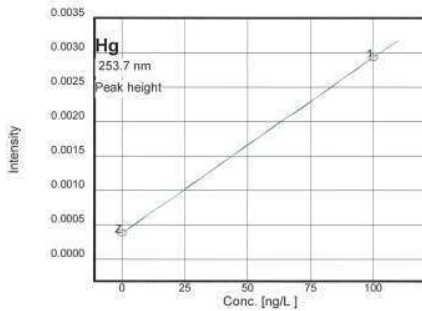
k1=0.000383 k2=0.000025

Recal. factor: ---

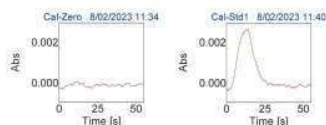
Slope	0.00003 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	171.082 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

Mercur

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

Hg ID	Without enrichment / FBR 100 ng/L PM_3-02-2023	8/02/2023	11:31
	Conc.	Abs	BG
Cal-Zero		0.000363	
		0.000324	
		0.000461	
	0 ng/L	0.000383	0.000070827 18.47
Cal-Std1		0.002954	
		0.002948	
		0.002892	
	100 ng/L	0.002931	0.000034104 1.163
Calibration	Calibration function: 01		11:43

**Peak plots**

Mercur

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**Mercur**

Report file: C:\WinAAS\TMP\2023\Result\WOIPro\_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**

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-IP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	12 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	10 NL/h

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เอกสารไม่ควบคุม







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 :**   
( ) 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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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-0015OC-2  
**Procedure used :-**

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

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

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- 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 )

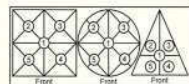
Applied Weight ( g )	Standard Deviation of Reading ( g )
100	0.00009
200	0.00007

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

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



Maximum difference between  
off-center and central loading  
( g )  
0.0005

### 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 )
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002

### 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 %.

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เอกสารไม่ควบคุม



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 :**   
( ) 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.

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0015OC-3  
Procedure used :-

Cert.No.: 23MM333  
Page: 2 of 3

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

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- 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 )

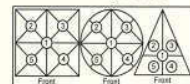
Applied Weight ( g )	Standard Deviation of Reading ( g )
3	0.0000027
6	0.0000030

เอกสารไม่ควบคุม



Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0015OC-3

Cert.No.: 23MM333  
Page: 3 of 3



#### 2. Effect of off center loading

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



## CERTIFICATE OF CALIBRATION

Certificate No. : SP23-008 Page 1 of 5

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

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

Location of calibration : Laboratory 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009



ID No. : UAE.WAT.051/2564

Received Date : 6 January 2023

Calibration Date : 6 January 2023

Issue Date : 10 January 2023

Condition Instrument : Used

Calibrated by :  Approved by :   
( Mr. Tanawat Rittidach ) ( Ms. Chonticha Sangnorn )  
Technical Manager Quality Manager

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

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

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FM-708-02 R01 1/11/2021



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



## REPORT OF CALIBRATION

Certificate No. : SP23-008 Page 2 of 5

Environment Condition : Ambient Temperature  $25 \pm 5$  °C

Relative humidity  $55 \pm 20$  %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

#### Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance 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 : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.


Wavelength 0.1 nm.

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FM-708-02 R01 1/11/2021



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

  
ISO 15189:2013  
CALIBRATION 884

REPORT OF CALIBRATION

Certificate No. : SP23-008Page 3 of 5


Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5787	0.574	0.0047	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.182	0.0080	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.114	0.0089	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.960	0.0034	0.0029	2.00
	1.9763	1.969	0.0073	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5191	0.516	0.0031	0.0031	2.00
	1.0003	0.997	0.0033	0.0033	2.00
	1.9987	1.991	0.0077	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5523	0.550	0.0023	0.0030	2.00
	1.0809	1.078	0.0029	0.0030	2.00
	2.0391	2.032	0.0071	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5601	0.558	0.0021	0.0031	2.00
	1.0512	1.049	0.0022	0.0030	2.00
	1.9294	1.922	0.0074	0.0079	2.00

FM-706-02 R01 1/11/2021

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

  
ISO 15189:2013  
CALIBRATION 884

REPORT OF CALIBRATION

Certificate No. : SP23-008Page 4 of 5

Photometric Accuracy :


Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7478	0.744	0.0038	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8686	0.863	0.0056	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2912	0.290	0.0012	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

FM-706-02 R01 1/11/2021

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ISO 15189:2013  
CALIBRATION 884

REPORT OF CALIBRATION

Certificate No. : SP23-008Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	241.0	0.72	0.18	2.00
279.45	278.8	0.65	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.8	0.14	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.5	0.52	0.18	2.00
536.59	536.5	0.09	0.18	2.00
637.98	638.0	-0.02	0.18	2.00
431.38	430.6	0.78	0.18	2.00
472.50	472.0	0.50	0.18	2.00
513.47	513.0	0.47	0.18	2.00
528.88	528.5	0.38	0.18	2.00
573.17	573.7	-0.53	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.0	0.40	0.18	2.00
740.72	740.5	0.22	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

FM-706-02 R01 1/11/2021

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

  
ISO 15189:2013  
CALIBRATION 884

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-007Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-1900

Serial No. : 2021-064

ID No. : UAE.WAS.006/2552

Received Date : 6 January 2023

Calibration Date : 6 January 2023

Issue Date : 10 January 2023

Condition Instrument : Used

Calibrated by : ( Mr.Tanawat Rittidach )

Approved by : ( Ms.Chonthicha Sangsarn )


Technical ManagerQuality 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-706-02 R01 1/11/2021

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



### REPORT OF CALIBRATION

Certificate No. : SP23-007 Page 2 of 5

Environment Condition : Ambient Temperature  $25 \pm 5$  °C

Relative humidity  $55 \pm 20$  %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance 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 : 4.0 nm.


Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.


Resolution of UUC : Photometric 0.001 Abs.

Wavelength 0.1 nm.

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



### REPORT OF CALIBRATION


Certificate No. : SP23-007 Page 3 of 5

Calibration Results : Without adjustment


Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5787	0.575	0.0037	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.181	0.0090	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.115	0.0079	0.0081	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.961	0.0024	0.0029	2.00
	1.9763	1.968	0.0083	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5191	0.518	0.0011	0.0031	2.00
	1.0003	1.000	0.0003	0.0033	2.00
	1.9987	1.993	0.0057	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5523	0.552	0.0003	0.0030	2.00
	1.0809	1.082	-0.0011	0.0030	2.00
	2.0391	2.031	0.0081	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5601	0.562	-0.0019	0.0032	2.00
	1.0512	1.052	-0.0008	0.0030	2.00
	1.9294	1.923	0.0064	0.0079	2.00

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




### REPORT OF CALIBRATION

Certificate No. : SP23-007 Page 4 of 5


Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7478	0.743	0.0048	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8686	0.861	0.0076	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2912	0.291	0.0002	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

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138-708-02-001 (1/1/2021)



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



### REPORT OF CALIBRATION

Certificate No. : SP23-007 Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.54	240.8	0.74	0.18	2.00
279.40	278.5	0.90	0.18	2.00
288.70	288.0	0.70	0.18	2.00
334.22	333.5	0.72	0.18	2.00
361.26	360.5	0.76	0.18	2.00
418.48	417.8	0.68	0.21	2.00
446.70	445.9	0.80	0.18	2.00
453.20	452.5	0.70	0.18	2.00
460.06	459.5	0.56	0.18	2.00
536.90	536.0	0.90	0.18	2.00
637.94	637.1	0.84	0.18	2.00
440.74	440.0	0.74	0.18	2.00
472.22	471.5	0.72	0.18	2.00
513.70	513.0	0.70	0.18	2.00
528.72	528.0	0.72	0.18	2.00
574.60	574.0	0.60	0.18	2.00
585.48	584.6	0.88	0.20	2.00
684.63	684.0	0.63	0.18	2.00
740.27	740.0	0.27	0.20	2.00
748.28	747.5	0.78	0.18	2.00
807.16	806.5	0.66	0.18	2.00
879.70	879.0	0.70	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 -

Uncontrolled Document  
138-708-02-001 (1/1/2021)

## Calibration Certificate

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

Page 1 of 5

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. Phrasphat Tuntit Scientist  
Approved by (Mr. Nuttapol Niyomchart)  
Specialist, Division of Calibration Laboratory  
Responsible for the Technical Management Team

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

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

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

## Calibration Report

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

Date of Calibration: 24 March 2023

Page 3 of 5

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	3.00	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	0.890	0	7.00	0.58	2.00
8	-89.156	-89	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: WLab Solids  
Serial No.: 1156983 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
6.805	6.86	22	97.96	0.0075	2.00
10.010	10.01	-160	97.96	0.0086	2.00
6.985	6.99	14	-	0.0093	2.00

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

## 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  
ID No.: UAE.WAS.003/2553  
Type: Bench top

Date of Calibration: 24 March 2023

Page 2 of 5

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-CO-003 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	22E1899	17 June 2023	
2.2 Digital Thermometer	2709007	Fluke	CC-656857-01	30 October 2023	
2.3 Thermo-Hygro Meter	NF1.BTH00317	PONPE	TE 650555-01	21 September 2023	
Certified Reference Material		Lot No.	Manufacturer	Ref N	Expire Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH216.LS	16 February 2025	
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217.LS	16 February 2025	
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220.LS	16 February 2024	
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH197.LS	16 February 2024	

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

3.1 Instruments No 2.1 through NSC-TSI-TIS 17025 Laboratory Accreditation of Calibration No.0008  
3.2 Instruments No 2.2 through NSC-TSI-TIS 17025 Laboratory Accreditation of Calibration No.0061  
3.3 Instruments No 2.3 through NSC-TSI-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 manometer. 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 BSM RaN Hi-13 LotN 25.05.2022; BSM RaN Hi-16 LotN 02.06.2022; BSM RaN Hi-13 LotN 25.05.2022; BSM RaN 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.

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

## 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

Page 4 of 5

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:

- 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 : ☒ Without adjustment ☐ After adjustment

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



## 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 Page 5 of 5

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 \*\*\*\*\*

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

## Calibration Report

Certificate No.: 2303527-001-01  
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: 5 July 2022 Page 2 of 5  
Location: Calibration Laboratory, National Food Institute  
Environment Condition: Ambient Temperature: ( 23.5 ± 1.5 ) °C Relative Humidity: ( 53 ± 5 ) %  
Condition of Equipment: Good Condition  
Condition of this Results of Calibration

1. Calibration Method: In house method / W-CO-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	Fuke	22E1959	17 June 2023
2.2. Digital Thermometer	2709007	Fuke	CC-640399-01	30 October 2022
2.3. Thermo-Hygro Meter	NFIBTH00518	PONPE	QR22-0351	18 February 2023
Certified Reference Material				
	Lot No.	Manufacturer	Batch No.	Expiry Date
2.4. pH buffer 4.008 (Primary pH buffer Solution)	805203	CPAchem	PH216.LS	21 April 2024
2.5. pH buffer 6.865 (Primary pH buffer Solution)	805204	CPAchem	PH217.LS	21 April 2024
2.6. pH buffer 10.01 (Primary pH buffer Solution)	805205	CPAchem	PH220.LS	21 April 2023
2.7. pH buffer 7.00 (Standard pH buffer Solution)	805206	CPAchem	PH107.LS	21 April 2023

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

- 3.1. Instruments No.2.1 through NIST-1815-1705 Laboratory Accreditation of Calibration No.0078  
3.2. Instruments No.2.2 through NIST-1815-1705 Laboratory Accreditation of Calibration No.0061  
3.3. Instruments No.2.3 through NIST-1815-1705 Laboratory Accreditation of Calibration No.0262  
3.4. Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Hammett cell using calibrated thermometer, bromometer, 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 H-27 LoIN 04.06.2021; BIM RefN H-28 LoIN 28.05.2021; BIM RefN H-27 LoIN 04.06.2021; BIM RefN H-28 LoIN 28.05.2021, 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.

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

## Calibration Certificate

Certificate No.: 2203527-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Sol Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakanong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter  
Manufacturer: METTLER TOLEDO  
Model: Seven Compact S220  
Serial No.: C113432421  
ID No.: UAE.WAT.009/2564  
Order No.: 2203527  
Operation No.: 2203527-001  
Date of Receipt: 30 June 2022  
Date of Calibration: 5 July 2022

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

Date of Issue: 5 July 2022

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

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

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

## Calibration Report

Certificate No.: 2203527-001-01  
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: 5 July 2022 Page 3 of 5

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	414.117	814	0.00	0.58	2.00
2	295.811	296	-2.00	0.58	2.00
4	177.402	177	-4.00	0.58	2.00
6	59.159	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	-177.403	-177	10.00	0.58	2.00
12	-295.812	-296	12.00	0.58	2.00
14	-414.119	-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.: 2210418 ID No.: N/A  
Performance of Electrode system (Three-Point Calibration at pH4, pH7 and pH10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.010	182	-	0.0071	2.00
6.865	6.850	14	100.0	0.0075	2.00
10.008	10.010	-168	-97.9	0.0093	2.00
0.005	-6.990	6	-	0.0087	2.00

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

## Calibration Report

**Certificate No.:** Z203527-001-01  
**Equipment:** Digital Thermometer with RTD  
Resolution: 0.1 °C Model: Seven Compact S220  
Serial No.: C113432421 ID No.: UAE.WAT.009/2564  
Manufacturer: METTLER TOLEDO

**Date of Calibration:** 5 July 2022 **Page 4 of 5**

**Location:** Calibration Laboratory, National Food Institute  
**Environment Condition:** Ambient Temperature 25 °C ± 1 °C  
Relative Humidity 48 % ± 3 %

### 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 650057-01	10-Dec-22	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 : ☒ Without adjustment ☐ After adjustment

F-CS-012 Revision: 01 Date: 28-04-65

2008 บางนา-สุขุมวิท 36 หมู่บ้านสุขุมวิท ถนนสุขุมวิท กรุงเทพมหานคร เอกสารไม่ควบคุม  
2008 Soi 36, Arun Amari Road, Bang Yi Khan, Suddhikot, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2462 0680 Fax: +66(0) 2462 0545

## Calibration Report

**Certificate No.:** Z203527-001-01  
**Equipment:** Digital Thermometer with RTD  
Resolution: 0.1 °C Model: Seven Compact S220  
Serial No.: C113432421 ID No.: UAE.WAT.009/2564  
Manufacturer: METTLER TOLEDO

**Date of Calibration:** 5 July 2022 **Page 5 of 5**

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

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : - S/N : -
- Dimension of probe : Diameter 9 mm., Length 120 mm.,
- Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.038	- 0.1	0.12
25.1	25.038	- 0.1	0.12
35.2	35.024	- 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 \*\*\*\*\*

F-CS-012 Revision: 01 Date: 28-04-65

2008 บางนา-สุขุมวิท 36 หมู่บ้านสุขุมวิท ถนนสุขุมวิท กรุงเทพมหานคร เอกสารไม่ควบคุม  
2008 Soi 36, Arun Amari Road, Bang Yi Khan, Suddhikot, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2462 0680 Fax: +66(0) 2462 0545



## Certificate of Calibration

**Certificate No.:** C24230059 **Page:** 2 of 2

**Equipment:** CONDUCTIVITY METER  
Model: Lab 955  
Serial No. (or ID.): 16300356  
Manufacturer: SI Analytics  
Electrode Serial No. 16070067  
Condition: In Condition  
**Certificate No.:** C24230059  
**Issued Date:** 16 March 2023  
**Job No.:** KSPR2304472  
**Page:** 1 of 2  
**Model:** LF413T **Brand:** SI Analytics

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

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

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

**Calibration By:** Mr. Atachai Ngamchanat  
**Calibration Date:** 16 March 2023  
**The Method used:** In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14  
**Traceability:** This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 838312, 838316

(Mr. Atachai Ngamchanat)  
Person in charge

(Mr. Nitinun Srihawan)  
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

John Kavanagh, CEO, Lab 955  
DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

เอกสารไม่ควบคุม

Delivering Growth - In Asia and Beyond.

CAL-FM-C24-09: 12 Sep 2022

### Calibration Results:

#### Before Adjustment

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	24.5 µS/cm	0.500 µS/cm	2.00	0.21 µS/cm
1413.0 µS/cm	1403 µS/cm	10.0 µS/cm	2.00	9.0 µS/cm
111.3 mS/cm	108.5 mS/cm	2.80 mS/cm	2.00	0.67 mS/cm

#### After Adjustment ; at 1413 µS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	24.8 µS/cm	0.200 µS/cm	2.00	0.21 µS/cm
1413.0 µS/cm	1413 µS/cm	0.0 µS/cm	2.00	9.0 µS/cm
111.3 mS/cm	108.8 mS/cm	2.50 mS/cm	2.00	0.67 mS/cm

The End of Certificate

John Kavanagh, CEO, Lab 955  
DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

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CAL-FM-C24-09: 12 Sep 2022





ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab 955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
16 Mar 2023			16 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ซองใส่ตัวอย่าง, ภายใน-นอกเครื่อง )	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Spectrophotometer					
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ (Battery Backup) $\geq 2.5$ VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวควบคุมความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV $< 3,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible $< 5,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ซองรักษาตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
pH Meter and Conductivity Meter					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันละออง Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
Turbidimeter					
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการกรองตัวอย่างของแสง ( $\geq 2.5$ ไมครอน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
Automatic titrator					
<input type="checkbox"/>	<input type="checkbox"/>	18. สลัก Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ: Electrode วัสดุทนกรดได้ 25.1°C ใน Control Waterbath ที่ 25.0  $\pm$  0.1°C

Mr.Atachai Ngamchanat

Service Engineer

บริษัท ดิเคช เอเชีย จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
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CAL-FM-R31-03: 20 Jul 2022

เอกสารนี้ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2710-9484



Cert.No.: 23MM112  
Page.: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance  
Manufacturer : Mettler Toledo  
Model : XSR205  
Serial No. : C009071872  
ID No. : UAE.WAO.012/2563  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phakhanong,  
Bangkok 10260  
Location : Balance Room  
Received order : 26 April 2023  
Calibration Date : 26 April 2023  
Ambient Temperature : 15 °C to 40 °C  
Relative Humidity : 30 % to 90 %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
(✓) Suwit Imjai  
Issue Date : 2 May 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.

