

ภาคผนวก ฎ  
เอกสารสอบเทียบเครื่องมือ

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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
<b>Ambient</b>									
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)	22P967	12 Aug 22	11 Aug 23	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2728	22 Jul 22	21 Jul 23	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1583	27 Jul 22	26 Jul 23	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050151	UAE Consultant Co., Ltd.	24062022	24 Jun 22	23 Jun 23	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778109	UAE Consultant Co., Ltd.	29062022	29 Jun 22	28 Jun 23	-
7	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
8	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778116	UAE Consultant Co., Ltd.	27102022	27 Oct 22	26 Oct 23	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778112	UAE Consultant Co., Ltd.	25102022	25 Oct 22	24 Oct 23	-
10	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
11	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778117	UAE Consultant Co., Ltd.	06102022	6 Oct 22	5 Oct 23	-
12	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201497733	UAE Consultant Co., Ltd.	12092022	12 Sep 22	11 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									
13	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
14	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040039	Thai Meteorological Department	260/22	12 Jul 22	11 Jul 23	-
15	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0106	Scarlet Tech Ltd.	14092022	14 Sep 22	13 Sep 23	-
16	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 GAL13KSE	UAE Consultant Co.,Ltd.	08022023	8 Feb 23	7 Feb 24	-
17	Total Hydrocarbons Analyzer	Total Hydrocarbons	Thermo Scientific	55i 1182920025	UAE Consultant Co.,Ltd.	25012023	25 Jan 23	24 Jan 24	-
18	Standard Gas	Total Hydrocarbons	Linde	D824432	Linde	09042013	4 Aug 20	4 Aug 28	-

## List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0081	Technology Promotion Association (Thailand-Japan)	23CH6	5 Jan 23	4 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE9M0028	Technology Promotion Association (Thailand-Japan)	23TW47	28 Feb 23	27 Feb 24	-
3	Conductivity Meter	Conductivity	Horiba	LAQUA-PH210 HC9L0014	Technology Promotion Association (Thailand-Japan)	23CH427	28 Mar 23	29 Mar 24	-



# Certificate of Calibration

Calibration Certification Information				
Cal. Date:	July 5, 2022	Rootsmer S/N:	438320	Ta: 297 °K
Operator:	Jim Tisch	Pa:	750.1	mm Hg
Calibration Model #:	G25A	Calibrator S/N:	1901	

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3540	3.3	2.00
2	3	4	1	0.9650	6.4	4.00
3	5	6	1	0.8640	8.0	5.00
4	7	8	1	0.8200	8.9	5.50
5	9	10	1	0.6780	12.9	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Vstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9859	0.7281	1.4073	0.9956	0.7353	0.8899
0.9818	1.0174	1.9902	0.9915	1.0274	1.2585
0.9797	1.1339	2.2251	0.9893	1.1451	1.4071
0.9785	1.1933	2.3337	0.9881	1.2050	1.4757
0.9732	1.4354	2.8146	0.9828	1.4496	1.7798
QSTD		m= 1.98897	QA		m= 1.24546
		b= -0.03691			b= -0.02334
		r= 0.99996			r= 0.99996

Calculations			
Vstd=	$\Delta Vol / (Pa - \Delta P) / Pstd / (Tstd / Ta)$	Va=	$\Delta Vol / (Pa - \Delta P) / Pa$
Qstd=	Vstd / ΔTime	Qa=	Va / ΔTime
For subsequent flow rate calculations:			
Qstd=	$1/m \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} - b \right)$	Qa=	$1/m \left( \sqrt{\Delta H \left( \frac{Ta}{Pa} \right)} - b \right)$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmer 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  
216-779-9009

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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: 0-2717-3009-24 FAX: 0-2719-9484

## Certificate of Calibration

Certificate No.: 22P967  
Page: 1 of 2

Equipment: U Tube Manometer  
Manufacturer: Dwyer  
Model: 1221-36-WM  
Serial No.: -  
ID No.: UAE.EFM.178/2561

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Condition As-Received: Used Item  
Received Date: 03 August 2022  
Calibration Date: 12 August 2022

Reference: 2208-0131WSC Submitted by: United Analyst and Engineering Consultant Co., Ltd.  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1010 mbar  
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to 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-0113-22	14 Jul 2023

- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 4.0146293 inH2O
- This instrument was used clean air as pressure media.
- This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.
- This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained at:-  
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Sunit Ausarnree  
Issue Date: 14 August 2022

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

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Cert.No.: 22P967  
Page: 2 of 2

Result of calibration:- Without adjustment  
Function:- Pressure Measurement  
Increasing Pressure  
Range: 0 inH2O to 36 inH2O  
Scale Interval: 0.1 inH2O (The Fifth Estimate)

UUC Indication				
Applied Pressure (inH2O)	High-port side (inH2O)	Low-port side (inH2O)	ΔP (inH2O)	Error (inH2O)
0.00	0.00	0.00	0.00	0.00
2.00	0.98	-0.94	1.92	-0.08
4.00	2.00	-1.98	3.98	-0.02
6.00	3.00	-2.98	5.98	-0.02
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.02	-5.96	11.98	-0.02
14.00	7.02	-6.96	13.98	-0.02
16.00	8.04	-7.98	16.02	0.02
18.00	9.04	-8.98	18.02	0.02
20.00	10.04	-9.98	20.02	0.02
22.00	11.06	-10.98	22.04	0.04
24.00	12.06	-12.00	24.06	0.06
26.00	13.06	-13.00	26.06	0.06
28.00	14.08	-14.02	28.10	0.10
30.00	15.08	-15.02	30.10	0.10
32.00	16.08	-16.04	32.12	0.12
34.00	17.10	-17.04	34.14	0.14
35.80	17.90	-17.86	35.76	-0.04

The uncertainty of measurement was ± 0.11 inH2O  
\* UUC = Unit Under Calibration  
\* ΔP = High-port side - Low-port side  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL: 0-2717-3009-24 FAX: 0-2719-9484

## Certificate of Calibration

Certificate No.: 22P2728  
Page: 1 of 2

Equipment: Aneroid Barometer  
Manufacturer: Barigo  
Model: -  
Serial No.: -  
ID No.: UAE.ANV.152/2550

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Condition As-Received: Used Item  
Received Date: 20 July 2022  
Calibration Date: 22 July 2022