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0459OC-1

Cert.No.: 23MM112  
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

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- 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 81 g Resolution 0.00001 g  
81 g to 220 g Resolution 0.0001 g

Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
( g )	( g )	( g )	( $\pm$ mg )	( k )
80	80.00005	-0.00005	0.15	2.00
200	199.9999	+0.0001	0.29	2.00

After Adjustment :

1. Determination of the standard deviation of weighing machine

( n = 10 )

Applied Weight	Standard Deviation of Reading ( g )
( g )	
80	0.000007
200	0.00000



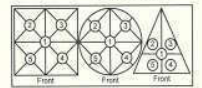
Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0459OC-1

Cert.No.: 23MM112  
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	Position 2	Position 3	Position 4	Position 5	Maximum difference between off-center and central loading ( g )
( g )	( g )	( g )	( g )	( g )	
-0.0001	-0.0001	0.0000	-0.0001	-0.0001	0.0001

3. Departure from nominal value

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
( g )	( g )	( g )	( $\pm$ mg )	( k )
Unload	0.00000	0.00000	0.014	2.13
0.05	0.05001	-0.00001	0.015	2.09
0.1	0.10001	-0.00001	0.015	2.09
1	1.00001	-0.00001	0.018	2.04
5	5.00003	-0.00003	0.026	2.00
20	20.00006	-0.00006	0.045	2.00
50	50.00006	-0.00006	0.080	2.00
80	80.00004	-0.00004	0.15	2.00
100	100.00000	0.0000	0.16	2.00
150	150.00000	0.0000	0.29	2.00
200	200.00000	0.0000	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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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.: 23MM113  
Page: 1 of 3

## Certificate of Calibration

Equipment : Electronic Balance  
Manufacturer : Mettler Toledo  
Model : XSR205  
Serial No. : C210685394  
ID No. : UAE.WAO.010/2565  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phakhanong,  
Bangkok 10260  
Location : Balance Room  
Received order : 26 April 2023  
Calibration Date : 26 April 2023  
Ambient Temperature : 15 °C to 40 °C  
Relative Humidity : 30 % to 90 %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
 ( ) Pornthippa Tameyakul  
 ( ) Malee Butkruea  
 (✓) Suwit Imjai  
Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0459OC-2  
Procedure used :-

Cert.No.: 23MM113  
Page: 2 of 3

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

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- 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 81 g	81 g to 220 g
Resolution	0.00001 g	0.0001 g

Before Adjustment	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Applied Weight (g)	80	79.99992	+0.00008	0.15
	200	199.9995	+0.0005	0.29

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

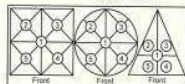
Applied Weight (g)	Standard Deviation of Reading (g)
80	0.00007
200	0.00004

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0459OC-2

Cert.No.: 23MM113  
Page: 3 of 3



Maximum difference between off-center and central loading (g)  
0.0001

### 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)
-0.0001	-0.0001	0.0000	-0.0001	-0.0001

### 3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.11
0.05	0.04999	+0.00001	0.015	2.09
0.1	0.09999	+0.00001	0.015	2.07
1	1.00000	0.00000	0.018	2.04
5	5.00000	0.00000	0.026	2.00
20	20.00002	-0.00002	0.045	2.00
50	50.00002	-0.00002	0.080	2.00
80	80.00002	-0.00002	0.15	2.00
100	100.00000	0.00000	0.17	2.00
150	150.00000	0.00000	0.29	2.00
200	199.99999	+0.00001	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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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.: 22TM1490  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 55  
Serial No. : B216.1666  
ID No. : UAE.WAO.027/2559  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Lab Floor 2  
Received Order : 19 October 2022  
Calibration Date : 19 October 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Preecha Hishib  
Approved by :   
 ( ) Pornthippa Tameyakul  
 ( ) Malee Butkruea  
 (✓) Suwit Imjai  
Issue Date : 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0046800





Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-05750C-1  
Procedure Used :-

Cert. No.: 22TM1490

Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument Model Serial No. Cert. No. Due Date  
1 ) Data Acquisition 34970A MY41021843 22LM4 10 Jan 2023

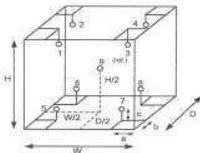
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	29	30
REL Humid. ( % )	47	40
AC Supply ( Volt )	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	( 104 ) °C	( 140,180 ) °C
1	18-04RTD-01	21-04TC-01
2	18-04RTD-02	21-04TC-02
3	18-04RTD-03	21-04TC-03
4	18-04RTD-04	21-04TC-04
5	18-04RTD-05	21-04TC-05
6	18-04RTD-06	21-04TC-06
7	18-04RTD-07	21-04TC-07
8	18-04RTD-08	21-04TC-08
9 (ref.)	18-04RTD-09	21-04TC-09

Probe Installation Details : Dimension of Chamber :  
a = 5.0 cm D = 0.33 m  
b = 5.0 cm W = 0.40 m  
c = 5.0 cm H = 0.40 m  
Capacity = 0.053 m<sup>3</sup>

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Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-05750C-1  
Procedure Used :-

Cert. No.: 22TM1490

Page : 3 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument Model Serial No. Cert. No. Due Date  
1 ) Data Acquisition 34970A MY41021843 22LM4 10 Jan 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 : Close

Measured Temperature ( °C )									
Point ( °C )	Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k		
104.0	104.0	104.0	0.061	1.3	1.7	0.42	2		
140.0	140.0	140.0	0.14	2.3	2.4	1.1	2		
180.0	180.0	180.0	0.21	3.5	3.6	1.3	2		

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES  
534-4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2715-3000-29 FAX. 0-2719-9884



Cert. No.: 23TM373

Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 55  
Serial No. : B212.0411  
ID No. : UAE.WAO.005/2556  
Submitted by : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Lab Floor 2  
Received Order : 11 April 2023  
Calibration Date : 11 - 12 April 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Krisda Malee

Approved by :  
( ) Ponthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 24 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.

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A 0053359



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2304-01560C-1  
Procedure Used :-

Cert. No.: 23TM373

Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument Model Serial No. Cert. No. Due Date  
1 ) Data Acquisition 34972A MY59003411 22LM165 26 Nov 2023

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

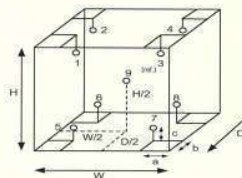
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	27	28
REL Humid. ( % )	45	44
AC Supply ( Volt )	221	220



Probe Installation Details : Dimension of Chamber :  
a = 5.0 cm D = 0.50 m  
b = 5.0 cm W = 0.80 m  
c = 5.0 cm H = 0.75 m  
Capacity = 0.30 m<sup>3</sup>

Ref. Std. ID No.: @ Calibration Point		
Position :	( 120 to 180 ) °C	( 104 ) °C
1	18-20TC-01	20RTD-2/1
2	18-20TC-02	20RTD-2/2
3	18-20TC-03	20RTD-2/3
4	18-20TC-04	20RTD-2/4
5	18-20TC-05	20RTD-2/5
6	18-20TC-06	20RTD-2/6
7	18-20TC-07	20RTD-2/7
8	18-20TC-08	20RTD-2/8
9 (ref.)	18-20TC-09	20RTD-2/9

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A 1133252



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2304-01560C-1  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM373  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.054	0.59	0.95	2
120.0	120.0	120.0	0.12	0.89	1.5	2
180.0	180.0	180.0	0.12	1.5	2.5	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.512	104.016	104.542	104.407	103.704	103.729	104.167	104.158	104.001	0.42
120.0	120.317	119.768	120.524	120.232	119.363	119.209	119.888	119.797	119.735	1.1
180.0	180.878	179.819	181.357	180.871	179.303	179.139	180.230	180.055	179.960	1.1

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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



## Calibration Certificate

Certificate No.: 2302827-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

Page 1 of 4

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. Phraphat Tuanjit) Manager, Division of Calibration Laboratory  
Date of Issue: 18 May 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.

F-C5-009 Revision: 01 Date: 20-04-65

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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

Page 2 of 4

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	8305567372	PCS	M23040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFLBTR 016/23	Quality Return	QR23-0489	21 February 2024

3. This certificate is traceable to SI UNIT

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

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

Calibration Results:

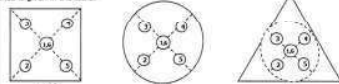
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.000032
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	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
100.0002	100.0002	100.0002	100.0002	100.0003	100.0002	0.0001

F-C5-012 Revision: 01 Date: 20-04-65

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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

Page 3 of 4

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
Unloaded	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

F-C5-012 Revision: 01 Date: 20-04-65

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## Calibration Report

**Certificate No.:** 2302827-001-01  
**Equipment:** Electronic Balance  
**Model:** XSR204  
**Serial No.:** CL17635043  
**Capacity:** 220 g  
**Manufacturer:** METTLER TOLEDO  
**Resolution:** 0.0001 g  
**ID No.:** UAE.WAO.012/2564

**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 -----

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

Uncontrolled Document

## Certificate of Calibration

Cert. No.: 23TM249  
Page: 1 of 3

**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 Hiahib  
**Approved by:** [Signature]  
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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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

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A 0051476



**Equipment:** BOD Incubator  
**Condition As-Received:** Used Item  
**Reference:** 2302-0287OC-1  
**Cert. No.:** 23TM249  
**Page:** 2 of 3

**Probe 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

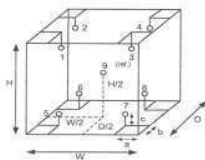
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



### Probe Installation Details:

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

### Dimension of Chamber:

D = 0.82 m  
W = 1.2 m  
H = 1.2 m  
Capacity = 0.89 m<sup>3</sup>

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

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

Uncontrolled Document

A 1149512



**Equipment:** BOD Incubator  
**Condition As-Received:** Used Item  
**Reference:** 2302-0287OC-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

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

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

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

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

**UUC\*:** Unit Under Calibration

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

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

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Uncontrolled Document

A 1149512



Cert. No.: 23TM375  
Page : 1 of 3

## Certificate of Calibration

Equipment : BOD Incubator  
Manufacturer : ARCO  
Model : UR-1320  
Serial No. :  
ID No. : UAE.WAO.018/2551  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Lab Floor 2  
Received Order : 11 April 2023  
Calibration Date : 12 April 2023  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
Calibrated by : Krisda Malee  
Approved by :  
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053360



Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2304-0156OC-2  
Cert. No.: 23TM375  
Page : 2 of 3

### 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	MY59003411	22LM165	26 Nov 2023

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

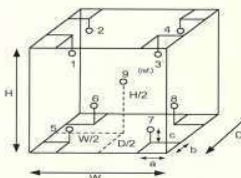
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	28	27
REL.Humid. ( % )	42	45
AC Supply ( Volt )	219	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 m<sup>3</sup>

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

Uncontrolled Document  
A 1196239



Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2304-0156OC-2  
Result of Calibration :- ( ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available  
Cert. No.: 23TM375  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor k
20.0	20.0	20.0	0.48	0.42	1.2	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.040	20.170	20.263	20.093	19.749	19.704	19.920	20.191	20.020	0.06

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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A 1196239



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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.Tanasut Rititach)  
Technical Manager

Approved by :  
(Ms.Chomthicha Sangneng)  
Quality Manager

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

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

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**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 2 of 5

Environment Condition : Ambient Temperature  $25 \pm 5$  °C  
Relative humidity  $55 \pm 20$  %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance 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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**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	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
	1.0005	0.9980	0.0025	0.0035	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

FM-708-02 R01 1/11/2021

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**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7478	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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**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 5 of 5

Wavelength Accuracy :



CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	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  
- NA = 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 -

FM-708-02 R01 1/11/2021

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CERTIFICATE OF CALIBRATION

Certificate No. : SP23-007Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-1900

Serial No. : 2021-064

ID No. : UAE.WAS.006/2552

Received Date : 6 January 2023

Calibration Date : 6 January 2023

Issue Date : 10 January 2023

Condition Instrument : Used



Calibrated by : (Mr.Tanawat Rittidach )Approved by : (Ms.Chonticha Sangnern )  
Technical ManagerQuality Manager

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

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

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REPORT OF CALIBRATION

Certificate No. : SP23-007Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C  
Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance 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 : 4.0 nm.



Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.  
Wavelength 0.1 nm.

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170-000-001-1/1/2021

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REPORT OF CALIBRATION

Certificate No. : SP23-007Page 3 of 5



Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5787	0.575	0.0037	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.181	0.0090	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.115	0.0079	0.0081	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.961	0.0024	0.0029	2.00
	1.9763	1.968	0.0083	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5191	0.518	0.0011	0.0031	2.00
	1.0003	1.000	0.0003	0.0033	2.00
	1.9987	1.993	0.0057	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5523	0.552	0.0003	0.0030	2.00
	1.0809	1.082	-0.0011	0.0030	2.00
	2.0391	2.031	0.0081	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5601	0.562	-0.0019	0.0032	2.00
	1.0512	1.052	-0.0008	0.0030	2.00
	1.9294	1.923	0.0064	0.0079	2.00

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



REPORT OF CALIBRATION


Certificate No. : SP23-007Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7478	0.743	0.0048	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8686	0.861	0.0076	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2912	0.291	0.0002	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

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170-000-001-1/1/2021

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



ISO 9001:2015  
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP23-007Page 5 of 5


Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.54	240.8	0.74	0.18	2.00
279.40	278.5	0.90	0.18	2.00
288.70	288.0	0.70	0.18	2.00
334.22	333.5	0.72	0.18	2.00
361.26	360.5	0.76	0.18	2.00
418.48	417.8	0.68	0.21	2.00
446.70	445.9	0.80	0.18	2.00
453.20	452.5	0.70	0.18	2.00
460.06	459.5	0.56	0.18	2.00
536.90	536.0	0.90	0.18	2.00
637.94	637.1	0.84	0.18	2.00
440.74	440.0	0.74	0.18	2.00
472.22	471.5	0.72	0.18	2.00
513.70	513.0	0.70	0.18	2.00
528.72	528.0	0.72	0.18	2.00
574.60	574.0	0.60	0.18	2.00
585.48	584.6	0.88	0.20	2.00
684.63	684.0	0.63	0.18	2.00
740.27	740.0	0.27	0.20	2.00
748.28	747.5	0.78	0.18	2.00
807.16	806.5	0.66	0.18	2.00
879.70	879.0	0.70	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 -  
Uncontrolled Document  
ISO 9001:2015 1/1/2021

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



ISO 9001:2015  
CALIBRATION DATA

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-008Page 1 of 5

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

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

Location of calibration : Laboratory 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009

ID No. : UAE.WAT.051/2564

Received Date : 6 January 2023

Calibration Date : 6 January 2023

Issue Date : 10 January 2023

Condition Instrument : Used

Calibrated by : ( Mr.Tanawat Rittidach )  
Technical Manager

Approved by : ( Ms.Chonthicha Sangnern )  
Quality Manager

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

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

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ISO 9001:2015 1/1/2021

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



ISO 9001:2015  
CALIBRATION DATA

REPORT OF CALIBRATION

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Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance 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 : 200 nm/min


Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.

Wavelength 0.1 nm.