Reference: 2207-0581WSC Submitted by: United Analyst and Engineering Consultant Co., Ltd.  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1010 mbar  
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

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

### Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505048	MP-0076-22	02 May 2023

- This instrument was installed in vertical orientation and center of the dial was used as the reference level.
- This result of calibration was made on requested at the point specified by customer.
- This result of calibration instrument was in absolute pressure.
- This instrument was used clean air as pressure media.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained at:-  
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Sunit Ausarnree  
Issue Date: 25 July 2022

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

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B 0293209



Cert.No.: 22P2728  
Page: 2 of 2

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

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

Increasing Pressure								
Applied Pressure (hPa)	956.27	967.46	978.89	989.56	999.85	1009.89	1020.55	1031.06
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	3.73	2.54	1.11	0.44	0.15	0.11	-0.55	-1.06

Decreasing Pressure								
Applied Pressure (hPa)	1031.19	1020.73	1009.81	999.92	989.72	979.13	967.71	956.64
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.19	-0.73	0.09	0.08	0.28	0.87	2.29	3.36

The uncertainty of measurement was  $\pm 0.30$  hPa

\* UUC = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SCI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL: 0-2717-3000-24 FAX: 0-2719-9484



## 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: 2207-0586WSC  
Ambient Temperature: ( 25  $\pm$  3 ) °C  
Relative Humidity: ( 50  $\pm$  20 ) %

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

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

81 Soi Udonsuk 41, Sukhumvit Road, Bangkok,  
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 Certificate 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 Dumvor  
Issue Date: 03 August 2022

Approved Signatory:   
( ) Chakrit Wawanyuan  
( ) Pornthipha Tameyskul  
( ) Viporn Tantiyawutti

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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
39.98	40.0	0.02	0.72

UUC\* : Unit Under Calibration

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

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United Analyst and Engineering Consultant Co., Ltd.

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

## MULTI-POINT GAS TEST REPORT

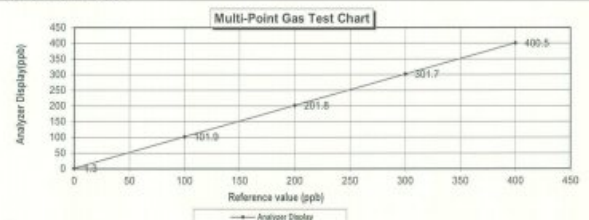
Test Date: June 24, 2022

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

Standard Gas Concentration			Diluter Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.75	PPM	Manufacturer:	Thermo Scientific
Nitric Oxide (NO)	45.35	PPM	Model:	146i
Methane (CH <sub>4</sub> )	-	PPM	Serial Number:	1180540071
Carbon Monoxide (CO)	1007			
Cylinder No.:	CC159599			
Expiration Date:	Jul 30, 2022			

### Multi-point gas test data

Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	1.30	1.30	1.30
Level 2	20.00%	100.0	1.90	1.86	1.86
Level 3	40.00%	200.0	1.80	0.89	0.89
Level 4	60.00%	300.0	1.70	0.56	0.56
Level 5	80.00%	400.0	0.50	0.12	0.12
Remark : Measuring Range		500.0 ppb	Average Difference (%)		0.95



Calculate by  
Somchai K.  
24, 06, 25

Approve by  
Ramon K.  
24, June, 2022

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### MULTI-POINT GAS TEST REPORT

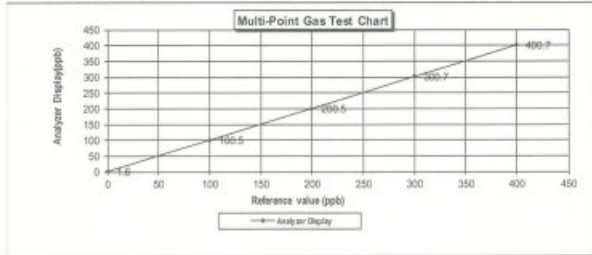
Test Date : June 29, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 428  
Manufacturer : Thermo Scientific Serial Number : 1201778109

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.75 PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.35 PPM	Model :	1461
Methane (CH <sub>4</sub> )	- PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	1007 PPM		
Cylinder No. :	CC1595999		
Expiration Date :	Jul 30, 2022		

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	1.6	1.60	1.60
Level 2 20.00%	100.0	100.5	0.50	0.50
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	400.7	0.70	0.17
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
Acceptable Limit $\pm 5\%$		0.55		



Calculate by

Sinchan Sangsri  
29 June 2022

Approve by

Phrakhanong  
29 June 2022

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### CERTIFICATE OF ANALYSIS

#### Grade of Product: IPA Protocol

Part Number: E64N99W/5401C5 Purity Grade Number: 122-02153137-  
Cylinder Number: EDC143262 Cylinder Volume: 44.4 L  
Label: 201 Duram (SAP) - NO Cylinder Pressure: 2010 PSI  
FCV Number: B2202 Valve Check: 330  
Gas Order: CC NO, COX SO2, BALN Calibration Date: Jun 21, 2021  
Expiration Date: Jun 21, 2024

This report is generated in accordance with the requirements of the Airgas Quality Management System (QMS) and is intended for use as a reference only. It does not constitute a warranty or a guarantee of performance. The data presented in this report is based on the results of the analysis performed on the sample provided. The data is subject to change without notice. The data is not to be used for any other purpose than the one for which it was intended.

Component	Requested Concentration	Actual Concentration	Purity Grade	Total Relative Uncertainty	Assay Dates
CO	45.01 PPM	45.06 PPM	61	$\pm 1.6\%$ (1.5% + 0.1%)	05/14/2021, 05/21/2022
NO	45.35 PPM	45.35 PPM	61	$\pm 1.6\%$ (1.5% + 0.1%)	05/14/2021, 05/21/2022
NITRIC OXIDE	45.35 PPM	45.35 PPM	61	$\pm 1.6\%$ (1.5% + 0.1%)	05/14/2021, 05/21/2022
CARBON MONOXIDE	1007 PPM	1007 PPM	61	$\pm 1.6\%$ (1.5% + 0.1%)	05/14/2021, 05/21/2022
METHANE	-	-	61	$\pm 1.6\%$ (1.5% + 0.1%)	05/14/2021, 05/21/2022