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CALIBRATION DATA

REPORT OF CALIBRATION

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Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5787	0.574	0.0047	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.182	0.0080	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.114	0.0089	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.960	0.0034	0.0029	2.00
	1.9763	1.969	0.0073	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5191	0.516	0.0031	0.0031	2.00
	1.0003	0.997	0.0033	0.0033	2.00
	1.9987	1.991	0.0077	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5523	0.550	0.0023	0.0030	2.00
	1.0809	1.078	0.0029	0.0030	2.00
	2.0391	2.032	0.0071	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5601	0.558	0.0021	0.0031	2.00
	1.0512	1.049	0.0022	0.0030	2.00
	1.9294	1.922	0.0074	0.0079	2.00

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**REPORT OF CALIBRATION**

Certificate No. : SP23-008 Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7478	0.744	0.0038	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8686	0.863	0.0056	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2912	0.290	0.0012	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

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**REPORT OF CALIBRATION**

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Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	241.0	0.72	0.18	2.00
279.45	278.8	0.65	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.8	0.14	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.5	0.52	0.18	2.00
536.59	536.5	0.09	0.18	2.00
637.98	638.0	-0.02	0.18	2.00
431.38	430.6	0.78	0.18	2.00
472.50	472.0	0.50	0.18	2.00
513.47	513.0	0.47	0.18	2.00
528.88	528.5	0.38	0.18	2.00
573.17	573.7	-0.53	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.0	0.40	0.18	2.00
740.72	740.5	0.22	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 TISIR 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. S2-ME8708640

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. T1152457, Chromium Lot No. T193249, Copper Batch No. T117098A, Iron Batch No. T126087A, Lead Lot No. T227873, 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 : ( Mr. Danai Srithongkum ) Approved by : ( Miss Subadda Deawong )  
2 ( Mr. Atitap Ratana ) Acting Director of Analytical Chemistry Laboratory  
Ref. 2015266012600366001  
Issued Date : 15 February 2023

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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
Average Absorbance	0.002	-0.001	0.001	0.000	0.000	0.001	-0.001	-0.001

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MTC. ACL. No. 387 / 66

## 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

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Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

## 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

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## 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

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Request No. 25-66 / 0323

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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. Dr. Sathit  
(Mr. Danai Srithongkum)  
2. Atipat  
(Mr. Atipat Ratana)

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

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End of Certificate

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Uncontrolled Document


# PinAAcle 900F Preventive Maintenance Report

Company Name: UNITED ANALYST AND ENGINEERING  
Instrument Location: BANGCHAK, PRAKHANONG  
BANGKOK, 10260  
Instrument Serial No.: PFB520031902  
Date: 20-Jul-2022

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## PinAAcle 900F Preventive Maintenance (PM)

Company Name:	UNITED ANALYST AND ENGINEERING		
Address (Instrument Location):	BANGCHAK, PRAKHANONG, BANGKOK, 10260		
Serial Number:	PFB520031902	PM Number:	2/2
Customer Name (if applicable):	K. SATHIDA	Telephone Number:	095-5580-049
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-01710010
Date PM Performed: (DD-MM-YYYY)	Jul 20, 2022	Next PM Due Date: (DD-MM-YYYY)	Jan 20, 2023
Standard Labor Hours to Complete PM :		5 hours	

Part Number	Release	Publication Date	
09370145 Rev.9	A	January 2018	

### Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900F by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

### General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM.

Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files.

The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer.

Update the PM sticker and instrument logbook as required.

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## Component List

Component / Specific Model	Serial #	Configuration Notes

## Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	N/A
N3160156	O-Ring Kits for Sampling Introduction (Stainless Steels Nebulizer)	N/A
N3160137	O-Ring Kits for Sampling Introduction (Plastic Nebulizer)	N/A
N9301714	Replacement Acetylene Filter Cartridge	N/A
T11001022	Replacement Air Filter Cartridge	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	25-76CUY1	30-Oct-2022

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 mL	AR	AR
N/A	0.5% HNO <sub>3</sub>	250 mL	AR	AR

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## Additional Tools Required for PM

Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MG0-252
N1013002	1.0A Neutral density filter	1	MG0-358
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190

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## Procedure Checklist

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

### 1. General:

- ✓ Review the instrument performance with the customer and document any recent problems.
- ✓ Inspect the customer log book and make any appropriate PM entries.
- ✓ Perform general inspection of system for cleanliness.

### 2. PC Instrument Software:

- ✓ Instrument Software user files/databases archived, packed, and/or deleted as needed.

### 3. Mechanical:

- ✓ Inspect and clean all fans and filters. Replace filters if necessary.
- ✓ Inspect all gas lines for leaks and/or wear. Replace if needed.
- ✓ Clean exterior of the instrument.
- ✓ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ✓ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification.
- ✓ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ✓ Check the drain system for signs of wear. Replace worn or damaged parts.
- ✓ Visually check for proper flame conditions when igniting the Air-C<sub>2</sub>H<sub>2</sub> and N<sub>2</sub>O-C<sub>2</sub>H<sub>2</sub> flames (if applicable).

### 4. Electrical:

- ✓ Inspect PC boards. Clean if necessary.
- ✓ Carefully check all internal and external cable connections.
- ✓ Check instrument firmware revisions upgrade to current levels (if necessary).
- ✓ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

### 5. Optics:

- ✓ Inspect and clean the sample compartment windows, if needed.
- ✓ Inspect optics. Clean or replace if necessary.

### 6. Gases:

- ✓ Verify that the Gases supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SOB.
- ✓ Verify that the acetylene filter and air filter element is dry. Replace if necessary.

### 7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

### 8. After PM Performance tests:

#### 8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 533.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.9848	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.1963	Passed

#### 8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0008	Passed

#### 8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

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#### 8.4 D, Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0049	Passed

#### 8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0003	Passed

#### 8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0005	Passed

#### 8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3353	Passed

### 10. Review:

- ✓ Review with the customer PM work performed.
- ✓ Review with the customer routine maintenance procedures.
- ✓ Discuss recommended customer supplied materials to have on hand.
- ✓ Attach PM sticker.

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## Additional Comments

### Additional Comments Regarding the PM

## Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.

This PinAAcle 900F Passes ☒ Fails ☐ the preventive maintenance.

### Review of Preventive Maintenance:

Authorized PerkinElmer Representative:	Date: 20-Jul-2022 (DD-MM-YYYY)
Authorized Customer Representative:	Date: 20-Jul-2022 (DD-MM-YYYY)

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## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results. Delivered by highly-trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak.

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

### Customer Information

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

### Service Engineer's Responsibilities

- Only complete/printout pages that relate to the system being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

### System Information

Instrument system name and ID	ICP 5110 VDV
Instrument system site and location	UAE / 3rd Floor Laboratory
List system component product numbers	List the serial numbers of each component
1. G2015A	1. MY18030001
2. G2015A	2. 1801-01988
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

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

## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

### General Preparation

- Discuss any specific questions or issues with the customer prior to starting.
- Review the instrument logbook.
- Perform general external inspection of system for cleanliness.
- Check for proper installation of safety-related parts, assemblies, sensors etc.
- Check for required firmware/software updates and verify with customers if they would like it installed.
- For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. N/A
- Run Instrument Performance test and record results in Instrument Performance Test Results Table - Pre PM.

### Inspect and clean the system

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

### G8481A Cooling water system

- Section NOT Applicable
- Drain cooling fluid and remove any particles from the chiller reservoir
- Remove, clean and reinstall water inlet metal mesh filter.
- Re fill with Polyclear cooling fluid.
- Clean the cooling system Air filter and the condenser by compressed air or vacuum cleaner.

## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

### SPS 3 Auto Sampler

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

### SPS 4 Auto Sampler

- Section NOT Applicable
- Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner
- Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles

### AVS 4.6.7

- Section NOT Applicable
- Replace valve rotor seal
- Check fittings for signs of leaks
- Check tubing including autosampler tubing for kinks or excessive wear
- Check high flow pump for signs of leaks

### Instrument Adjustment

- Check position of Zn peak, adjust if required.
- Check Argon Ratio, adjust to specified value if required.
- Perform Detector Calibration.
- Perform Instrument Calibration.
- Run Instrument Performance Test and record results in Instrument Performance Test Results Table - Post PM.
- For systems using ICP Expert version 7.3 and above run the following Instrument tests and record the result in the Instrument Test Results Table
  - Subsystem Communications Test
  - Air Flow



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- ☒ Water Flow
- ☒ Gas Flows
- ☒ RF Generator
- ☒ Camera Test
- ☒ Optics Test
- ☒ Nebulizer Test

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	4100.6	8364.8	4375.0	8400.8
Mn 257.610 nm SRBR	11064.7	31842.1	12801.7	30846.2
Al 396.152 nm SBR	7.5	14.9	9.9	16.8
K 766.491 nm SBR	5.1	36.8	6.4	39.7

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

Instrument Test Results Table

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

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

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ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	224.540	VAC	227.913	VAC
Mains Current	0.204	A	0.184	A
Instrument Temperature	22.8	°C	22.7	°C
RF Air Flow (sensor speed)	15.0	Hz	15.0	Hz
Plasma Exhaust Temperature	No measurement		26.7	°C
Water Flow Oscillator	No measurement		1.64	L/min
Water Flow Detector	1.06	L/min	1.06	L/min
Water Inlet Temperature	18.0	°C	18.0	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-33.8	°C	-33.8	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	671.94	kPa	677.33	kPa
Purge Gas Supply Pressure*1	674.30	kPa	645.40	kPa
Option Gas Supply Pressure*1	N/A	kPa	N/A	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		164.63	kPa
Plasma Gas Flow	No measurement		11.92	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1200	W
RF Supply Current	No measurement		8.663	A
RF Supply Voltage	No measurement		164.660	V

\*1 If option installed

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ICP-OES Parts List Table

Part description	Part Number	Product / Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-08014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-08015	All	1
Polyclear Cooling Fluid	G3292-80010	G8481A	
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-08002	All	1
High Capacity Air Filter	G8010-60189	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-00002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-00002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineers stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710048000	SPS 4	

Restore system

For HF applications, ask the customer to reinstall their sample introduction system.

Leave system in an idle state: on and purging.

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

Service Review

- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section below if there are additional comments.

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- ☒ Review the service and any test results with the customer.
- ☒ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

Service Engineer Comments (optional)

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

Other Important Customer Web Links

How to get information on your product:

- ☒ Literature Library - <http://www.agilent.com/en-us/products/icp-oes/icp-oes-systems/5110-icp-oes#literature>
- ☒ Need to know more? - <http://www.agilent.com/crosslab/university/>
- ☒ Need technical support, FAQs? - <http://www.agilent.com/en-us/support/landing/icp-oes>
- ☒ Need supplies? - [www.agilent.com/chem/supplies](http://www.agilent.com/chem/supplies)

Service Completion

Service request number: 600565987 Date service completed: 30 Nov 2017

Agilent signature: [Signature] Customer signature: [Signature]

Document part number: G8014-00075

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Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	Test Before PM
Test Completed On	11/20/2022 9:35:32 AM
Result Summary	
Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

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Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.62	
As (188.980 nm)	≤ 8.20	6.20	
C (193.027 nm)	≤ 11.50	8.35	
Mo (202.032 nm)	≤ 8.20	6.41	
Cr (206.158 nm)	≤ 13.40	9.04	
Zn (213.857 nm)	≤ 8.70	6.62	
Pb (220.353 nm)	≤ 9.90	7.13	
Co (228.615 nm)	≤ 17.20	11.71	
Ba (230.424 nm)	≤ 9.40	7.21	
Mn (257.610 nm)	≤ 13.30	9.50	
Mn (260.568 nm)	≤ 20.30	14.33	
Cr (267.716 nm)	≤ 11.00	8.14	
Cu (324.754 nm)	≤ 25.00	16.98	
Cu (327.395 nm)	≤ 14.20	11.24	
Sr (338.071 nm)	≤ 33.50	24.47	
Ba (455.403 nm)	≤ 44.00	33.88	
Sr (460.733 nm)	≤ 36.00	17.22	
Ba (493.408 nm)	≤ 36.00	25.48	
Ba (614.171 nm)	≤ 42.00	25.47	
Ar (679.283 nm)	≤ 74.00	58.02	
K (766.491 nm)	≤ 80.00	64.94	

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Sensitivity Test		Pass			
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	147.7	1156.5	55.5
Se (196.026 nm)	≥ 41.0	SRBR	111.1	1195.3	97.7
Zn (213.857 nm)	≥ 1421.0	SRBR	4100.6	51959.5	159.6
Pb (220.353 nm)	≥ 46.0	SRBR	192.5	2808.6	185.7
Mn (257.610 nm)	≥ 3518.0	SRBR	11064.7	264165.0	567.6
Al (396.152 nm)	≥ 3.4	SBR	7.5	49047.9	5770.5
Ba (493.408 nm)	≥ 34.0	SBR	107.4	1887710.3	17407.5
K (766.491 nm)	≥ 1.8	SBR	5.1	100805.9	16626.4
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	234.9	3056.4	152.9
Se (196.026 nm)	≥ 159.0	SRBR	218.1	3695.1	271.6
Zn (206.200 nm)	≥ 234.0	SRBR	1306.5	15850.4	144.5
Zn (213.857 nm)	≥ 1743.0	SRBR	8364.0	163037.8	476.4
Cd (214.439 nm)	≥ 4227.0	SRBR	7718.5	143240.2	342.8
Pb (220.353 nm)	≥ 320.0	SRBR	576.3	14465.2	580.4
Mn (257.610 nm)	≥ 10625.0	SRBR	31842.1	1411257.3	1958.9
Cr (267.716 nm)	≥ 1048.0	SRBR	4492.1	183110.6	1632.2
Cu (324.754 nm)	≥ 19.0	SBR	46.2	371487.5	7862.9
Al (396.152 nm)	≥ 6.0	SBR	14.9	278447.4	17552.6
Ba (493.408 nm)	≥ 60.0	SBR	190.6	10061527.3	52519.8
K (766.491 nm)	≥ 24.0	SBR	36.8	1922163.4	50858.1

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Precision Test		Pass
Radial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.82
Se (196.026 nm)	≤ 2.60	0.71
Zn (213.857 nm)	≤ 1.50	0.43
Pb (220.353 nm)	≤ 2.60	0.76
Mn (257.610 nm)	≤ 1.50	0.60
Al (396.152 nm)	≤ 1.50	0.48
Ba (493.408 nm)	≤ 1.50	0.89
K (766.491 nm)	≤ 1.50	0.42
Axial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.57
Se (196.026 nm)	≤ 1.50	0.76
Zn (206.200 nm)	≤ 1.50	0.61
Zn (213.857 nm)	≤ 1.50	0.51
Cd (214.439 nm)	≤ 1.50	0.59
Pb (220.353 nm)	≤ 1.50	0.52
Mn (257.610 nm)	≤ 1.50	0.54
Cr (267.716 nm)	≤ 1.50	0.54
Cu (324.754 nm)	≤ 1.50	0.69
Al (396.152 nm)	≤ 1.50	0.91
Ba (493.408 nm)	≤ 1.50	0.85
K (766.491 nm)	≤ 1.50	1.22

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เอกสารไม่ควบคุม

Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9507	
Firmware Version	3442	
Tested By	PM Functional test	
Test Completed On	11/30/2022 11:43:36 AM	
Result Summary		
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
Water Flow Test	Pass	
Gas Flows Test	Pass	
RF Generator Test	Pass	
Camera Test	Pass	
Optics Test	Skipped	
Advanced Valve System Test	Skipped	
Resolution Test	Skipped	
Sensitivity Test	Skipped	
Precision Test	Skipped	
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
30% Air Flow (relative speed)	75% Air Flow (relative speed)	
14.00	19.00	
Water Flow Test	Pass	
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.44	1.05	18.51

Page 1 of 2

เอกสารไม่ควบคุม

Gas Flows Test						Pass
Inertial Flow Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure	
0.70	0.70	163.37	2.00	1.99	108.49	
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure	
2.00	2.00	112.85	18.00	17.91	23.46	
RF Generator Test						Pass
RF Power Supply Test	Passed					
RF Power Supply (V)	147.437					
RF Oscillator Test	Passed					
RF Oscillator Frequency (MHz)	0.000					
Work Coil Current (A)	45.069					
RF Power Supply Current (A)	1.997					
Camera Test				Pass		
	Integration Time (ms)	Standard Deviation	Status			
Electronic Offset Test	1000	5.305	Passed			
Dark Current Test	6000	0.578	Passed			
Array Test	5	0.024	Passed			
Linearity Test		0.118	Passed			

Page 2 of 2

เอกสารไม่ควบคุม

Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9507	
Firmware Version	3442	
Tested By	PM Performance test	
Test Completed On	11/30/2022 12:10:42 PM	
Result Summary		
Subsystem Communications Test	Skipped	
Air Flow Test	Skipped	
Water Flow Test	Skipped	
Gas Flows Test	Skipped	
RF Generator Test	Skipped	
Camera Test	Skipped	
Optics Test	Pass	
Advanced Valve System Test	Skipped	
Resolution Test	Pass	
Sensitivity Test	Pass	
Precision Test	Pass	
Optics Test	Pass	
	Radial	Axial
Intensity	5674608	5823476
Wavelength	737.212	737.212

Page 1 of 4

เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.79	
As (188.980 nm)	≤ 8.20	6.09	
C (193.027 nm)	≤ 11.50	8.29	
Mo (202.032 nm)	≤ 8.20	6.30	
Cr (206.158 nm)	≤ 13.40	9.05	
Zn (213.857 nm)	≤ 8.70	6.77	
Pb (220.353 nm)	≤ 9.50	7.02	
Co (228.615 nm)	≤ 17.20	11.67	
Ba (230.424 nm)	≤ 9.40	7.39	
Mn (257.610 nm)	≤ 13.30	9.48	
Mn (260.568 nm)	≤ 20.30	14.25	
Cr (267.716 nm)	≤ 11.00	7.94	
Cu (324.754 nm)	≤ 25.00	18.99	
Cu (327.395 nm)	≤ 14.20	11.33	
Sr (338.071 nm)	≤ 33.50	24.44	
Ba (455.403 nm)	≤ 44.00	33.86	
Sr (460.733 nm)	≤ 36.00	17.51	
Ba (493.408 nm)	≤ 36.00	25.56	
Ba (514.171 nm)	≤ 42.00	24.96	
As (575.203 nm)	≤ 74.00	60.38	
K (766.491 nm)	≤ 80.00	65.63	