Type	Lot ID	Cylinder No.	Calibration Standards	Uncertainty	Expiration Date
IPRM	2010121	0000000	45.01 PPM NITRIC OXIDE IN NITROGEN	$\pm 1.6\%$	Feb 21, 2023
FRM	1706	1180525	50.0 PPM NITRIC OXIDE IN NITROGEN	$\pm 1.6\%$	Feb 21, 2023
MPM	40-4236262	0000001	45.01 PPM NITRIC OXIDE IN NITROGEN	$\pm 1.6\%$	Feb 21, 2023
MPM	1901100	0247007	45.01 PPM NITRIC OXIDE IN NITROGEN	$\pm 1.6\%$	Jun 21, 2022
MPM	1901101	1004077	50.0 PPM CARBON MONOXIDE IN NITROGEN	$\pm 1.6\%$	Jun 21, 2022

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
ANALYZER: 428/1000/1000/1000/1000	FID	05/14/2021
NO: 428/1000/1000/1000/1000	FID	05/14/2021
CO: 428/1000/1000/1000/1000	FID	05/14/2021
CH4: 428/1000/1000/1000/1000	FID	05/14/2021

Trade Data Available Upon Request

NOTE: TO: 4531000007

Calculated by: 26.40g

NET WT: 4.71g

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

Approved for Release



CERT 00000001

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### MULTI-POINT GAS TEST REPORT

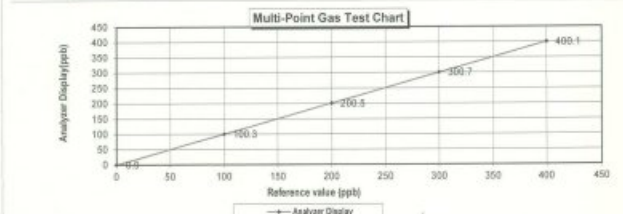
Test Date : Oct 27, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo Scientific Serial Number : 1201778116

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68 PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM	Model :	1461
Methane (CH <sub>4</sub> )	- PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8 PPM		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.9	0.90	0.90
Level 2 20.00%	100.0	100.3	0.30	0.30
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	400.1	0.10	0.02
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
Acceptable Limit $\pm 5\%$		0.34		



Calculate by

Sinchan Sangsri  
27 Oct 2022

Approve by

Phrakhanong  
27 Oct 2022

เอกสารไม่ควบคุม

### MULTI-POINT GAS TEST REPORT

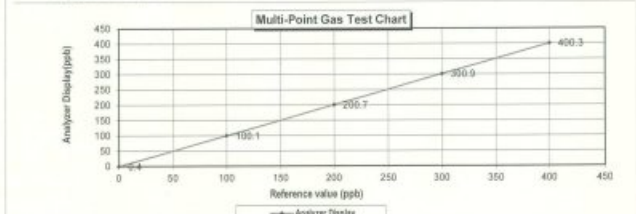
Test Date : Oct 25, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo Scientific Serial Number : 1201778112

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68 PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM	Model :	1461
Methane (CH <sub>4</sub> )	- PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8 PPM		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.4	0.40	0.40
Level 2 20.00%	100.0	100.1	0.10	0.10
Level 3 40.00%	200.0	200.7	0.70	0.35
Level 4 60.00%	300.0	300.9	0.90	0.30
Level 5 80.00%	400.0	400.3	0.30	0.07
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
Acceptable Limit $\pm 5\%$		0.24		



Calculate by

Sinchan Sangsri  
25 Oct 2022

Approve by

Phrakhanong  
25 Oct 2022

เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS

### Grade of Product: IPA Protocol

Part Number: E0143252 Reference Number: 127-402135-67-1  
Cylinder Number: E0143252 Cylinder Volume: 144.4 LPS  
Leakage: 124 - Dufum (SAP) - H2O Cylinder Pressure: 2016 PSI  
PWP Number: 522021 Valve Outlet: 600  
Gas Purity: CO, NO, NOX, SO2, BMLN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Our test is performed in accordance with the ISO 9001:2015 standard. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
NI HAZARDOUS	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
CH4	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
CO	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
SO2	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
BMLN	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021

Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021

Test Date Available Upon Request

NOTES: See page 2 for details.

NET WT: 4.20kg

Approved for Release



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## MULTI-POINT GAS TEST REPORT

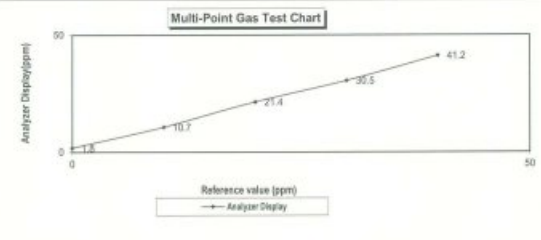
Test Date : Oct 6, 2022

Equipment : Gas Analyzer (CO) Model : 48  
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 : 1461
Methane (CH <sub>4</sub> )	- PPM Serial Number : 1180540071
Carbon Monoxide (CO)	984.8 PPM
Cylinder No. :	E0143262
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
Level 2 20.00%	10.0	0.7	6.5	6.5
Level 3 40.00%	20.0	1.4	6.5	6.5
Level 4 60.00%	30.0	0.5	1.6	1.6
Level 5 80.00%	40.0	1.2	2.9	2.9
Remark : Measuring Range	50.0 ppm	Average Difference (%)	3.89	
Acceptable Limit ± 5%				



Calculate by

Sirichai Sangsri

10/06/22

Approve by

10/06/22

10/06/22

Page 1 of 1

เอกสารไม่ควบคุม

## MULTI-POINT GAS TEST REPORT

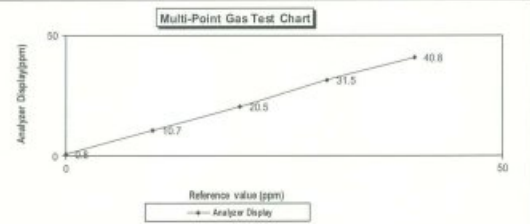
Test Date : Sep 12, 2022

Equipment : Gas Analyzer (CO) Model : 48  
Manufacturer : Thermo Scientific Serial Number : 1201497733