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เอกสารไม่ควบคุม



Sensitivity Test					
Pass					
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	147.8	1149.3	54.8
Se (196.026 nm)	≥ 41.0	SRBR	111.6	1222.8	101.0
Zn (213.857 nm)	≥ 1421.0	SRBR	4375.0	52592.3	143.7
Pb (220.353 nm)	≥ 46.0	SRBR	199.8	2744.4	166.5
Mn (257.610 nm)	≥ 3518.0	SRBR	12801.7	285591.0	406.0
Al (396.152 nm)	≥ 3.4	SBR	9.9	52688.6	4873.6
Ba (493.408 nm)	≥ 34.0	SBR	154.6	2287291.6	14698.1
K (766.491 nm)	≥ 1.8	SBR	6.4	106701.6	14350.9
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	242.4	3170.1	154.8
Se (196.026 nm)	≥ 159.0	SRBR	226.1	4134.5	289.3
Zn (213.857 nm)	≥ 234.0	SRBR	1126.6	13782.0	146.5
Zn (213.857 nm)	≥ 1743.0	SRBR	8400.8	177166.3	442.5
Cd (214.439 nm)	≥ 4227.0	SRBR	7001.9	125884.2	321.6
Pb (220.353 nm)	≥ 320.0	SRBR	536.3	12909.3	532.6
Mn (257.610 nm)	≥ 10625.0	SRBR	30846.2	1267989.0	1738.8
Cr (267.716 nm)	≥ 1048.0	SRBR	4396.0	167335.6	1424.4
Cu (324.754 nm)	≥ 19.0	SBR	52.1	373690.7	7033.1
Al (396.152 nm)	≥ 6.0	SBR	16.8	266357.7	15112.4
Ba (493.408 nm)	≥ 60.0	SBR	226.7	10173441.5	44971.7
K (766.491 nm)	≥ 24.0	SBR	39.7	1874136.2	46055.7

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เอกสารไม่ควบคุม

Precision Test		
Pass		
Radial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.60
Se (196.026 nm)	≤ 2.60	0.84
Zn (213.857 nm)	≤ 1.50	0.29
Pb (220.353 nm)	≤ 2.60	0.59
Mn (257.610 nm)	≤ 1.50	0.28
Al (396.152 nm)	≤ 1.50	0.28
Ba (493.408 nm)	≤ 1.50	0.59
K (766.491 nm)	≤ 1.50	0.23
Axial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.71
Se (196.026 nm)	≤ 1.50	0.43
Zn (213.857 nm)	≤ 1.50	0.46
Zn (213.857 nm)	≤ 1.50	0.37
Cd (214.439 nm)	≤ 1.50	0.49
Pb (220.353 nm)	≤ 1.50	0.48
Mn (257.610 nm)	≤ 1.50	0.74
Cr (267.716 nm)	≤ 1.50	0.26
Cu (324.754 nm)	≤ 1.50	0.51
Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.61
K (766.491 nm)	≤ 1.50	0.84

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-29 FAX: 0-2719-3484



Cert. No.: 23TM726  
Page : 1 of 3

## Certificate of Calibration

Equipment : Cooled Incubator  
Manufacturer : Binder  
Model : KB 400 E6  
Serial No. : 2020000015535  
ID No. : UAE.MIC.018/2564  
Submitted by : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory (302)  
Received Order : 27 April 2023  
Calibration Date : 27 April 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Tawatchai Pama  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 12 May 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 : Cooled Incubator  
Condition As-Received : Used Item  
Reference : 2304-04610C-1  
Procedure Used :-

Cert. No.: 23TM726  
Page : 2 of 3

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.

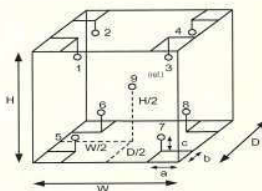
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	20	19
REL Humid. ( % )	72	82
AC Supply ( Volt )	230	231



Probe Installation Details : Dimension of Chamber :  
a = 10 cm D = 0.48 m  
b = 10 cm W = 0.65 m  
c = 10 cm H = 1.2 m  
Capacity = 0.37 m<sup>3</sup>

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 : Cooled Incubator  
Condition As-Received : Used Item  
Reference : 2304-0461OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM726  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
35.0	35.0	35.0	0.0090	0.16	0.21	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.913	34.997	34.834	34.893	35.034	35.027	35.025	35.035	34.980	0.30

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK, 10259  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM726  
Page : 1 of 3

## Certificate of Calibration

Equipment : Incubator  
Manufacturer : Memmert  
Model : IPP 260  
Serial No. : V616.0066  
ID No. : UAE.MIC.032/2559  
Submitted by : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory (302)  
Received Order : 27 April 2023  
Calibration Date : 27 - 28 April 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Tawatchai Pama

Approved by :   
Pormthippa Tameyakul  
Malee Butkruea  
Suwit Imjai

Issue Date : 11 May 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.

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Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2304-0461OC-6  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM728  
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
25.0	25.0	25.0	0.020	0.81	1.2	2
36.0	36.0	36.0	0.15	1.1	1.6	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
25.0	25.541	25.354	25.388	25.278	24.341	24.349	24.379	24.455	24.747	0.30
36.0	35.275	35.351	35.768	35.941	36.543	36.590	36.653	36.728	36.232	0.39

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

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

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

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

UUC\* : Unit Under Calibration

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

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

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เอกสารไม่ควบคุม



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2304-0461OC-6

Cert. No.: 23TM728  
Page : 2 of 3

### 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.

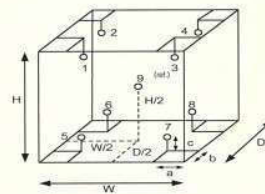
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	22
REL Humid. ( % )	76	83
AC Supply ( Volt )	231	231



### Probe Installation Details :

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

### Dimension of Chamber :

D = 0.50 m  
W = 0.64 m  
H = 0.80 m  
Capacity = 0.26 m<sup>3</sup>

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





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM194  
Page : 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 14  
Serial No. : L416.0612  
ID No. : UAE.MIC.003/2560  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory  
Received Order : 15 February 2023  
Calibration Date : 15 February 2023  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
Calibrated by : Suwit Imjai  
Approved by :   
( ) Ponthippa Tameyakul  
( ) Malee Butkruea  
Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295QC-3  
Procedure Used :-

Cert. No.: 23TM194  
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

#### 1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

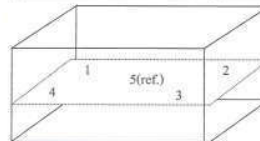
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	22	65	231
Finished of Calibration	22	63	230



Front

Position :	Ref. Std. ID No.:
1	4804539-001
2	4804539-002
3	4804539-003
4	4804539-004
5(ref.)	4804539-005

เอกสารไม่ควบคุม



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295QC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM194  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			1	2	3	4	5 (ref.)
44.5	44.5	44.6	44.520	44.509	44.498	44.552	44.530

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.077	0.037	0.15	2

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

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

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

UUC\* : Unit Under Calibration

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

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

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM374  
Page : 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 14  
Serial No. : L414.1407  
ID No. : UAE.MIC.006/2558  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory  
Received Order : 11 April 2023  
Calibration Date : 11 April 2023  
Ambient Temperature :  $(26 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
Calibrated by : Krisda Malee  
Approved by :   
( ) Ponthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0155OC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM374  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )					Uncertainty ( ± °C )
			1	2	3	4	5 (ref.)	
44.5	44.5	44.5	44.508	44.486	44.456	44.478	44.483	0.15

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Coverage Factor k
44.5	0.065	0.031	2

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

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

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

UUC\* : Unit Under Calibration

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

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

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เอกสารไม่ควบคุม

๑ 1159268



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0155OC-3  
Procedure Used :-

Cert. No.: 23TM374  
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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

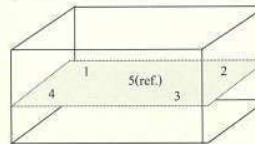
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply ( Volt )
	( °C )	( %R.H. )	
Beginning of Calibration	26	55	220
Finished of Calibration	25	56	221



Front

Position :	Ref. Std. ID No.:
1	4804539-001
2	4804539-002
3	4804539-003
4	4804539-004
5(ref.)	4804539-005

เอกสารไม่ควบคุม

๑ 1159268



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1121  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Autoclave  
Manufacturer : ALP  
Model : CL-40L  
Serial No. : 807298  
ID No. : UAE.MIC.019/2560  
Submitted by : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : 301 Room  
Received Order : 11 July 2022  
Calibration Date : 11 July 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Preecha Hiahib  
Approved by :   
( ) Pornthippa Tameyakul  
( / ) Malee Butkrusa  
( ) Suwit Imjai

Issue Date : 18 July 2022

The Uncertainties are for a confidence probability of approximately 95 %

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services

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Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2207-0245OC-7  
Procedure Used :-

Cert. No.: 22TM1121  
Page.: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T.

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	34970A	MY44060450	22LM46	28 Mar 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.

4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which

could be infected with organisms categorized as Hazard Group 1, 2 and 3\*\*

(\*\* = Categorization of pathogens according to hazard and categories of containment, second edition, 1990 )

It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source



	Environmental		
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	29	49	220
Finished of Calibration	32	48	220

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	22-14TC-01
2 =	Temperature sensor	22-14TC-02
3 =	Exhaust port	22-14TC-03

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๑ 1159268



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2207-0245OC-7  
Result of Calibration : ( \* ) Without Adjustment

Cert. No.: 22TM1121  
Page.: 3 of 3

Operating parameter Set : Temperature = 115 °C		Sterilization period = 15 minute					
UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor k
116	116	1	116.523	0.14	0.08	0.90	2
		2	116.566				
		3	116.440				

Operating parameter Set : Temperature = 121 °C		Sterilization period = 30 minute					
UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor k
122	122	1	122.503	0.19	0.12	0.91	2
		2	122.637				
		3	122.558				

Average\* : The average of 30 values in each position.  
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.  
UUC\* : Unit Under Calibration.  
Note : The reported uncertainty of measurement was included stability and excluded uniformity.  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534-4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2717-3800-29 FAX. 0-2719-9484



Cert. No.: 23TM763  
Page : 1 of 3

## Certificate of Calibration

Equipment : Autoclave  
Manufacturer : ALP  
Model : CL-40L  
Serial No. : 808763  
ID No. : UAE.MIC.026/2563  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory (301)  
Received Order : 27 April 2023  
Calibration Date : 27 April 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Preecha Hiahb  
Approved by :   
( ) Porthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

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A 0053944



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2304-0461OC-2  
Procedure Used :-

Cert. No.: 23TM763  
Page : 2 of 3

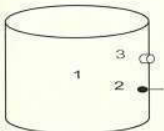
Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

- Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023
- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.
- This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3\*\*  
(\*\* = Categorization of pathogens according to hazard and categories of containment, second edition, 1990 )  
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.  
This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source



Environmental			
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	27	60	220
Finished of Calibration	27	58	220

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	18-20TC-04
2 =	Temperature sensor	18-20TC-05
3 =	Exhaust port	18-20TC-06

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a 1159968



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2304-0461OC-2  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM763  
Page : 3 of 3

Operating parameter Set : Temperature = 115.0 °C		Sterilization period = 15 minute					
UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor k
115.0	115.0	1	115.213	0.22	0.08	0.75	2
		2	115.166				
		3	115.260				

Operating parameter Set : Temperature = 121.0 °C		Sterilization period = 30 minute					
UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor k
121.0	121.0	1	121.260	0.29	1.1	0.75	2
		2	121.224				
		3	121.284				

Average\* : The average of 30 values in each position.  
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.  
UUC\* : Unit Under Calibration  
Note : The reported uncertainty of measurement was included stability and excluded uniformity.  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95 %.

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a 1159967





# Certificate of Calibration

Equipment: Balance  
Model: PX623  
Serial No. (or ID.): C236754745  
Manufacturer: Ohaus  
Condition: New

Certificate No.: C01223732  
Issued Date: 09 December 2022  
Job No.: KSPR2215576  
Page: 1 of 2

Customer: United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,  
Phraekhanong District, Bangkok, THAILAND 10260

Environment Condition: Temperature 26 °C ± 0.5 °C  
Humidity 53 %RH ± 3.9 %RH

Calibration Place: United Analyst and Engineering Consultant Co., Ltd. (301 Microbiology Room)  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,  
Phraekhanong District, Bangkok, THAILAND 10260

Calibration By: Mr. Adisai Maknoi  
Calibration Date: 09 December 2022  
The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14  
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02221765



(Mr. Adisai Maknoi)



(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

This certificate is issued for the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ( $k=2$ ) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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DKSH Technology Limited  
2533 หมู่ 4 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangchak, Phraekhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

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CAL-FM-C01-14: 12 Sep 2022

## Calibration Results:

### Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		200 (g)				
		Reference Points (g)				
A	B	C	D	E		
-	0.000	0.000	0.000	0.000		

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0004
500	0.0005

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0010	2.03
5	5.0001	5.000	0.000	0.0010	2.03
10	10.0001	10.000	0.000	0.0010	2.03
20	20.0001	20.000	0.000	0.0010	2.03
50	50.0001	50.000	0.000	0.0010	2.03
100	100.0001	100.000	0.000	0.0011	2.03
200	200.0004	200.000	0.000	0.0011	2.02
300	300.0005	300.000	-0.001	0.0013	2.01
400	400.0008	400.001	0.000	0.0014	2.01
500	500.0003	500.000	0.000	0.0017	2.00
600	600.0004	600.000	0.000	0.0019	2.00

The End of Certificate

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DKSH Technology Limited  
2533 หมู่ 4 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
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CAL-FM-C01-14: 12 Sep 2022

## Statements of conformity:

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab 14. Therefore, those parameters have not been assessed separately.

### Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule: ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk < 50% PFA.  
☒ Choice B Non-binary statement with guard band ( $w = 1 U$ ), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.  
☐ Choice C Customer defined. Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r U$ ).  
; PFA – Probability of False Accept



(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

## Statements of conformity:

### Without Adjustment

Readability: 0.001 g

Nominal Value g	Error of indication g	Guard band (w) g	Tolerance (±) g	Conformity
1	0.000	0.0010	0.002	Pass
5	0.000	0.0010	0.010	Pass
10	0.000	0.0010	0.020	Pass
20	0.000	0.0010	0.040	Pass
50	0.000	0.0010	0.100	Pass
100	0.000	0.0011	0.200	Pass
200	0.000	0.0011	0.400	Pass
300	-0.001	0.0013	0.600	Pass
400	0.000	0.0014	0.800	Pass
500	0.000	0.0017	1.000	Pass
600	0.000	0.0019	1.200	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

The End of Statements of conformity

บริษัท เทคโนโลยี เคเอส ดีเคช จำกัด  
DKSH Technology Limited  
2533 หมู่ 4 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

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CAL-FM-C01-14: 12 Sep 2022

บริษัท เทคโนโลยี เคเอส ดีเคช จำกัด  
DKSH Technology Limited  
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CAL-FM-C01-14: 12 Sep 2022



## DMA-80 Direct Mercury Analyzer SERVICE PROTOCOL REPORT

To be filled in before service visit (1<sup>st</sup> page)**Customer information:**

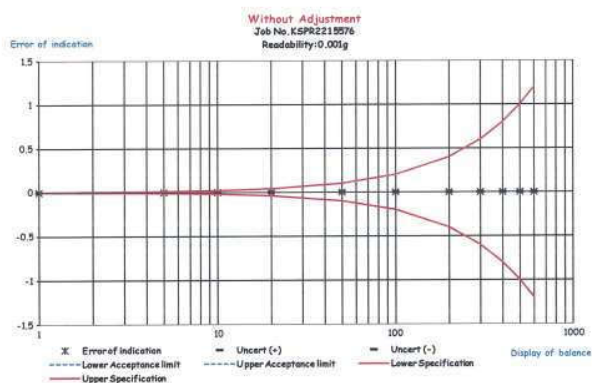
Company: บริษัท อีซีเอส เทคโนโลยี จำกัด  
 Department: Lab  
 Person in charge: นาย อรรถสิทธิ์  
 Address: 3 หมู่ 3 ถนนสาย 11  
 Tel.:  
 E-mail:

**Technical data:**

Unit Serial Number: 11030092  
 Terminal type or USB-640 Gateway: Terminal 640 SN 1011000091  
 Software, type and revision: Easy control Rev. 02-D  
 Air Compressor (if present): - SN -  
 Gas system pump (if present): - SN -  
 Installation and last maintenance dates: Inst on: Maint on:

NOTE: after achievement of the following protocol a filled and signed copy of this report has to be sent to Milestone srl at: [service@milestonesrl.com](mailto:service@milestonesrl.com)

For the best result of the test below we recommended to use the Milestone DMA-80 Service Kit (PN DMA-SKIT).



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**1. VISUAL INSPECTION**

	Good	Damaged	Corroded/Dirty
External chassis	✓		
Inside	✓		
Electric parts	✓		
Screws	✓		

**2. ELECTRICAL SAFETY TEST**

Using a suitable testing device check the below reported parameters and take note of the results.

Parameter	Result	OK	Not OK
Insulating resistance: $R_{ins} \geq 0.5M\Omega$	Actual value: 99.9 MΩ	✓	
Grounding resistance: $R_{gs} \leq 100m\Omega$	Actual value: 0.7 MΩ		✗

**3. PRESSURE CHECK**

Gas carrier	Oxygen (purity $O_2 > 99.95\%$ )	Milestone air compressor
Oxygen	Purity: 99.99%	✓

The pressure at the supply source manometer should be approx. 4.0 bar  
 The flow rate depends by type of cuvette installed on the DMA-80 unit.