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO <sub>2</sub> )	44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO)	45.94 PPM Model : 1461
Methane (CH <sub>4</sub> )	- PPM Serial Number : 1180540071
Carbon Monoxide (CO)	984.8 PPM
Cylinder No. :	E0143262
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	0.8	0.8	0.8
Level 2 20.00%	10.0	0.7	6.5	6.5
Level 3 40.00%	20.0	0.5	2.4	2.4
Level 4 60.00%	30.0	1.5	4.8	4.8
Level 5 80.00%	40.0	0.8	2.0	2.0
Remark : Measuring Range	50.0 ppm	Average Difference (%)	3.30	
Acceptable Limit ± 5%				



Calculate by

Sirichai Sangsri

9/12/22

Approve by

12/09/22

12/09/22

Page 1 of 1

เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS

### Grade of Product: IPA Protocol

Part Number: E0143252 Reference Number: 127-402135-67-1  
Cylinder Number: E0143252 Cylinder Volume: 144.4 LPS  
Leakage: 124 - Dufum (SAP) - H2O Cylinder Pressure: 2016 PSI  
PWP Number: 522021 Valve Outlet: 600  
Gas Purity: CO, NO, NOX, SO2, BMLN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Our test is performed in accordance with the ISO 9001:2015 standard. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue. The test results are valid for 12 months from the date of issue.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
NI HAZARDOUS	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
CH4	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
CO	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
SO2	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021
BMLN	45.20 PPM	45.20 PPM	61	± 0.45 MET %	06/14/2021, 06/14/2021

Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024
PMMA	2241131	CO2/NO2	45.20 PPM	± 0.45 MET %	Jun 21, 2024

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021
ANALYST 4000	FIR	Jun 21, 2021

Test Date Available Upon Request

NOTES: See page 2 for details.

NET WT: 4.20kg

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

Approved for Release

Approve by

12/09/22

12/09/22

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# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 12 July, 2022

Certification No. 260/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

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

Serial No. : Data Logger 20040039 wind speed and wind direction 20040180

ID No. : No.10/20

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1004.8 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

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

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity 31

Calibrated by : H. Watcharapol Subwat

Signed :

Mr. Watcharapol Subwat

Mechanical Engineer

(Authorized Signatory)

for the Chief

เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 260/22

12 July, 2022

Page : 2 of 2

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	m/sec	inches H <sub>2</sub> O	inches H <sub>2</sub> O	m/sec	m/sec
1.00	-	-	-	0.6	0.40
3.02	-	-	-	2.5	0.52
5.00	-	-	-	4.0	1.00
7.04	-	-	-	6.4	0.64
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.6	0.41
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.6	0.42

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

Calibrated by :

H. Watcharapol Subwat

Mr. Watcharapol Subwat  
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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

Velocity				
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	4.7-5.3	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
135°	135°	1	132-138	Pass
225°	225°	0	222-228	Pass
315°	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	1001-1019	Pass

Environment conditions :

Air temperature: 22 °C  
Relative humidity: 55 %  
Static pressure: 102.2 kPa

Performed by :

Certified by Head of Engineering Department

This certificate may not be published or reproduced, except in full, unless obtaining permission in writing from Scarlet Tech Ltd.  
4F-3, No. 347, 2nd Sec., Heping E. Rd., Daein Dist., Taipei City 105, Taiwan

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United Analyst and Engineering Consultant Co., Ltd.

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

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

### MULTI-POINT GAS TEST REPORT

Test Date : Feb 8, 2023

Equipment : Hydrocarbon Analyzer

Model : APHA-370

Manufacturer : HORIBA

Serial Number : GAL13KSE

#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) : PPM  
Nitric Oxide (NO) : PPM  
Methane (CH<sub>4</sub>) : 39.8 PPM  
Carbon Monoxide (CO) : PPM  
Cylinder No. : D824432  
Expiration Date : Aug 4, 2028

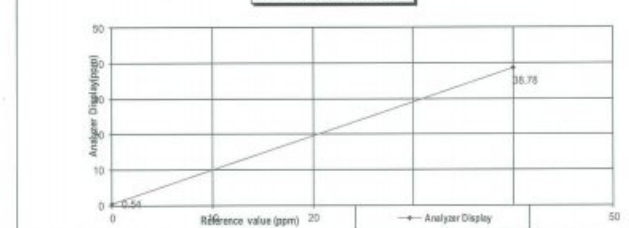
#### Dilutor Detail

Manufacturer :  
Model :  
Serial Number :

#### Multi-point gas test data

Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.00	0.54	0.54	0.54	0.54
Level 2	80.00%	40.00	38.78	-1.22	-3.15	3.15
Remark : Measuring Range :			50.00 ppm	Average Difference (%) :		1.84

#### Multi-Point Gas Test Chart



Calculate by

Apinat u.  
8, Feb, 2023

Approve by

8, Feb, 2023

เอกสารไม่ควบคุม







Cert.No.: 23CH4  
Page: 3 of 3

#### Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,(7.10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode S/N.: 990C0019	4.008	4.11	139.5	0.0085	2.05
	6.887	6.36	-32.1	0.011	2.00
	6.887	7.00	-33.1	0.011	2.00
	7.0075	-0.23	-205.2	0.0035	2.00

Function : Temperature Measurement

( $^{\circ}$ ) Without adjustment

This equipment was connected with Temperature Probe.

- Model : T652

- Serial No. : 989C0039

Dimension of probe:

- Length : 122 mm.

- Diameter : 15.5 mm

- Dimension Depth : 85 mm

Calibration Point ( $^{\circ}$ C)	Standard Temperature ( $^{\circ}$ C)	UUC* Reading ( $^{\circ}$ C)	Error ( $^{\circ}$ C)	Uncertainty of measurement ( $\pm$ $^{\circ}$ C)	Coverage factor k
25.0	25.004	25.0	-0.004	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 %.

-o0o-

เอกสารไม่ควบคุม



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

Cert.No.: 23TW47  
Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : Horiba  
Model : LAQUA-DO210  
Serial No. : HE9M0028  
ID No. : UAE.EFM.013/2563 (EFM.DO.02/63)  
Received Date : 27 February 2023  
Test Date : 28 February 2023  
Reference : 2302-0944WSC-1  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
Phrakhanong, Bangkok 10260  
Laboratory Condition : Temperature (  $25 \pm 5$  )  $^{\circ}$ C  
Humidity (  $50 \pm 20$  ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
Tested by : Walailak Sinithean  
Approved by :   
Approved Signatory  
( / ) Malee Butkruas  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul  
Issue Date : 3 March 2023

เอกสารไม่ควบคุม  
a 0308928



Cert.No.: 23TW47  
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.: 9K9G0090

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.12	0.0089

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.