	Correct value	Actual value	Final value	Correct value	Actual value	Final value	Correct value	Actual value	Final value
Inlet pressure	3.1 bar	-	-	3.1 bar	-	-	3.1 bar	3.1 bar	Pass
Flow rate	10-12 l/h	-	-	8-10 l/h	-	-	6-8 l/h	7 l/h	Pass

Check all possible leakage points and their conditions:

	Good	Damaged	Corroded
Tubing	✓		
Silicon joints	✓		
O-rings	✓		
Cuvette sealing O-rings	✓		
Gas connections	✓		
Valves	✓		
Sample boat carrier	✓		
Catalyst flange	✓		

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**4. AUTOSAMPLER SYSTEM**

	OK	Not OK	Re-Adjusted
Calibration of autosampler motor	✓		
Cylinders alignment	✓		

	Fast	Slow	Normal
Speed of pneumatic cylinders			✓

Using the maintenance grease, periodically lightly lubricate all exposed steel rods of the horizontal and vertical cylinders.

**5. COMPONENTS CHECK**

Conditions of the different parts used/installed on DMA unit:

	OK	Not OK	Replaced	Cleaned
Catalyst tube			✓	
Amalgamator			✓	
Quartz boats			✓	
Nickel boats				
Autosampler plate	✓			
Gas kit accessories				

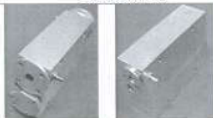

**6. TEMPERATURES**

	Correct value	Actual value	Final value
Drying/Decomposition furnace	If controlled by Infrared sensor: $850^\circ C \pm 10^\circ C$ If controlled by thermocouple: $650^\circ C \pm 10^\circ C$	-	-
Catalyst furnace	$915^\circ C \pm 10^\circ C$	560 °C	Pass
Amalgamator stand by temperature	$170^\circ C \pm 10^\circ C$	170 °C	Pass
Amalgamator heating temperature	$850^\circ C \pm 10^\circ C$	850 °C	Pass
Cuvette	$125^\circ C \pm 5^\circ C$	125 °C	Pass

**7. SPECTROMETER**

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The spectrometer can be equipped with a single beam system (ducon lamp) or with a dual beam system (tricell lamp).

Old cuvette type							Actual cuvette type						
													
Gain			Offset			Gain			Offset				
Correct value	Actual value	Final value	Correct value	Actual value	Final value	Correct value	Actual value	Final value	Correct value	Actual value	Final value		
3.8VDC	-	-	0.015VDC	-	-	3.8VDC	3.8V	Pass	0.015VDC	0.015V	Pass		
	-	-	0.005VDC	-	-		-	-		-	-		

Dualcell system	-	-	-	-	-	-	-	-	-	-	-
Tricell system*	-	-	-	-	-	3.96VDC	-	-	0.005VDC	-	-

(\*) The recommended Hg lamp operating signal should be around 3.95VDC (for detector 2) and 3.93VDC (for detector 1).

	OK	Not OK
Conditions of the spectrometer system	✓	
Alignment between lamp, cuvette and detector	✓	
Cuvette cleaning (glass windows, sealing O-rings...)	✓	
Lamp intensity	✓	
Operation of the mechanical shutter (if present)	✓	

## 8. MILESTONE AIR COMPRESSOR

Maintenance	OK	Date last service
Drain (compressor)		
Replacing air filters (air filter)		
Check sealing connections		

## 9. PARTS TO BE REPLACED

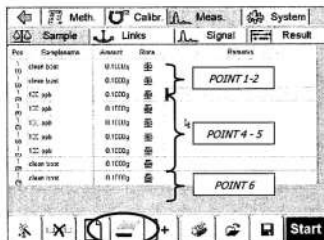
PN	DESCRIPTION	Replaced	Not
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4

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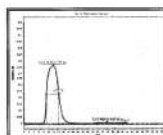
5

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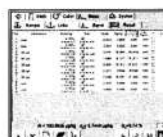
Now, it is possible to evaluate:

### - Peaks



- The shape of the peak must be regular.
- The distance between Peak Cell 1 and Peak Cell 2 must be between 11 to 15 seconds.

### - Results



- The obtained absorbance (height) of the Blank must be < 0.0020.
- The obtained absorbance (height) must be > 0.42 for each 100ppb analysis (0.22 with cuvette installed until December 2005, DMA s/n 05120292).
- The relative standard deviation (rsd) is < 1.5 %.
- After two blanks (after 10mg measurements), the absorbance is ~ 0.0020.

### - Temperatures & signal profiles

6

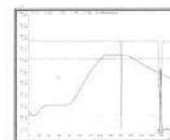
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		Replaced
DMA8133	Catalyst tube: 6 months if the unit runs daily, 1 year if the unit is used rarely. In case of analysis of sample with high organic concentration the lifetime of the catalyst can be less than 6 months.	✓
DMA8134	Amalgamator: 6 months if the unit runs daily, 1 year if the unit is used rarely.	✓
DMA8195A	Hg lamp tri-cell (model 2011) (for kit p/n DMA8355): 2 years	-
DMA8137	Hg lamp dual-cell: 2 years	✓
70200	Hg trap 1 year	✓
DMA8058/B	Amalgamator coil 1 year or as soon as the heating is not more homogeneous	✓
DMA8142	Nickel sample boats (set of 40pcs) 2 years if strongly used, replace after 1 year	-
DMA8347	Quartz sample boats (set of 10pcs) 4 years	✓
DMA8335	Metal sample boat carrier 2 years	✓
SL0108	PU-tube diam. 6/4 mm for internal O <sub>2</sub> /air supply 2 years	✓
SO0376D	Heating coil for drying/decomposition 2 years	✓

## 10. TESTING PROCEDURE

It consists to run some measurements for the evaluation of the analytical performance of the unit, like: absorbance, peaks shape, temperatures, lamp signal and verify the proper working of whole system.

- Run minimum 2 blanks on the same sample boat (quartz if possible) in manner to clean it
- Run blanks until absorbance value (height) decrease under 0.0020
- Set a fresh and stabilized 100µg/L Hg standard according to the prescriptions reported on the DMA80 User Manual. The quality of the used standard is fundamental for the success of the entire procedure
- Weight approximately 100µg of the fresh 100µg/L - Standard (10ng) and start the analysis as a single measurement mode
- Repeat five times the test
- Run again two blanks measurements



- The Hg lamp signal must be between 3.8 and 4.5V and stable. A few minutes after the start of the analysis the lamp does switch off because of the zero detection but then it instantly returns to the original condition. In case of Tricell configuration two green colour graphics are reported. After the zero shuttering the time necessary to return to full signal is longer on Tricell compare to Ducon lamp.
- During the run the catalyst oven temperature must be stable around to 615°C.
- The drying and ashing furnace must be follow the set temperature method.
- During the run the Amalgamator furnace temperature must be stable at the stand by temperature (170°C). Then at the release step it must raise up to 850/900°C.
- The Cuvette temperature must be stable at approximately 125°C.
- The Hg absorbance peaks must be correctly detected and reported.

## 11. FINAL REPORT

All screws inserted and tightened	Pass
All tubing sealing connections checked, cleaned or replaced and tightened	Pass
All heating elements are working	Pass
Sensors installed, checked and tightened	Pass
Safety devices (thermo switch) fully checked	Pass
All exhaust and cooling fans are functioning	Pass
Testing procedure successfully passed	Pass
Necessary tools available at customer's site	Pass
Last revision of User Manual available at customer's site	Pass
Advised customer about care and maintenance instructions	Pass

Remarks:

7

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[illegible]

Working hours of Service Engineer

Date	Service Engineer Name	Signature
18/11/15	[Redacted]	[Redacted]

Laboratory Manager / Operator  
acceptance signature:

# FOSS

## Customer Service Report

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

Report No:	6623
------------	------

Date: July 26, 2022      7/26/2022  
 Customer: United Analyst and Engineering      Address: \_\_\_\_\_  
 Instrument: KT9100      Serial: 31893052

Hours	Travel To Customer	Labour	Travel From Customer	
Start	8:00	8:00-12:00	12:50	
Blotch	30 mins	12:30-15:00	17:30	1 hrs

Job Type							
Application		Special		Standard			
Normal	<input type="checkbox"/>	Courtesy Visit	<input type="checkbox"/>	Installation	<input checked="" type="checkbox"/>	Training	<input type="checkbox"/>
Distributor	<input type="checkbox"/>	PMA Onboarding	<input type="checkbox"/>	Quote	<input type="checkbox"/>	In House	<input type="checkbox"/>
Internal	<input type="checkbox"/>	Warranty	<input type="checkbox"/>	Repair	<input type="checkbox"/>	PM	<input type="checkbox"/>
Digital Service	<input type="checkbox"/>	Sales Support	<input type="checkbox"/>	Remote	<input type="checkbox"/>	Other	<input type="checkbox"/>

PO/Quote Number:	If applicable:
------------------	----------------

PMA Type	Registration	Contract No.	Registration
----------	--------------	--------------	--------------

[illegible][illegible]

I confirm this report is accurate and complete			
Signed FOSS	[Redacted]	Signed Customer	[Redacted]
Name	Burton, Chom	Name	Katherine Ruppel
Would you be willing to participate in a brief survey in order to tell us how we performed?			

## เอกสารไม่ควบคุม

## เอกสารไม่ควบคุม

# FOSS

## Customer Service Report

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

Report No:	6534
------------	------

Date: 25/1/2022  
 Customer: Field Analyst and Engineering  
 Address: 173414  
 Instrument: KT300  
 Serial: 9198952



Hours	Travel To Customer	Labour	Travel from Customer
Start	9:00	9:15 am	9:45
Finish	8:5	1:40 pm	9:40

Job Type						
Application		Special		Standard		
Normal	x	Courtesy Visit	x	Installation		Training
Distributor		PMA Onboarding		Quote		In House
Internal	x	Warranty	x	Repair		PM
Digital Service		Sales Support		Remote		Other

PO/Quote Number:	45001002
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PMA Type	7 applicable	Contract No.	7 applicable
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[illegible][illegible]

I confirm this report is accurate and complete			
Signed FOSS		Signed Customer	
Name	T. J. Williams	Name	T. J. Williams

Would you be willing to participate in a brief survey in order to tell us how we performed?

**FOSS**

## Installation Qualification

**Kjeltec™ 8100 Distillation Unit**

**This IQ applies to Kjeltex™ 8100 Distillation Unit manufactured by FOSS Analytical. The installation is performed by FOSS trained service personnel.**

## 1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical AB's Application Notes.

## 2 Purpose

This installation Qualification is designed to assure that:

- The Kjeltac instrument is received complete, with all required parts in good condition.
- The location of the instrument is environmentally and ergonomically suitable
- The instrument is assembled and configured correctly
- Suitable electricity and water are supplied to the instrument, see table 2 for requirements.

### 3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit	91989052

**FOSS Analytical A/S**  
69 Slangerupgade  
DK-3400 Hillerød  
Denmark

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Fax +45 7010 3371  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

**FOSS Analytical AB**  
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Sweden  
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Fax +46 42 360349  
E-mail [support@foss.dk](mailto:support@foss.dk)  
Web [www.foss.dk](http://www.foss.dk)

Customer Support, 6003 7242 / Rev. 1

www.toshiba.com

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## เอกสารไม่ควบคุม



## 4 Control of Received Equipment

### 4.1 Verify that the correct instrument type and accessory kit items are received and in proper condition

The packing list (shipped with the instrument) specifies all the items. The installer will verify that all items are received as shipped on the packing list. For each item listed, verify that the acceptance criteria are met. If so, write "Y" in the right column of the table immediately following.

Packing List Item	Acceptance Criteria	Pass (Y/N)
Kjeltrec 8100 Distillation Unit	No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Accessory kit, according to packing list	Included. No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Handling device for digestion tube	Included. No visible damage	Y
Tanks with level sensors for Waste, Alkali and Water	Included. No visible damage	Y
Receiver flask	Included. No visible damage	Y
One digestion tube 250ml	Included. No visible damage	Y
One digestion tube 100 ml		Y
Tube adapter	Included. No visible damage	Y
User manual	Kjeltrec 8100 Distillation Unit	Y
Owners guide	Kjeltrec 8100 Distillation Unit	Y
Quick guide	Kjeltrec 8100 Distillation Unit	Y
Spare parts manual	Kjeltrec 8100 Distillation Unit	Y
Application notes	AN 300 included AN 303 included	Y

## 5 Installation

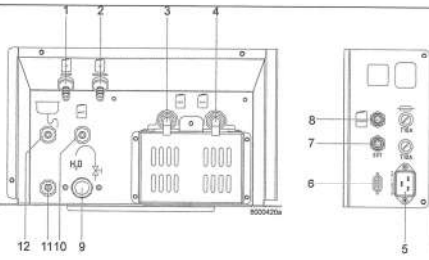
### 5.1 The equipment must be installed in a suitable location with power, water and draining available

Verify that the instrument installation site meets the acceptance criteria given in the table below. If so, write "Y" in the right column of the table immediately following.

Location Requirements	Acceptance Criteria	Pass (Y/N)
Adequate space for instrument	Dimensions 48x58x69 cm	Y
AC supply available for instrument	200-240 V 50/60Hz	Y
Current	10 A	Y
Cold water supply available	2 L/min at 30°C	Y
Drain	For cooling water and waste (depending on local waste disposal legislation)	Y
Ambient temperature	Max. 40°C	Y
Ambient humidity	Max. 80% relative	Y
Internal fuses	T10A AH	Y

### 5.2 The instrument must be assembled correctly

Verify that all tubes are correct connected. If so, write "Y" in the right column of the table immediately following.

Instrument Tubing Connections	Acceptance Criteria	Pass (Y/N)
 1. Deionised water in (steam generator) 2. Deionised water in (dilution water) 3. *) Receiver solution in 4. Alkali in 5. Power 6. Not used 7. External titration module 8. Level sensors 9. Cooling water in (tap water) 10. Waste water out (tube drain vessel) 11. Drain 12. Cooling water out (tap water) *) Only on Kjeltrec 8200	Visual verification by installer	Y

### 5.3 The instrument should be assembled and powered up

Connect the distilling unit to the power supply. Perform the start up procedure and check that the expected response is obtained. If so, write "Y" in the right column of the table immediately following.

Action	Expected Response	Pass (Y/N)
Switch on the power	The instruments start up and the self test will run. The sample counter shows the number of analysed samples since first power and the Software Version shows the version of the instruments software.	Y
	After start-up, Program 1 is loaded and the Analyse menu is displayed.	Y
Turn on the cold water tap	No visible reaction	Y
Press the "Manual" view	The Manual menu is opened	Y
Open the door with the handle, place the test tube and receiver flask in position. Close the door.		Y
Select <b>Dilution</b> and press <b>Start</b>	Water is added to the tube	Y
Select <b>Alkali</b> and press <b>Start</b>	Alkali is added to the tube	Y
Select <b>Steam</b> and press <b>start</b>	After heating up, steam is entering the tube	Y
Select <b>Drain</b> and press <b>Start</b>	The tube is drained	Y

## 6 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

## 7 IQ Documentation

Upon successful completion and recording of all instructions above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Installed By: Pannipa Onnom  
 Company: Foss SEA  
 Customer Name: United Analyst and Engineering  
 Company: United Analyst and Engineering  
 Date completed: July 25, 2022

## Kjeltec™ 8100 Distillation Unit

This OQ applies to Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The operation qualification is performed by FOSS trained service personnel.

### 1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical Application Notes.

### 2 Purpose

This procedure is designed to test the function of the instrument according to factory test specifications:

- Alkali volume
- Distillation Accuracy
- Distillation Repeatability

### 3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit, 200-240 V 50/60 Hz	91 99052

#### Dedicated Analytical Solutions

FOSS Analytical AS  
 49 Slangerupgade  
 DK-3400 Hillerød  
 Denmark  
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 E-mail support@foss.dk  
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FOSS Analytical AB  
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 SE-263 21 Hålsjö  
 Sweden  
 Tel +46 42 361500  
 Fax +46 42 340349  
 E-mail support@foss.se  
 Web www.foss.se

## 4 Performance

### 4.1 Verify the dispensed volumes of reagents

Note! To verify the dispensed volumes of reagents a triple test should be done to be statistic correct. Then calculate a mean value.

1. Choose "Manual" in the menu. (When starting up the instrument Program 1 is loaded)
2. Open the safety door by pressing **Open** and place a tube in the instrument. Close the safety door.

#### Water

1. Press **Dilution** and then press **Start**. 80 ml of water will be filled into the tube.
2. Measure the collected water in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Note! If the water volume needs to be calibrated, go to 4.8.5 Dilution Pump Calibration in the User Manual.

#### Alkali

1. Press **Alkali** and then press **Start**. 50 ml of alkali will be filled into the tube.
2. Measure the collected alkali in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Table 1 Volume control

Test	Result	Expected result	Passed (Y/N)
Water volume	<u>83</u> ml <u>83</u> ml <u>82</u> ml Mean <u>82.67</u> ml	76-84 ml	Y
Alkali volume	<u>47</u> ml <u>52</u> ml <u>53</u> ml Mean <u>52.33</u> ml	47-54 ml	Y

### 4.2 Verify the distillation procedure, accuracy and precision

The distillation principle is to convert ammonium ( $\text{NH}_4^+$ ) into ammonia ( $\text{NH}_3$ ) by using an alkali ( $\text{NaOH}$ ) and thereafter steam distil it into a receiver flask containing boric acid and titrate with standard acid solution using colorimetric end-point detection. Ammonium sulphate, a substance with known ammonia content, can be used to check the accuracy of the distillation. The recovery is calculated from obtained result.

The way to perform this test will be described in the following.