-o0o-

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a 1150779



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.: 23LM30  
Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : Horiba  
Model : LAQUA-DO210  
Serial No. : HE9M0028  
ID No. : UAE.EFM.013/2563 (EFM.DO.02/63)  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udumsuk 41, Sukhumvit Road,  
Bangkok, Phrakhanong,  
Bangkok 10260  
Location : TPA On Site Calibration Laboratory  
Received Order : 27 February 2023  
Calibrated Date : 3 March 2023  
Ambient Temperature : (  $28 \pm 10$  )  $^{\circ}$ C  
Relative Humidity : (  $50 \pm 30$  ) %  
AC Line Voltage : (  $220 \pm 22$  ) V  
Calibrated by : Kunchit Promprat  
Approved by :   
Approved Signatory  
( / ) Pornthippa Tameyakul  
( / ) Malee Butkruas  
( ) Suwit Imjai  
Issue Date : 8 March 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.

เอกสารไม่ควบคุม  
A 0051784



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2302-0944WSC-2  
Procedure Used :-  
Cert. No.: 23LM30  
Page.: 2 of 2

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	1502A	A7B843	23124	04 Jan 2024

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

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

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
25.0	60	24.996	25.0	0.004	0.16	2.00
30.0	60	30.006	30.0	-0.006	0.16	2.00
35.0	60	34.998	35.0	0.002	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 %.

-o0o-

Malu

เอกสารไม่ควบคุม  
a 1151552



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES, EQUIPMENT CALIBRATION AND TESTING SERVICES  
304/4 PATTANAKARN ROAD 6/7 E. SANGHVIK, SIAMTOWN, BANGKOK 10100  
TEL : 02-017-0702 FAX : 02-017-0441



Cert.No.: 23CH-427  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Conductivity Meter  
Manufacturer : Horiba  
Model : LK9LA-EC210  
Serial No. : HC9L0014  
ID No. : UAE-EFM.00712583(EFM.SCT.C1/83)  
Condition As-Received : Used Item  
Received Date : 28 March 2023  
Calibration Date : 29 March 2023  
Reference : 2303-0988W620-1  
Submitted by : United Analysts and Engineering Consultant Co., Ltd.  
3 Soi Jidonsuk 41, Suanmooli Road, Bangpakok,  
Phuketnang, Bangkok 10260  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH6 by direct measurement  
with certified reference materials (CRM)  
- CP-CH6 by comparison with standard thermometer

Calibrated by : Waleak Srithean

Approved by :   
Approved Signatory

( / ) Malak Bulkras  
( ) Saitip Meangmai  
( ) Waleak Srithean

Issue Date : 31 March 2023

The Uncertainties are for a confidence probability of approximately 95%

Approved by the Technology Promotion Association (Thailand-Japan) on behalf of the Association

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a 1151552



Cert.No.: 23CH427  
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	9549224	130RC003	22484	17 Apr 2023
2) Ref. Std. Thermometer	4082051	110RC014	224306	27 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/ISO National Accreditation Board, Accredited No. AR-1825

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 µS/cm	CPA Chem	826595	09 July 2023
12880 mS/cm	CPA Chem	823329	20 June 2023

- Control Conductivity calibration solution temperature by Water bath (25.0 ± 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.: 9B9F0004

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.0 µS/cm	1406 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12880 mS/cm	1249 mS/cm	1276 mS/cm	11.08 mS/cm	2.00

Remark : - UUC\* = Unit Under Calibration

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Cert.No.: 23CH427  
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#### Calibration Results

Function : Temperature Measurement

( \* ) Without adjustment

This equipment was connected with Temperature Probe:

- Model :	33B3
- Serial No. :	9B9F0004

Dimension of probe:

- Length :	110 mm
- Diameter :	16 mm
- Immersion Depth :	120 mm

Calibration Point ( °C )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of Measurement ( ± °C )	Coverage factor k
25.0	25.001	25.0	-0.001	0.13	2.00
30.0	29.999	30.0	0.001	0.13	2.00
35.0	34.998	35.0	0.001	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

-o0o-

Malu

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โครงการผลิตปิโตรเลียมบนบก พื้นที่ผลิต WBNE และพื้นที่ผลิต STE แปลงสำรวจบนบกหมายเลข L44/43 อำเภอเวียงชัยบุรี  
และอำเภอศรีเทพ จังหวัดเพชรบูรณ์ ระหว่างเดือนมกราคม - มิถุนายน พ.ศ. 2566  
บริษัท อีโค โอเรียนท์ รีซอสเซส (ประเทศไทย) จำกัด

ใบรับรองสอบเทียบเครื่องมือประจำห้องปฏิบัติการ สำหรับตรวจวัดคุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพอากาศในบรรยากาศโดยทั่วไป									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	TH2058-097-040722- ACC-TH	7 Apr 22	6 Apr 23	-
2	Analytical Balance (Readability 0.1 mg)	(PM-10)	Mettler-Toledo	AB204-S/FACT / B108115858	Mettler-Toledo (Thailand) Ltd.	TH2058-098-040722- ACC-TH	7 Apr 22	6 Apr 23	-
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพน้ำ									
3	Gas Chromatography - Mass Spectrometer (GC-MS)	สารกลุ่ม BTEX เบนซีน (Benzene), โทลูอีน (Toluene), เอทิลเบนซีน (Ethylbenzene), ไซลีนทั้งหมด (Total Xylene)	Bruker Scion	451-GC / BR1201M099 Scion-SQ / GQS1203F021 CP8400 / BR1203M331	World Tech Enterprise Co.,Ltd.	Certificate of Calibration PM/OQ	19 May 22	18 May 23	-
4	Inductively Coupled Plasma- Optical Emission Spectrometer (ICP-OES)	กลุ่มโลหะหนัก : ตะกั่ว (Pb), นิกเกิล (Ni), แบเรียม (Ba), ปรอททั้งหมด (Total Hg), ซีลีเนียม (Se),	Agilent Technologies	System ID:G8015A G8015AA / MY1803001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30 Nov 22	29 Nov 23	-
5	Atomic Absorption Spectrometer (AAS)	ทองแดง (Cu),แมงกานีส (Mn),สังกะสี (Zn), เหล็ก (Fe), สารหนู (As), แคดเมียม (Cd), โครเมียมเฮกซะวาเลนต์ (Cr6+)	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute Of Science And Technological Research (TISTR)	MTC.ACL. No. 486/65	7 Mar 22	6 Mar 23	-
6	Conductivity Meter	การนำไฟฟ้า(EC) ความเค็ม (Salinity)	SI Analytics	Lab955 / 16300356	SPC Calibration Center Co.,Ltd.	C24220084	22 Mar 22	21 Mar 23	-
7	pH Meter	ค่าความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2201793-001-01	1 Mar 22	28 Feb 23	-
8	pH Meter		Hanna Instrument	HI2211 / 8165345	National Food Institute, Ministry of Industry, Thailand	2202097-001-01	16 Mar 22	15 Mar 23	-