#### Chemical Check

Use ammonium sulphate ( $\text{NH}_4)_2\text{SO}_4$ , purity > 99.5 % \*

Mol. weight = 132.14 g/mol, Nitrogen content in ammonium sulphate (99.5 %) = 21.09% \*

#### Analysis conditions according to AN 300

Water	80 ml
Alkali	50 ml NaOH (40%w/w)
Receiver solution	30 ml boric acid (4%)
Distillation time	5 minutes
SAFE	5 seconds
Titrant	0.2N HCl

#### For reagent preparation see Appendix A

1. Start the instrument and run two blanks without chemicals according to above analysis conditions, distil into a receiver flask containing boric acid. Titrate with a standard acid solution using colorimetric end-point detection. If the blanks are less than 0.2 ml continue with the recovery tests:
2. Weigh 0.15 g ammonium sulphate into a tube. Prepare 6 samples (tubes).
3. Run the six samples according to above analysis conditions. Titrate with a standard acid solution using colorimetric end-point detection.
4. Calculate the recovery according to below equations. Expected results of recovery should be 100%±1%.

Recovery test	Result	Expected result	Passed (Y/N)
Blank value (water blank)	1. <u>0.03</u> ml 2. <u>0.19</u> ml	0.05-0.20 ml	Y
Recovery	1. <u>100.30</u> % 2. <u>100.10</u> % 3. <u>100.15</u> % 4. <u>99.91</u> % 5. <u>99.97</u> % 6. <u>100.11</u> %		
Accuracy	Mean Value: <u>100.05</u>	99-101%	Y
Precision	SD: <u>0.852</u>	SD <1%	Y

\*) **Note!** Please also note that the below calculations must be adjusted if other purity levels of ammonium salts are used. A certificate for the chemical supplier should be available

Purity	Nitrogen content
99,5%	21.09% ✓
99,6%	21.12%
99,7%	21.14%
99,8%	21.16%
99,9%	21.18%

$$\% \text{ Nitrogen} = \frac{(ml_{\text{sample}} - ml_{\text{blank}}) \times N \times 14,007 \times 100}{MR_{\text{sample}}} \quad \begin{matrix} 0.1095 \\ 21.72 \end{matrix}$$

N = Normality of titrant to 4 places of decimal.

$$\% \text{ Recovery} = \frac{\% \text{ Nitrogen}}{21.09} \times 100$$

mg - Sample

1. 21.56
- 2.
- 3.
- 4.
- 5.
- 6.

## 5 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

## 6 OQ Documentation

Upon successful completion of tests above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Performed By: \_\_\_\_\_

Company: \_\_\_\_\_

Customer Name: \_\_\_\_\_

Company: \_\_\_\_\_

Date completed: \_\_\_\_\_

## 7 Appendix A

### 7.1 Preparation of Reagents

#### 7.1.1 Alkali

To convert ammonium into ammonia an excess of sodium hydroxide is necessary.

Use 400 g NaOH per litre of solution. Commercially available in concentrations up to 50 %. Do not use concentrations above 40 % as this will lead to crystal formation impairing the function of the pumps. If you can only buy concentrations > 40 %, dilute it before use.

#### 7.1.2 Titrant acid, determination of concentration

To be able to achieve accurate nitrogen / protein results, one must be quite sure that the HCl (hydrochloric acid) concentration is what it is supposed to be. A titration against a predetermined solution of sodium carbonate as described below is thus necessary. Incorrect HCl concentration can otherwise cause substantial errors.

##### • Standard substance

Weigh approx. 10 g of anhydrous sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). Use a mortar to make a fine powder. Dry it for 1 h at 265 °C or 2 h at 200 °C. After cooling in a desiccator, transfer the sodium carbonate to a beaker with a tight lid. Store it in a desiccator.

##### • Indicator solutions

Dissolve 0.1 g methyl red in 100 ml methanol. Dissolve 0.1 g bromocresol green in 100 ml methanol.

##### • Procedure

Weigh approx. 0.4 g of the standard substance, using an analytical balance, note the weight ( $W_1$ ). Transfer the sodium carbonate to a receiver flask and add 40 ml of  $\text{H}_2\text{O}$  (distilled or deionized). Add 8 drops from each of the indicator solutions. Titrate to pink. Note the amount in ml used ( $A_1$ ). Boil this solution for a few minutes. The solution will turn green. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour change occurs. Note also this volume

( $A_2$ ). Boil the solution for a few minutes. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour occurs. Note also this volume ( $A_3$ )

**Note!** Temperature changes will influence the volume and the concentration of the titrant solution. The working temperature of the titrant should approximate that of its temperature during standardization. If temperature corrections are necessary, sufficient accuracy may be obtained by use of a correction table. (AOAC 942.25)

### 7.2 Calculation

$$\text{Molarity (M)} = \frac{18,870 \times W_1}{(A_1 + A_2 + A_3)}$$

**Note!** Concentration must be accurate to four digits, i.e. 0.2000 M.

**Note!** The colour change of this official procedure (AOAC 936.15) may be difficult to see, therefore a pH meter or a mixed indicator (e.g. 0.1 g Methyl red and 0.1 g Bromocresol green in 100 ml methanol) will make it much easier to perform.

### 7.3 Receiver Solution

Boric acid 4 % with bromocresol green / methyl red indicator solution

In order to obtain accurate results the receiver solution is adjusted so that a small (0.05-0.20 ml) positive blank is obtained when running a blank sample. The 4 % boric acid receiver solution is prepared by dissolving 400 g of boric acid in about 5-6 l very hot deionized water. Mix and add more hot deionized water to a volume of about 9 l. Cool the solution to room temperature and add 100 ml of bromocresol green solution (100 mg in 100 ml methanol) and 70 ml of methyl red solution (100 mg in 100 ml of methanol). Dilute to 10 l with deionized water and mix carefully.

**Note!** The addition of alkali is to achieve a positive blank value. This should, however, be kept between 0.05 - 0.20 ml titrant, to obtain good repeatability when testing blanks.

Adjustment of the boric acid is made by the following procedure:

1. Transfer 25 ml boric acid solution to a receiver flask and add 100 ml of distilled water. If the solution in the flask is still red, titrate with 0.1 M sodium hydroxide solution until a neutral grey colour is obtained. Calculate the amount of sodium hydroxide solution necessary to adjust the boric acid solution in the 10 l flask with the formula: ml 1.0 M alkali = ml titrant x 40
2. Add the calculated amount of 1.0 M alkali solution to the boric acid solution. Mix.
3. To check proceed as follows using 25 ml of the boric acid solution. Run a blank. If the value of this blank is high (0.5 ml of 0.2 M HCl) the boric acid is incorrectly adjusted. This might create irregular blanks. For correction add HCl directly into the boric acid tank, mix it carefully and repeat until a reading of 0.05 - 0.20 ml HCl is obtained. If a positive blank is not achieved, add further small quantities of 1 M NaOH and repeat the check until a satisfactory value is achieved.



## Kjeltec™ 8100 Distillation Unit Tecator™ 2508/2520 Digestor

### 1 Scope

This PQ applies to the Digestion system 2508/2520 (including exhaust and scrubber unit) and Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The user of the instrument performs the PQ.

### 2 Intended Use

The Digestion system (including exhaust and scrubber) and Kjeltec 8100 Distillation Unit are intended for laboratory use analyzing parameters as specified in FOSS Application Notes.

### 3 Purpose

The guidelines are intended to assist the user in successfully developing Performance Qualifications for the specific application(s) to which the instrument is applied.

The Performance Qualification (PQ) includes the process of demonstrating that the Digestion system 2508/2520 (including exhaust and scrubber unit) and the Kjeltec 8100 Distillation unit consistently perform according to a specification appropriate for its routine use. Main activities in the PQ phase are:

- Preventive maintenance
- On-going verification tests

This document suggests routines to fulfill the requirements for an acceptable PQ but the final procedure should be adapted to local routines for similar equipment.

### 4 Definition of Test Procedures

#### 4.1 Preventive Maintenance

Maintenance of the Kjeltec 8100 should be performed according to the instructions in manual, see User Manual Kjeltec 8100/8200 Distillation Unit, chapter 5. Maintenance. A yearly service is recommended (service agreement).

Maintenance of the Digestion block (including exhaust and scrubber) should be performed according to instruction in the user manual, see User Manual Tecator Digestor, chapter 5. Maintenance.

#### Dedicated Analytical Solutions

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Customer Support, 6003 7363 / Rev. 2

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#### External Quality Control Program

It is recommended to participate in an external quality control program, such as a proficiency program or ring test, with equivalent sample material as analysed within the laboratory.

#### Calculation and Expression of Results

$$W_N = \frac{14.007(V_s - V_r)N \times 100\%}{m}$$

Where:

$W_N$  is the nitrogen content of the sample, expressed as a percentage by mass.

$V_r$  is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the sample test, in milliliters, expressed to the nearest 0.05 ml.

$V_s$  is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the blank test, in milliliters, expressed to the nearest 0.05 ml.

$N$  is the numerical value of the exact normality of the hydrochloric acid standard volumetric solution, expressed to four decimal places.

$m$  is the numerical value of the mass of the test portion, in milligrams, expressed to the nearest 1 mg for sample weights >1 g or to the nearest 0.1 mg for sample weights <1 g.

### 5 Maintenance

#### 5.1 Maintenance Kjeltec™ 8100

See instructions in User Manual - Kjeltec 8100/8200, chapter 5 Maintenance.

#### 5.2 Maintenance Tecator™ Digestor

See instructions in User Manual - Tecator Digestor, chapter 5 Maintenance.

### 6 The Maintenance Record Charts

This record charts are provided to assist you in keeping your system in good working order. Please make copies and use them regularly as they can often help us to help you in the unlikely event a system malfunction.

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### 4.2 Ongoing Qualification Tests

#### Block Temperature

The temperature for the digestion is limited by the boiling point for the sulphuric acid, this can be increased by adding a salt ( $K_2SO_4$ ) to the digestion mixture. It's important that the optimal ratio between acid and salt is kept; please follow recommendation in AN 300 or suggested procedures for a specific kind of sample material.

The block temperature itself can be controlled external by inserting a temperature probe in the intended hole in the aluminium block (front row of holes).

Use the reagents and method procedure specified in AN 300. Use only reagents of recognized analytical grade, unless otherwise specified and distilled or demineralised water or water of equivalent purity.

*Suggested standard material for internal quality control:*

Ammonium sulphate  $[(NH_4)_2SO_4]$ , min. 99.5 % (mass fraction), with certified purity.

**Note: The above chemical is usually readily available with a certificate specifying the purity.**

Alternatively ammonium iron(II) sulphate,  $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ , with certified purity may be used.

Tryptophan ( $C_{11}H_{12}N_2O_2$ ), minimum assay 99 % (mass fraction). Nitrogen content 137.2 g/kg. Do not dry in an oven before use.

Acetanilide ( $C_8H_9NO$ ), minimum assay 99 % (mass fraction). Nitrogen content 103.6 g/kg. Do not dry in an oven before use.

Sucrose, ( $C_{12}H_{22}O_{11}$ ), with a nitrogen content of not more than 0.002 % (mass fraction). Do not dry in an oven before use.

#### Blank Tests

Carry out a blank test following the currently used procedure for digestion, distillation and titration taking 2 ml of water and about 0.7 g of sucrose instead of the test portion. Keep a record of blank values. If blank values change, identify the cause.

**Note: The amount of titrant used in the blank test should always be greater than 0.0 ml. Blanks within the same laboratory should be consistent across time.**

### 4.3 Recovery Tests

Regularly run recovery studies to check the accuracy of procedure and equipment:

- Nitrogen loss:** - Use 0.12 g ammonium sulphate and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Add all other reagents as stated in the method currently used (Kjeltabs,  $H_2SO_4$ , etc.). Digest and distil under same conditions as for sample. Recoveries shall be >99 %.
- Digestion efficiency:** - Use a test portion of minimum 0.15 g of tryptophan or acetanilide and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Determine the nitrogen content according to the current procedure in use. The recoveries of tryptophan shall be >98.5 %; the recoveries of acetanilide shall be >99.5 %.
- Distillation and titration efficiency:** - Distil 0.10 – 0.15 g ±0.0001 g ammonium sulphate, omitting the digestion step. The recoveries should be >99.5 %.

**Note: Results less than 98.5 % or more than 101.0 % in either of the recovery tests indicate failures in the procedure and/or inaccurate concentration of the standard volumetric hydrochloric acid solution (should be adjusted to four decimals accuracy according to procedure in AN 300)**

Customer Support, 6003 7363 / Rev. 2

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1012



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

## Verification Certificate

Certificate No.: 2203368-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: Digestor Unit  
Manufacturer: VELP SCIENTIFICA  
Model: DKL20  
Serial No.: 213517  
ID No.: UAE.WAS.005/2555  
Order No.: 2203368  
Operation No.: 2203368-001  
Date of Receipt: 22 June 2022  
Date of Calibration: 23-24 June 2022

Calibrated by Mr.Nuttapol Niyomchat Specialist  
Approved by (Mr.Pheraphat Tuanjit)  
Manager, Division of Calibration Laboratory  
Responsible for the Technical Management Team  
Date of Issue: 30 June 2022

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.

FCS-009 Revision: 01 Date: 20-04-65

2008 ถนนสุขุมวิท 36 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
2008 ซอย 36 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
Tel +66(0) 2432 8580 Fax +66(0) 2432 8545

เอกสารไม่ควบคุม

FB 6071

## Verification Report

**Certificate No.:** 2203368-001-01  
**Equipment:** Digestor Unit  
Model: DKL20 Serial No.: 213517  
Resolution: 1 °C ID No.: UAE.WAS.005/2555  
Manufacturer: VELP SCIENTIFICA  
**Date of Calibration:** 23-24 June 2022 Page 2 of 4

**Location:** Laboratory Room, NATIONAL FOOD INSTITUTE  
**Environment Condition:** Ambient Temperature ( 25 ± 1 ) °C  
Relative Humidity ( 58 ± 8 ) %  
Line Voltage ( 224 ± 2 ) Volt

### Condition of this results of Calibration:

- This instrument was calibrated by insert standard thermocouples type S/R into its chamber and Calibration according to NFI Method W-TE-026 based on BS 4309 : 1968 : LABORATORY ELECTRIC RESISTANCE FURNACE.  
- The temperature scale used was based on ITS - 90 .  
- All data show below were final values and the initial data may be obtained upon request.

### 2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34970A Type R	MY44045375/MY41194453 R/CH1 to R/CH3	TC22/0044	5-May-2023	N.M. Technical Center Laboratory

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

### UUC\* Description

Time of Record 1 Hour 6 Minute At 380 °C

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

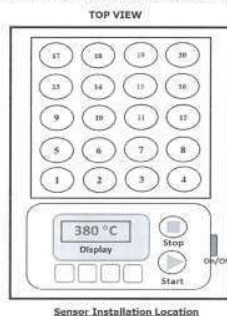
F-CS-012 Revision: 01 Date: 20-04-65

## Verification Report

**Certificate No.:** 2203368-001-01  
**Equipment:** Digestor Unit  
Model: DKL20 Serial No.: 213517  
Resolution: 1 °C ID No.: UAE.WAS.005/2555  
Manufacturer: VELP SCIENTIFICA  
**Date of Calibration:** 23-24 June 2022 Page 4 of 4

**Calibration point:** 380 °C  
**Calibration result:** Continued

Figure 1. Location of Reference Standard and Block Diagram of Digestion Unit



### Note:

- UUC\* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

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

## Verification Report

**Certificate No.:** 2203368-001-01  
**Equipment:** Digestor Unit  
Model: DKL20 Serial No.: 213517  
Resolution: 1 °C ID No.: UAE.WAS.005/2555  
Manufacturer: VELP SCIENTIFICA  
**Date of Calibration:** 23-24 June 2022 Page 3 of 4

**Calibration point:** 380 °C

### Calibration result:

Table1 : Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	378 - 380	0.23	381.88	2.4
2	380	378 - 380	0.64	382.15	2.4
3	380	378 - 380	0.21	382.38	2.4
4	380	378 - 380	0.40	380.44	2.4
5	380	378 - 380	0.34	378.52	2.4
6	380	378 - 380	0.25	379.64	2.4
7	380	378 - 380	0.31	382.46	2.4
8	380	378 - 380	0.29	381.13	2.4
9	380	378 - 380	0.36	382.25	2.4
10	380	378 - 380	0.17	382.23	2.4
11	380	378 - 380	0.24	382.47	2.4
12	380	378 - 380	0.39	381.63	2.4
13	380	378 - 380	0.63	382.02	2.5
14	380	378 - 380	0.46	382.39	2.5
15	380	378 - 380	0.38	381.69	2.5
16	380	378 - 380	0.38	377.97	2.4
17	380	378 - 380	0.50	379.87	2.4
18	380	378 - 380	0.33	380.73	2.4
19	380	378 - 380	0.56	378.47	2.4
20	380	378 - 380	0.41	378.77	2.4

### Note:

- UUC\* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

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

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

ภาคผนวก จ  
หนังสือรับรองการขึ้นทะเบียน  
ห้องปฏิบัติการวิเคราะห์เอกชน

---





ที่ อก ๐๓๑๐(๑)/ ๘ ๗ ๒ ๔



กรมโรงงานอุตสาหกรรม  
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๕ พฤษภาคม ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๑๖ พฤษภาคม ๒๕๖๖

ตามที่ห้องปฏิบัติการดังกล่าว บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด  
ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๑๕๕ สถานที่ตั้งเลขที่ ๓ ซอยอุดมสุข ๔๑ ถนนสุขุมวิท แขวงบางจาก  
เขตพระโขนง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้ยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ ราย