ใบรับรองสอบเทียบเครื่องมือประจำห้องปฏิบัติการ สำหรับตรวจวัดคุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพน้ำผิวดิน และน้ำใต้ดิน									
9	Analytical Balance (Readability 0.1 mg)	ปิโตรเลียมไฮโดรคาร์บอนทั้งหมด (TPH), น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	AB-204S/FACT / 1129361010	National Food Institute, Ministry of Industry, Thailand	2203120-001-01	1 Jun 22	31 May 23	-
10	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (Total Suspended Solids : TSS)	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	22MM210	26 Apr 22	25 Apr 23	-
11	Hot Air Oven	ของแข็งละลายน้ำทั้งหมด (Total Dissolved Solids : TDS)	Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23	-
12	Incubator	แบคทีเรียกลุ่มฟีคอลโคลิฟอร์ม (Fecal Coliform Bacteria)	Memmert	IPP 260 / V615.0187	Technology Promotion Association (Thailand-Japan)	22TM563	7 Apr 22	6 Apr 23	-
13	Incubator		Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	22TM672	5 May 22	4 May 23	-
14	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	22TM333	17 Feb 22	16 Feb 23	-
15	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	22TM334	17 Feb 22	16 Feb 23	-
16	Analytical Balance		Mettler-Toledo	MS603S / B0070110311	Mettler-Toledo (Thailand) Ltd.	22058-096-040722-ACC-7	7 Apr 22	6 Apr 23	-
17	Auto Clave		ALP	CL-40L / 808763	Technology Promotion Association (Thailand-Japan)	22TM681	27 May 22	26 May 23	-

Due Date of Calibration\* : กำหนดตามแผนการสอบเทียบประจำปี อย่างน้อยปีละ 1 ครั้ง

Mettler-Toledo (Thailand) Ltd.  
848/4 - 848/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0362  
MT-TH.ServiceSupport@mt.com



## Accuracy Calibration Certificate

## Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Phra Khanong Contact: Sureti Chotnolk  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number: 

## Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument  
Model: AB204-S Asset Number: UAE.AIR.019/2550  
Serial No.: 1128312528 Terminal Model: N/A  
Building: N/A Terminal Serial No.: N/A  
Floor: 2 Terminal Asset No.: N/A  
Room: Balance Room 2 (206)

Range	Max. Capacity	Readability (g)
1	220 g	0.0001 g

## Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
METTLER TOLEDO Work Instruction: CP-W002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity span of the weighing instrument was adjusted before calibration with a built-in weight.  
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

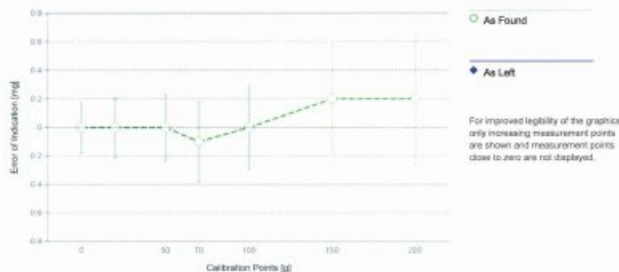
	Temperature	Humidity
As Found	Start: 22.5 °C End: 21.4 °C	Start: 56.1 % End: 63.2 %

As Found Calibration Date: 07-Apr-2022 Calibration:   
As Left Calibration Date: N/A  
Issue Date: 08-Apr-2022 Approved Signatory:   
☒ Kasakorn Tassanachaisakul  
☐ Sans Jitriyom  
☐ Surachet Sukkate

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## Error of Indication

As Found	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.18 mg	2
2	0.1000 g	0.1000 g	0.0000 g	0.19 mg	2
3	1.0000 g	0.9999 g	-0.0001 g	0.19 mg	2
4	5.0000 g	5.0000 g	0.0000 g	0.19 mg	2
5	10.0000 g	9.9999 g	-0.0001 g	0.20 mg	2
6	20.0000 g	20.0000 g	0.0000 g	0.21 mg	2
7	50.0000 g	50.0000 g	0.0000 g	0.23 mg	2
8	70.0001 g	70.0000 g	-0.0001 g	0.28 mg	2
9	100.0000 g	100.0000 g	0.0000 g	0.29 mg	2
10	150.0000 g	150.0002 g	0.0002 g	0.40 mg	2
11	200.0001 g	200.0003 g	0.0002 g	0.46 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor  $k$  – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

## Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

## Weight Set 1: OIML E2

Weight Set No.: WS60 Date of Issue: 23-Feb-2022  
Certificate Number: C208581631 Calibration Due Date: 14-Aug-2023

## Thermo Hygrometer

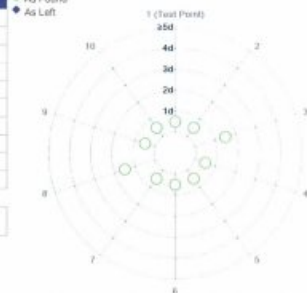
Equipment No.: IN161 Date of Issue: 14-Jun-2021  
Certificate Number: 21H1220 Calibration Due Date: 01-Jun-2022

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## Measurement Results

## Repeatability

Test Load: 100 g	As Found	As Left
1	99.9999 g	N/A
2	100.0000 g	N/A
3	99.9998 g	N/A
4	100.0000 g	N/A
5	99.9999 g	N/A
6	100.0000 g	N/A
7	99.9999 g	N/A
8	100.0001 g	N/A
9	99.9999 g	N/A
10	100.0000 g	N/A
Standard Deviation	0.00008 g	N/A



The '1' in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the difference from the mean value.

## Eccentricity

Test Load: 100 g	Position	As Found	As Left
1	100.0000 g	N/A	N/A
2	99.9998 g	N/A	N/A
3	99.9998 g	N/A	N/A
4	100.0001 g	N/A	N/A
5	100.0001 g	N/A	N/A
Maximum Deviation	0.0002 g	N/A	N/A



The '1' in the graph represents the readability of the range/interval in which the test was performed.

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## Remarks

Equipment condition: Good  
Next calibration according to customer's procedure  
Calibration data not decide by calibration laboratory  
Test weight by Filter pan: 1 g = 0.9999 g, 3 g = 3.0000 g, 5 g = 5.0000 g

## End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

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Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with  $k=2$  in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / ^\circ\text{C}$   
Temperature range on site for the evaluation of the measurement uncertainty in use:  $3 \text{ K}$

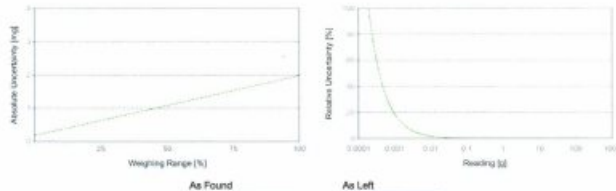
Linearization of Uncertainty Equation

Range			As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.19 \text{ mg} + 0.00817 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found	As Left
0.0220 g	0.19 mg	0.86%
0.2200 g	0.19 mg	0.087%
2.2000 g	0.21 mg	0.0090%
22.0000 g	0.37 mg	0.0017%
220.0000 g	2.0 mg	0.00090%



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CERTIFICATE OF CALIBRATION

Certificate No.: CI-011-45

Page 1 of 2 Pages

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

RECEIVED DATE: 25 Oct 2022  
MEASUREMENT DATE: 31 Oct 2022  
ISSUE DATE: 02 Nov 2022

ENVIRONMENTAL CONDITIONS:

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

CALIBRATION CONDITION:

Preconditioning: 24 hours at ambient conditions  
Measurement Condition: The average values during measurement are  $24.5$  °C and  $61.0\%$  RH.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:  
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G55/MC/W2-00. The W2-004 was used as a calibration guideline.

Traceability:  
This certificate provides a traceability of the measurement to recognize the national standards and to recognize the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G221802

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

Calibrated by:  
Mr. Sotawat Thuchad  
Mr. Jiraporn Lertsomphol



Approved signatory:  
Mr. Parinya Booncharoen  
Calibration Department Manager

THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION IS GRANTED IN WRITING FROM THE LABORATORY

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Continuation of Certificate of Calibration Number CI-011-45

Page 2 of 2 Pages

MEASUREMENT RESULTS:

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

Table 1: The results of  $Q$  Standard calibration data

Plate	Flow rate $\text{m}^3/\text{min}$	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	$\Delta p_{\text{meter}}$ mmHg	$\Delta p_{\text{Orifice}}$ mmHg	$\gamma$	Standard Flow [ $Q_s$ ] $\text{m}^3/\text{min}$
1	0.702	758.204	24.560	23.900	57.190	1.568	1.252	0.650
2	0.999	758.182	24.620	24.010	60.852	3.088	1.756	0.919
3	1.119	758.204	24.550	23.960	40.965	4.167	2.041	1.060
4	1.169	758.228	24.540	24.060	30.007	4.728	2.174	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	2.652	1.366

Slope (m): 1.96180  
Intercept (b): -0.03332  
Correlation coefficient (r): 0.99914  
Uncertainty (k=2): 0.017  $\text{m}^3/\text{min}$

Table 2: The results of  $Q$  actual calibration data

Plate	Flow rate $\text{m}^3/\text{min}$	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	$\Delta p_{\text{meter}}$ mmHg	$\Delta p_{\text{Orifice}}$ mmHg	$\gamma$	Standard Flow [ $Q_s$ ] $\text{m}^3/\text{min}$
1	0.702	758.204	24.560	23.900	57.190	1.568	0.785	0.651
2	0.999	758.182	24.620	24.010	60.852	3.088	1.101	0.920
3	1.119	758.204	24.550	23.960	40.965	4.167	1.279	1.060
4	1.169	758.228	24.540	24.060	30.007	4.728	1.362	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	1.664	1.366

Slope (m): 1.22877  
Intercept (b): -0.02091  
Correlation coefficient (r): 0.99914  
Uncertainty (k=2): 0.018  $\text{m}^3/\text{min}$

\*\*\*End of Certificate of Calibration\*\*\*



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Mettler-Toledo (Thailand) Ltd.  
848/4 - 848/5 Lualaba Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH.ServiceSupport@mt.com

Accuracy Calibration Certificate

Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Phra Khanong  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number: 6332433054

Weighing Device

Manufacturer: Mettler Toledo  
Model: AB204-SFACT  
Serial No.: B108115858  
Building: N/A  
Floor: 2  
Room: Balance Room 2 (206)  
Instrument Type: Weighing Instrument  
Asset Number: UAE.AIR.016/2556  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
METTLER TOLEDO Work Instruction: CPW002/20

This calibration certificate contains measurements for As Found and As Left calibrations.

The sensitivity/span of the weighing instrument was adjusted before As Found and As Left calibrations with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

Temperature		Humidity	
As Found	Start: $22.6^\circ\text{C}$ End: $22.1^\circ\text{C}$	Start: 58.6 %	End: 51.9 %
As Left	Start: $22.3^\circ\text{C}$ End: $22.4^\circ\text{C}$	Start: 46.2 %	End: 50.8 %

As Found Calibration Date: 07-Apr-2022  
As Left Calibration Date: 07-Apr-2022  
Issue Date: 08-Apr-2022  
Calibrator: Sotawat Thuchad  
Approved Signatory: Parinya Booncharoen

Signature: Sotawat Thuchad  
Signature: Parinya Booncharoen  
Signature: Sotawat Thuchad  
Signature: Parinya Booncharoen

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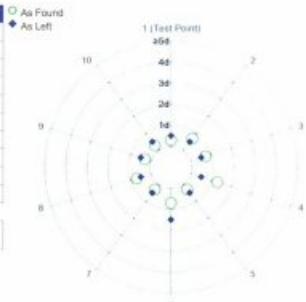
## Measurement Results