- |                                  |                            |
|----------------------------------|----------------------------|
| ๑) นางสาวพริดา เจริญชัยสมบัติ    | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๐ |
| ๒) นายสงกรานต์ มาลีทอง           | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๑ |
| ๓) นางสาววรรณรัตน์ คุณาพันธุ์ชัย | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๒ |
| ๔) นางสาววรรณรัตน์ ลาพรม         | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๓ |
| ๕) นางสาวสุวรรณี จันทร์ประทีป    | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๔ |
๒. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๔ ราย
- |                           |                            |
|---------------------------|----------------------------|
| ๑) นางสาววิภา ฝ้ายสิทธิ์  | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๕ |
| ๒) นางสาวเออริน สุจริต    | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๖ |
| ๓) นางสาวเพ็ญพิชชา รอดทอง | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๗ |
| ๔) นางสาวณิชา แสงสว่าง    | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๘ |

อนึ่ง หนังสือฉบับนี้จะหมดอายุพร้อมหนังสือต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์  
เอกชน คือในวันที่ ๒ กุมภาพันธ์ ๒๕๖๘ ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ทันทีบนเว็บไซต์  
กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายประพนธ์ คำรณพงษ์)

ผู้อำนวยการกองส่งเสริมและพัฒนาระบบนิเทศ  
ปฏิบัติการทางเคมีและสิ่งแวดล้อม กรมโรงงานอุตสาหกรรม

UNITED ANALYST AND ENGINEERING  
CONSULTANT COMPANY LIMITED

ดำเนินการถูกต้อง

กองวิจัยและพัฒนาระบบนิเทศโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๕๓๐ ๖๓๑๒ ต่อ ๒๑๐๓-๕

โทรสาร ๐ ๒๕๓๐ ๖๓๑๒ ต่อ ๒๑๐๓

ไปรษณีย์อิเล็กทรอนิกส์ saraban@dwr.mail.go.th



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



- ๒ -

อนึ่ง หนังสือฉบับนี้จะหมดอายุพร้อมหนังสือต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
ที่ อก ๐๓๑๐(๑)/๘๗๗๗ ลงวันที่ ๔ กุมภาพันธ์ ๒๕๖๘ คือในวันที่ ๒ กุมภาพันธ์ ๒๕๖๘ ทั้งนี้ สามารถยื่นคำขอ  
ผ่านระบบอิเล็กทรอนิกส์ได้ทันทีบนเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบมาด้วย

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายประพนธ์ คำรณพงษ์)

ผู้อำนวยการกองส่งเสริมและพัฒนาระบบนิเทศ  
ปฏิบัติการทางเคมีและสิ่งแวดล้อม กรมโรงงานอุตสาหกรรม

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ดำเนินการถูกต้อง

กองวิจัยและพัฒนาระบบนิเทศโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๕๓๐ ๖๓๑๒ ต่อ ๒๑๐๓-๕ โทรสาร ๐ ๒๕๓๐ ๖๓๑๒ ต่อ ๒๑๐๓

ไปรษณีย์อิเล็กทรอนิกส์ saraban@dwr.mail.go.th

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ดำเนินการถูกต้อง



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



ที่ อก ๐๓๑๐(๑)/ ๖ ๐ ๒ ๘



กรมโรงงานอุตสาหกรรม  
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๒ มีนาคม ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรและสารมลพิษที่วิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๓๐ มกราคม ๒๕๖๖

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือเปลี่ยนแปลงบุคลากรและสารมลพิษที่วิเคราะห์

บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด จำนวน ๒ แผ่น

ตามที่หนังสือที่อ้างถึง บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด  
ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๑๕๕ สถานที่ตั้งเลขที่ ๓ ซอยอุดมสุข ๔๑ ถนนสุขุมวิท  
แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรและสารมลพิษที่วิเคราะห์  
ความละเอียดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้ยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๒ ราย

- |                         |                            |
|-------------------------|----------------------------|
| ๑) นายวิเชษฐ์ สุวรรณราช | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๖ |
| ๒) นายพิพัฒน์ ตั้งมกุล  | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๗ |
๒. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๑ ราย
- |                             |                            |
|-----------------------------|----------------------------|
| ๑) นางสาวอรุณ ประสานศรี     | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๘ |
| ๒) นายพล นิยมนิยม           | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๓๙ |
| ๓) นายศุภกร สวนศรี          | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๐ |
| ๔) นายศุภณัฐ คีลาพันธ์      | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๑ |
| ๕) นายโชคชัย หุ่นใส         | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๒ |
| ๖) นายธนวิชัย กลิ่นบ้านเกาะ | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๓ |
| ๗) นายธีรวัฒน์ ธรรมสุวรรณ   | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๔ |
| ๘) นายภัทรพงศ์ ชะขุนทด      | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๕ |
| ๙) นางสาวณัฐกานดา พลนิกรกิจ | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๖ |
| ๑๐) นางสาวฉันทพร พงษ์ภูมิ   | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๗ |
| ๑๑) นางสาวพรชิตา ชรณดิษฐ์   | ทะเบียนเลขที่ ๖-๑๕๕-๖-๐๐๔๘ |

๓. ให้เพิ่มขอบข่ายสารมลพิษที่วิเคราะห์ในดิน ตามสิ่งที่ส่งมาด้วย

UNITED ANALYST AND ENGINEERING  
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ดำเนินการถูกต้อง

อนึ่ง...

เอกสารแนบท้ายหนังสือเปลี่ยนแปลงบุคลากรและสารมลพิษที่วิเคราะห์

บริษัท ยูโนเด็ค แอนนาลิติกส์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด เลขทะเบียน ๖-๑๕๕

ที่ อก ๐๓๑๐(๑)/ ๖ ๐ ๒ ๘

ลงวันที่ ๒๒ มีนาคม ๒๕๖๖

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๑๖ รายการ

ดิน จำนวน 16 รายการ

ลำดับที่	สารมลพิษ	วิธีการวิเคราะห์
1	Benzene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
2	Carbon tetrachloride	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
3	1,2-Dichloroethane	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
4	1,1-Dichloroethylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
5	cis-1,2-Dichloroethylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
6	trans-1,2-Dichloroethylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
7	Ethylbenzene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
8	Methylene chloride	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
9	Styrene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
10	Tetrachloroethylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
11	Toluene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
12	Trichloroethylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
13	m-Xylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
14	o-Xylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
15	p-Xylene	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>
16	Xylene (Total)	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(1,2)</sup>

เอกสารอ้างอิง...

เอกสารอ้างอิง

1. United States Environmental Protection Agency. Test Methods for Evaluation Solid Waste Physical/Chemical Methods. Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis. SW-846 Method 5021A, 2014.
2. United States Environmental Protection Agency. Test Methods for Evaluation Solid Waste Physical/Chemical Methods. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry. SW-846 Method 8260D, 2018.



ดำเนินการถูกต้อง

กลุ่มมาตรฐานวิธีการวิเคราะห์ของมลพิษและประเมินสิ่งแวดล้อมปฏิบัติการ กองวิจัยและเตือนภัยมลพิษโรงงาน กรมโรงงานอุตสาหกรรม โทร. ๐ ๕๔๓๖๐ ๖๒๑๒ ต่อ ๒๑๓๑๕



ที่ อก ๐๓๑๐(๑)/ ๑๕๕๕๕๕

กรมโรงงานอุตสาหกรรม  
ถนนพหลโยธินที่ ๒ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๕ ตุลาคม ๒๕๖๕

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท ยูนิเทค แอนนาลิสต์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขณิฉาสมาสิทธิ์ของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๑๘ ตุลาคม ๒๕๖๕

ตามหนังสือที่อ้างถึง บริษัท ยูนิเทค แอนนาลิสต์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๑๕๕๕ สถานที่ตั้งเลขที่ ๓ ซอยสุขุมสุข ๔๓ ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดดังนี้

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้อยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๔ ราย

- |                                       |                             |
|---------------------------------------|-----------------------------|
| ๑) นายสุธรรมา แก้วชัยนอก              | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๒ |
| ๒) นายกันต์พงศ์ บุญพวง                | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๓ |
| ๓) นายณัฐพล พงศ์ธำพร                  | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๔ |
| ๔) นางสาวธัญญ์กานันท์ อินใจดีกัญจนการ | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๕ |

๒. ให้เพิ่มผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๒ ราย

- |                          |                             |
|--------------------------|-----------------------------|
| ๑) นายกันต์พงศ์ บุญพวง   | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๓ |
| ๒) นายสุธรรมา แก้วชัยนอก | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๐๒ |

๓. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๒ ราย

- |                            |                             |
|----------------------------|-----------------------------|
| ๑) นายชินวัฒน์ หอยสิงห์    | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๐ |
| ๒) นายประพันธ์ แก้วคำ      | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๑ |
| ๓) นายกิตติศักดิ์ มูลสินธุ | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๒ |
| ๔) นายคุณานนท์ อุดมการณ์   | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๓ |
| ๕) นายชาญณรงค์ อ้ายอ       | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๔ |
| ๖) นางสาวจิตติมาศ ศรีวรรณ  | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๕ |
| ๗) นายสุจิตต์ โพธิ์เงิน    | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๖ |
| ๘) นายเจษฎา ชัยศรี         | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๗ |
| ๙) นายชุต หนองสุรินทร์     | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๘ |
| ๑๐) นายสุวิทย์ ชุมเอียด    | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๒๙ |
| ๑๑) นายสุวิทย์ ห่อโท       | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๓๐ |
| ๑๒) นายชัย บัวสด           | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๑๓๑ |



ดำเนินการถูกต้อง

อนึ่ง หนังสือฉบับนี้...

อนึ่ง หนังสือฉบับนี้จะมีผลต่ออายุ/ต่ออายุ/ขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ที่ อก ๐๓๑๐(๑)/๑๕๕๕๕๕ ลงวันที่ ๕ กุมภาพันธ์ ๒๕๖๕ คือในวันที่ ๒ กุมภาพันธ์ ๒๕๖๕ ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบมาด้วย

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นายประสม คำพงษ์)  
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน  
ปฏิบัติการกรมโรงงานอุตสาหกรรม



ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

กองวิจัยและเตือนภัยมลพิษโรงงาน  
กลุ่มมาตรฐานวิธีการวิเคราะห์ของมลพิษและประเมินสิ่งแวดล้อมปฏิบัติการ  
โทร. ๐ ๕๔๓๖๐ ๖๒๑๒ ต่อ ๒๑๓๑๕  
โทรสาร ๐ ๕๔๓๖๐ ๖๒๑๒ ต่อ ๒๑๓๑๕  
ไปรษณีย์อิเล็กทรอนิกส์ sarabang@dlw.mail.go.th



ดำเนินการถูกต้อง



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



ที่ อก ๐๓๑๐(๑)/ ๑๒ ๑๕๕๕

กรมโรงงานอุตสาหกรรม  
ถนนพหลโยธินที่ ๒ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๐๑ กันยายน ๒๕๖๕

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท ยูนิเทค แอนนาลิสต์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขณิฉาสมาสิทธิ์ของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๒๖ สิงหาคม ๒๕๖๕

ตามหนังสือที่อ้างถึง บริษัท ยูนิเทค แอนนาลิสต์ แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๑๕๕๕ สถานที่ตั้งเลขที่ ๓ ซอยสุขุมสุข ๔๓ ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดดังนี้

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้อยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๔ ราย

- |                                  |                             |
|----------------------------------|-----------------------------|
| ๑) นายบริดา ไชยมูลกุล            | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๓ |
| ๒) นายปิยะนัฐ ศรีโรจน์           | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๔ |
| ๓) นายธีรเมธ สุขศรี              | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๕ |
| ๔) นางสาวศิริวรรณ ขอนพา          | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๖ |
| ๕) นายศักดิ์สิทธิ์ เกิดชัย       | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๗ |
| ๖) นางสาวลัดดาวัลย์ โพธิ์พันธ์   | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๘ |
| ๗) นางสาวกมลวรรณ เจริญพันธ์      | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๑๙ |
| ๘) นางสาวจันทร์จิรา ประกอบทรัพย์ | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๐ |

๒. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๑ ราย

- |                               |                             |
|-------------------------------|-----------------------------|
| ๑) นางสาวนาถาภา แพรนโนเมือง   | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๑ |
| ๒) นางสาวกมลวรรณ สิมมา        | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๒ |
| ๓) นายนิวัฒน์ วงศ์คำ          | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๓ |
| ๔) นายประพันธ์ฤทธิ์ เลื่อนนาง | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๔ |
| ๕) นางสาวกมลวิภา อ้ายอ        | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๕ |
| ๖) นางสาวภาณุพร ชื่นนุกุล     | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๖ |
| ๗) นางสาวณัฏฐา มอนคุณ         | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๗ |
| ๘) นายณัฏฐพล อมรสิทธิ์        | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๘ |
| ๙) นางสาวศิริพร ทองขาว        | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๒๙ |
| ๑๐) นางสาวณิชากร สุภาพงษ์     | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๓๐ |
| ๑๑) นางสาวกมลวรรณ คำดี        | ทะเบียนเลขที่ ๖-๑๕๕๕-๖-๐๐๓๑ |



ดำเนินการถูกต้อง

อนึ่ง หนังสือฉบับนี้...

อนึ่ง หนังสือฉบับนี้จะทยอยออกหรือหนังสือที่รอรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
ที่ อก ๐๓๓๐(๑)/๒๕๖๕ ลงวันที่ ๕ กุมภาพันธ์ ๒๕๖๕ คือในวันที่ ๒ กุมภาพันธ์ ๒๕๖๕ ทั้งนี้ สามารถยื่นคำขอ  
ผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบหนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นางจินดา เกษศรีพันธ์)  
ผู้อำนวยการกองวิจัยและพัฒนาระบบอุตสาหกรรม  
ปฎิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม



ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

กองวิจัยและพัฒนาระบบอุตสาหกรรม  
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและทะเบียนห้องปฏิบัติการ  
โทร. ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๐๓-๕  
โทรสาร ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๑๕  
ไปรษณีย์อิเล็กทรอนิกส์ saraban@dlw.mail.go.th



ดำเนินการถูกต้อง



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



ที่ อก ๐๓๓๐(๑)/ ๕๖๕ ๕

กรมโรงงานอุตสาหกรรม  
ถนนพหลโยธิน  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๑ มกราคม ๒๕๖๕

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท ยูไนเต็ด แอนาไลติก แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขอคืนสถานะห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๓๐ มีนาคม ๒๕๖๕

ตามหนังสือที่อ้างถึง บริษัท ยูไนเต็ด แอนาไลติก แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด  
ห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๓๔๕ สถานที่ตั้งเลขที่ ๓ ซอยอุดมสุข ถนนสุขุมวิท แขวงบางจาก  
เขตพระโขนง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์ ความละเอียดเดิมแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๓. ให้ยกเลิกผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๒ ราย
  - ๑) นางมานิตา แฉียงใหญ่ ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๐๐๕
  - ๒) นางสาวกมลวรรณ คงคำ ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๐๑๒
๒. ให้ยกเลิกเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๒ ราย
  - ๑) นางสาวศิริพร อภิรัตน์ ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๐๖๔
  - ๒) นางสาวพรนิจา กลิ่นนุ่น ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๐๘๔
๓. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๒ ราย
  - ๑) นางสาวธัญญลักษณ์ ธนโชติกาญจนการ ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๑๐๕
  - ๒) นางสาวจิราพร จีรา พุ่มกอบทรัพย์ ทะเบียนเลขที่ ๖-๓๔๕-๓-๐๑๐๘

อนึ่ง หนังสือฉบับนี้จะทยอยออกหรือหนังสือที่รอรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
ที่ อก ๐๓๓๐(๑)/๒๕๖๕ ลงวันที่ ๕ กุมภาพันธ์ ๒๕๖๕ คือในวันที่ ๒ กุมภาพันธ์ ๒๕๖๕ ทั้งนี้ สามารถยื่นคำขอ  
ผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบหนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

(นางจินดา เกษศรีพันธ์)  
ผู้อำนวยการกองวิจัยและพัฒนาระบบอุตสาหกรรม  
ปฎิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม



ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

กองวิจัยและพัฒนาระบบอุตสาหกรรม

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและทะเบียนห้องปฏิบัติการ  
โทร. ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๐๓-๕ โทรสาร ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๑๕  
ไปรษณีย์อิเล็กทรอนิกส์ saraban@dlw.mail.go.th



ดำเนินการถูกต้อง



"อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว"



ที่ อก ๐๓๓๐(๑)/ ๑๖๕ ๕

กรมโรงงานอุตสาหกรรม  
ถนนพหลโยธิน  
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๑๕ กุมภาพันธ์ ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท ยูไนเต็ด แอนาไลติก แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขอคืนสถานะห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๒๕ ธันวาคม ๒๕๖๔

- สิ่งที่ส่งมาด้วย
๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๔๐ ราย
  ๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๐๖ ราย
  ๓. ขอบข่ายสารเคมีที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม

ตามหนังสือที่อ้างถึง บริษัท ยูไนเต็ด แอนาไลติก แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด  
ขอต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ๖-๓๔๕ สถานที่ตั้งเลขที่ ๓  
ซอยอุดมสุข ๔๓ ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท ยูไนเต็ด แอนาไลติก แอนด์ เอ็นจิเนียริง  
คอนซัลแตนท์ จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้  
ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๔๐ ราย ตามสิ่งที่ส่งมาด้วย ๑  
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๐๖ ราย ตามสิ่งที่ส่งมาด้วย ๒  
ค. ขอบข่ายสารเคมีที่ได้รับขึ้นทะเบียนไว้วิเคราะห์ในน้ำเสีย น้ำโคลน อากาศเสีย สิ่งปฏิกูล  
หรือวัสดุที่ไม่ใช้แล้ว และดิน ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะทยอยออกในวันที่ ๒ กุมภาพันธ์ ๒๕๖๕ หากประสงค์ต่ออายุหนังสือ  
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อ  
กรมโรงงานอุตสาหกรรมภายใน ๓๐ วัน ก่อนวันสิ้นสุดอายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบ  
หนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

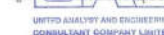
(นางจินดา เกษศรีพันธ์)  
ผู้อำนวยการกองวิจัยและพัฒนาระบบอุตสาหกรรม  
ปฎิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม



ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์

กองวิจัยและพัฒนาระบบอุตสาหกรรม

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและทะเบียนห้องปฏิบัติการ  
โทร. ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๐๓-๕ โทรสาร ๐ ๒๕๓๐ ๖๓๓๒ ต่อ ๒๑๑๕  
ไปรษณีย์อิเล็กทรอนิกส์ saraban@dlw.mail.go.th



ดำเนินการถูกต้อง





ทอนไชยธรรมมณีนที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จังหวัด

วันที่ ๒๕ กรกฎาคม ๒๕๖๓

NR 46 778073

16 o,p'-DDT...36 Oil & Grease..

น้ำใต้ดิน จำนวน 126 รายการ

4 Anthracene.



ลำดับ	สารมลพิษ	วิธีวิเคราะห์
4	Anthracene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
5	Antimony	Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
6	Arsenic	1) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(4)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
7	Atrazine	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
8	Barium	1) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
9	Benz(a)anthracene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
10	Benzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
11	Benzo(b)fluoranthene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
12	Benzo(k)fluoranthene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
13	Benzoic acid	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
14	Benzo(a)pyrene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

15 Benzo(g,h,i)perylene...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
15	Benzo(g,h,i)perylene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
16	Beryllium	Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
17	Bis(2-chloroethyl)ether	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
18	Bis(2-ethylhexyl)phthalate	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
19	Bromodichloromethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
20	Bromoform	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
21	Butanol	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
22	Butyl benzyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
23	Cadmium	1) Digestion, Direct Air-Acetylene Flame Method <sup>(4)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
24	Carbazole	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
25	Carbon disulfide	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
26	Carbon tetrachloride	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
27	Chlordane	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
28	p-Chloroaniline	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
29	Chlorobenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

30 Chlorodibromomethane...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
30	Chlorodibromomethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
31	Chloroform	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
32	2-Chlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
33	Chromium	1) Digestion, Direct Air-Acetylene Flame Method <sup>(4)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
34	Chromium (III)	1) Digestion, Direct Air-Acetylene Flame Method; Colorimetric Method; Calculation <sup>(4)</sup> 2) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation <sup>(4)</sup>
35	Chromium (VI)	1) Colorimetric Method <sup>(4)</sup> 2) Extraction, Air-Acetylene Flame Method <sup>(4)</sup>
36	Chrysene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
37	Cyanide	Distillation, Colorimetric Method <sup>(4)</sup>
38	2,4-D	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup>
39	DDD	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
40	DDE	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
41	DDT	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

42 Dibenzo(a,h)anthracene...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
42	Dibenzo(a,h)anthracene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
43	Di-n-butyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
44	1,2-Dichlorobenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
45	1,3-Dichlorobenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
46	1,4-Dichlorobenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
47	3,3'-Dichlorobenzidine	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
48	1,1-Dichloroethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
49	1,2-Dichloroethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
50	1,1-Dichloroethylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
51	cis-1,2-Dichloroethylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
53	2,4-Dichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
54	1,2-Dichloropropane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
55	1,3-Dichloropropane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
56	1,3-Dichloropropene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
57	Dieldrin	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

58 Diethyl phthalate...



ลำดับ	สารมลพิษ	วิธีวิเคราะห์
58	Diethyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
59	2,4-Dimethylphenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
60	2,4-Dinitrophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
61	2,4-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
62	2,6-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
63	Di-n-Octyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
64	Endosulfan	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
65	Endrin	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
66	Ethylbenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
67	Fluoranthene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
68	Fluorene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
69	Heptachlor	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

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70 Heptachlor epoxide...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
70	Heptachlor epoxide	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
71	Hexachlorobenzene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
73	n-Hexane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
74	α-HCH	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
75	β-HCH	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
76	γ-HCH	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
77	Hexachlorocyclopentadiene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
78	Hexachloroethane	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
79	Indeno(1,2,3-cd)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
80	Isophorone	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
81	Lead	1) Digestion, Direct Air-Acetylene Flame Method <sup>(4)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>

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CONSULTANT COMPANY LIMITED

82 Manganese...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
82	Manganese	1) Digestion, Direct Air-Acetylene Flame Method <sup>(4)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
83	Mercury	Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(4)</sup>
84	Methanol	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup>
86	Methyl bromide	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
87	Methylene chloride	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
89	2-Methylnaphthalene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
90	Methyl tert-butyl ether	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
91	Naphthalene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
92	Nickel	1) Digestion, Direct Air-Acetylene Flame Method <sup>(4)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(4)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
95	N-Nitrosodi-n-propylamine	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

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96 Polychlorinated Biphenyls...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
96	Polychlorinated Biphenyls - PCB 1016 - PCB 1221 - PCB 1232 - PCB 1242 - PCB 1248 - PCB 1254 - PCB 1260	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
98	pH	Electrometric Method <sup>(4)</sup>
99	Phenanthrene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
100	Phenol	1) Distillation, Chloroform Extraction Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
101	Pyrene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(4)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
102	Selenium	1) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(4)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
103	Silver	Digestion, Inductively Coupled Plasma Method <sup>(4)</sup>
104	Styrene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
105	1,1,2,2-Tetrachloroethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
106	Tetrachloroethylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>
107	Toluene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(4)</sup>

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108 Toxaphene...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
108	Toxaphene	1) Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(6)</sup> 2) Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
109	TPH (C <sub>3</sub> - C <sub>6</sub> )	1) Purge and Trap, Gas Chromatographic Method <sup>(1,2,1)</sup> 2) Purge and Trap, Gas Chromatographic/Mass spectrometric Method <sup>(1,2,1)</sup>
110	TPH (C <sub>5,6</sub> - C <sub>10</sub> )	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(9,21)</sup>
111	TPH (C <sub>10,16</sub> - C <sub>33</sub> )	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(9,21)</sup>
112	1,2,4-Trichlorobenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
113	1,1,1-Trichloroethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
114	1,1,2-Trichloroethane	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
115	Trichloroethylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
116	2,4,5-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
117	2,4,6-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
118	1,3,5-Trimethylbenzene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
119	Vanadium	Digestion, Inductively Coupled Plasma Method <sup>(6)</sup>
120	Vinyl acetate	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
121	Vinyl chloride	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
122	m-Xylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
123	o-Xylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>

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124 p-Xylene...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
124	p-Xylene	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
125	Xylene (Total)	Purge and Trap Gas Chromatographic/Mass Spectrometric Method <sup>(6)</sup>
126	Zinc	1) Digestion, Direct Air-Acetylene Flame Method <sup>(6)</sup> 2) Digestion, Electrothermal Atomic Absorption Spectrometric Method <sup>(6)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(6)</sup>

தாகს (பெற்றுவருவ) ஜானவ 25 ராயகர

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
1	Antimony	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
2	Arsenic	1) Isokinetic Sampling, Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
3	Cadmium	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
4	Carbon Monoxide	Instrumental Analyzer Method <sup>(3)</sup>
5	Chlorine	Isokinetic Sampling, Ion Chromatographic Method <sup>(3)</sup>
6	Chromium	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
7	Cobalt	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
8	Copper	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
9	Cresol	Absorption Sampling, Gas Chromatographic Method <sup>(3)</sup>

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10 Dioxins/Furans...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
10	Dioxins/Furans	Isokinetic Sampling <sup>(3)</sup>
11	Hydrogen Chloride	Isokinetic Sampling, Ion Chromatographic Method <sup>(3)</sup>
12	Hydrogen Fluoride	Isokinetic Sampling, Ion Chromatographic Method <sup>(3)</sup>
13	Hydrogen Sulfide	Absorption Sampling, Iodometric Method <sup>(3)</sup>
14	Lead	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
15	Manganese	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
16	Mercury	Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(3)</sup>
17	Nickel	1) Isokinetic Sampling, Digestion, Direct Air-Acetylene Flame Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
18	Opacity	Ringelmann's Method <sup>(1)</sup>
19	Oxides of Nitrogen	1) Absorption Sampling, Phenoldisulfonic acid Method <sup>(6)</sup> 2) Instrumental Analyzer Method <sup>(3)</sup>
20	Selenium	1) Isokinetic Sampling, Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(3)</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
21	Sulfur Dioxide	1) Absorption Sampling, Barium-Thorin Titrimetric Method <sup>(3)</sup> 2) Instrumental Analyzer Method <sup>(3)</sup>
22	Sulfuric Acid	Isokinetic Sampling, Barium-Thorin Titrimetric Method <sup>(3)</sup>
23	Total Suspended Particulate	Isokinetic Sampling, Gravimetric Method <sup>(3)</sup>
24	Vanadium	Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>(3)</sup>
25	Xylene	1) Gas Chromatographic/Mass Spectrometric Method <sup>(3)</sup> 2) Absorption Sampling, Gas Chromatographic Method <sup>(3)</sup>

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สิ่งปลูก...

สิ่งปลูกหมีอยู่ที่ไม่ใช้แล้ว จำนวน 35 รายการ

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
2	Antimony	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
3	Arsenic	1) Waste Extraction, Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(2,6,13)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 3) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(7,13)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
6	Cadmium	1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,14)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 3) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,14)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
7	Chlordane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(9,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
8	Chromium	1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,13)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup>

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3) Digestion,...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
9	Chromium (III)	3) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup> 1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation <sup>(2,6,14,16)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation <sup>(7,8,13,16)</sup> 3) Digestion, Flame Atomic Absorption Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation <sup>(7,8,14,16)</sup> 4) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation <sup>(7,8,13,14)</sup>
10	Chromium (VI)	1) Waste Extraction, Colorimetric Method <sup>(2,16)</sup> 2) Alkaline Digestion, Colorimetric Method <sup>(8,14)</sup>
11	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
12	Copper	1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,14)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 3) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
13	2,4-D	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
14	DDD	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>

15 DDE...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
15	DDE	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
16	DDT	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
17	Dieldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
18	Endrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
19	Heptachlor	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
20	Lead	1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,14)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 3) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
21	Lindane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
22	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(2,17)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup>

3) Digestion...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
23	Methoxychlor	3) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(18)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup> 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method <sup>(19)</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
24	Molybdenum	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
25	Nickel	1) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,14)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 3) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
26	Polychlorinated Biphenyls - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,23)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,23)</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(2,9,23)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,23)</sup>

- 2,2',4,5,5'-...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
27	- 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5,6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl Pentachlorophenol	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(2,9,24)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,24)</sup> Electrometric Method <sup>(31,35)</sup>
28	pH	1) Waste Extraction, Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(2,6,20)</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup>
29	Selenium	3) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(2,6,20)</sup> 4) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>

30 Silver...



ลำดับ	สารมลพิษ	วิธีวิเคราะห์
30	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup>
31	Thallium	2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
32	Toxaphene	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
33	Trichloroethylene	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>(3,5,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
34	Vanadium	1) Waste Extraction, Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup> 2) Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
35	Zinc	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup> 3) Waste Extraction, Digestion, Flame Atomic Absorption Spectrometric Method <sup>(2,6,14)</sup> 4) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>(2,6,13)</sup> 5) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 6) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>

## สินค้าจำนวน 125 รายการ

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
2	Acetone	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>

3 Aldrin...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
3	Aldrin	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
4	Anthracene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
5	Antimony	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
6	Arsenic	1) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(7,15)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
7	Atrazine	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
8	Barium	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
9	Benz(a)anthracene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
10	Benzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
11	Benzo(b)fluoranthene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
12	Benzo(k)fluoranthene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
13	Benzoic acid	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
14	Benzo(a)pyrene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>

15 Benzo(g,h,i)perylene...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
15	Benzo(g,h,i)perylene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
16	Beryllium	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
17	Bis(2-chloroethyl)ether	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
18	Bis(2-ethylhexyl)phthalate	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
20	Bromoform	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
21	Butanol	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
22	Butyl benzyl phthalate	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
23	Cadmium	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
24	Carbazole	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
25	Carbon disulfide	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
27	Chlordane	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
28	p-Chloroaniline	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>

31 Chloroform...

ลำดับ	สารมลพิษ	วิธีวิเคราะห์
31	Chloroform	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
32	2-Chlorophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
33	Chromium	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
34	Chromium (III)	1) Digestion, Flame Atomic Absorption Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation <sup>(7,8,14,16)</sup> 2) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation <sup>(7,8,13,14)</sup>
35	Chromium (VI)	Alkaline Digestion, Colorimetric Method <sup>(8,18)</sup>
36	Chrysene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
37	Cyanide	Extraction, Distillation, Colorimetric Method <sup>(8,29,30)</sup>
38	2,4-D	Ultrasonic Extraction, Gas Chromatographic Method <sup>(27)</sup>
39	DDD	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
40	DDE	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
41	DDT	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
42	Dibenz(a,h)anthracene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>

43 Di-n-butyl phthalate...

ลำดับ	สารเคมี	วิธีวิเคราะห์
43	Di-n-butyl phthalate	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
47	3,3'-Dichlorobenzidine	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
53	2,4-Dichlorophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
57	Dieldrin	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
58	Diethyl phthalate	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
59	2,4-Dimethylphenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>

60 2,4-Dinitrophenol...

ลำดับ	สารเคมี	วิธีวิเคราะห์
60	2,4-Dinitrophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
61	2,4-Dinitrotoluene	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
62	2,6-Dinitrotoluene	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
63	Di-n-Octyl phthalate	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
64	Endosulfan	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
65	Endrin	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
67	Fluoranthene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,24)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
68	Fluorene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,24)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
69	Heptachlor	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
70	Heptachlor epoxide	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>

71 Hexachlorobenzene...

ลำดับ	สารเคมี	วิธีวิเคราะห์
71	Hexachlorobenzene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
73	n-Hexane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
74	α-HCH	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
75	β-HCH	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
76	γ-HCH	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
77	Hexachlorocyclopentadiene	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
78	Hexachloroethane	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
79	Indeno[1,2,3-cd]pyrene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,24)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
80	Isophorone	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
81	Lead	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,15)</sup>
82	Manganese	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,15)</sup>

83 Mercury...

ลำดับ	สารเคมี	วิธีวิเคราะห์
83	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,15)</sup> 3) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method <sup>(7,14)</sup>
84	Methanol	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
85	Methoxychlor	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
86	Methyl bromide	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
87	Methylene chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
88	2-Methylphenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
89	2-Methylnaphthalene	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
90	Methyl tert-butyl ether	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
91	Naphthalene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,24)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
92	Nickel	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,15)</sup>
93	Nitrobenzene	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
94	N-Nitrosodiphenylamine	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
95	N-Nitrosodi-n-propylamine	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>

96 Polychlorinated Biphenyls...

ลำดับ	สารเคมี	วิธีวิเคราะห์
96	Polychlorinated Biphenyls - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 Polychlorinated Biphenyls - 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4,6'-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6'-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5'-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5,6'-Heptachlorobiphenyl	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>  Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup>



ดำเนินการถูกต้อง

- 2,2',3,4,5,5',6-...

ลำดับ	สารเคมี	วิธีวิเคราะห์
	- 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	
97	Pentachlorophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
98	Phenanthrene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
99	Phenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
100	Pyrene	1) Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,26)</sup> 2) Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
101	Selenium	1) Digestion, Hydride Generation/Atomic Absorption Spectrometric Method <sup>(7,22)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
102	Silver	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
103	Styrene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
106	Toluene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
107	Toxaphene	Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
108	TPH (C <sub>8</sub> -C <sub>9</sub> )	1) Purge and Trap, Gas Chromatographic Method <sup>(12,25)</sup> 2) Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
109	TPH (C <sub>8</sub> -C <sub>10</sub> )	Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
110	TPH (C <sub>10</sub> -C <sub>25</sub> )	Ultrasonic Extraction, Gas Chromatographic Method <sup>(10,22)</sup>
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>

112 1,1,1-Trichloroethane...

ลำดับ	สารเคมี	วิธีวิเคราะห์
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
115	2,4,5-Trichlorophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
116	2,4,6-Trichlorophenol	Ultrasonic Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>(10,26)</sup>
117	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
118	Vanadium	Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>
119	Vinyl acetate	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
120	Vinyl chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
121	m-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
122	o-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
123	p-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
124	Xylene (Total)	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>(12,25)</sup>
125	Zinc	1) Digestion, Flame Atomic Absorption Spectrometric Method <sup>(7,14)</sup> 2) Digestion, Inductively Coupled Plasma Method <sup>(7,13)</sup>

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ข้อมูลสาธารณะนี้เป็นการวิเคราะห์ข้อมูลและตีพิมพ์เผยแพร่โดยไม่ถือลิขสิทธิ์ การแก้ไขและเปลี่ยนแปลงโดยไม่แจ้งให้ทราบ อาจไม่ถูกต้องตามที่ปรากฏในเอกสารฉบับนี้