### Repeatability

Test Load: 100 g

	As Found	As Left
1	100.0005 g	99.9999 g
2	100.0004 g	100.0000 g
3	100.0004 g	99.9999 g
4	100.0006 g	100.0000 g
5	100.0005 g	99.9998 g
6	100.0004 g	99.9998 g
7	100.0005 g	100.0000 g
8	100.0004 g	100.0000 g
9	100.0005 g	100.0000 g
10	100.0005 g	100.0000 g

Standard Deviation	0.00007 g	0.00007 g
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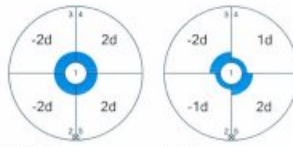
The "d" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0005 g	100.0000 g
2	100.0003 g	99.9999 g
3	100.0003 g	99.9998 g
4	100.0007 g	100.0001 g
5	100.0007 g	100.0002 g

Maximum Deviation	0.0002 g	0.0002 g
-------------------	----------	----------



The "d" in the graph represents the readability of the range/interval in which the test was performed.

### Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

#### Weight Set 1: OIML E2

Weight Set No.:	WS80	Date of Issue:	23-Feb-2022
Certificate Number:	C208581631	Calibration Due Date:	14-Aug-2023

#### Thermo Hygrometer

Equipment No.:	IN161	Date of Issue:	14-Jun-2021
Certificate Number:	21H1220	Calibration Due Date:	01-Jun-2022

### Remarks

FACT adjustment functionality activated  
Value of the built-in weight adjusted  
Equipment condition: Good  
Next calibration according to customer's procedure  
Calibration data not decide by calibration laboratory  
Test weight by Fiker pan: 1 g = 1.0000 g, 3 g = 3.0000 g, 5 g = 5.0000 g

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

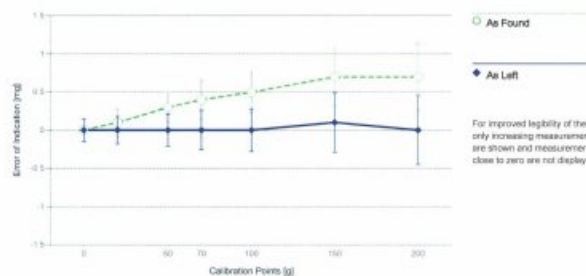
### Error of Indication

#### As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.1000 g	0.1001 g	0.0001 g	0.16 mg	2
3	1.0000 g	0.9999 g	-0.0001 g	0.16 mg	2
4	5.0000 g	5.0000 g	0.0000 g	0.16 mg	2
5	10.0000 g	10.0001 g	0.0001 g	0.17 mg	2
6	20.0000 g	20.0001 g	0.0001 g	0.16 mg	2
7	50.0000 g	50.0003 g	0.0003 g	0.20 mg	2
8	70.0001 g	70.0005 g	0.0004 g	0.26 mg	2
9	100.0000 g	100.0005 g	0.0005 g	0.27 mg	2
10	150.0000 g	150.0007 g	0.0007 g	0.38 mg	2
11	200.0001 g	200.0006 g	0.0005 g	0.44 mg	2

#### As Left

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.1000 g	0.1000 g	0.0000 g	0.16 mg	2
3	1.0000 g	0.9999 g	-0.0001 g	0.17 mg	2
4	5.0000 g	5.0000 g	0.0000 g	0.17 mg	2
5	10.0000 g	10.0000 g	0.0000 g	0.17 mg	2
6	20.0000 g	20.0000 g	0.0000 g	0.16 mg	2
7	50.0000 g	50.0000 g	0.0000 g	0.21 mg	2
8	70.0001 g	70.0001 g	0.0000 g	0.26 mg	2
9	100.0000 g	100.0000 g	0.0000 g	0.38 mg	2
10	150.0000 g	150.0001 g	0.0001 g	0.39 mg	2
11	200.0001 g	200.0001 g	0.0000 g	0.45 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-16. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

### Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $2.5 \cdot 10^{-4} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use:  $3 K$

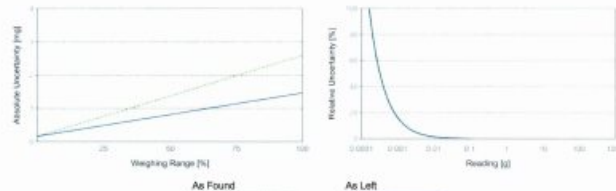
#### Linearization of Uncertainty Equation

Range	As Found	As Left
d Max		
1 0.0001 g 220 g	$U_1 = 0.16 \text{ mg} + 0.0111 \text{ mg/g} \cdot R$	$U_1 = 0.16 \text{ mg} + 0.00592 \text{ mg/g} \cdot R$

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

#### Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found	As Left
0.0220 g	0.16 mg 0.73%	0.16 mg 0.73%
0.2200 g	0.16 mg 0.074%	0.16 mg 0.073%
2.2000 g	0.18 mg 0.0084%	0.17 mg 0.0079%
22.0000 g	0.40 mg 0.0018%	0.29 mg 0.0013%
220.0000 g	2.6 mg 0.0012%	1.5 mg 0.0006%





## Certificate of Calibration

Certificate No. : 23P1403  
Page : 1 of 2

Equipment : U-Tube Manometer

Manufacturer : Dwyer

Model : 1221-36-WIM

Serial No. : -

ID No. : UAE.EFM.181/2561

Condition As-Received: Used Item

Received Date : 26 April 2023

Calibration Date : 09 May 2023

Reference : 2304-0703WSC

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

Ambient Temperature : ( 23 ± 2 ) °C

Relative Humidity : ( 50 ± 15 ) %

Atmospheric Pressure : 1010 mbar

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

Procedure used : The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to 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 requested at the point specified by customer.

3. Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussamee  
Issue Date : 11 May 2023

Approved Signatory : Attapol P.  
( ) Phalinee Prabpai  
( ) Sura Suwannasri  
(x) Attapol Penurach

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B 0314243



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)

UUC Indication				
Applied Pressure (inH <sub>2</sub> O)	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)	ΔP (inH <sub>2</sub> O)	Error (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	-4.02	8.02	0.02
10.00	5.00	-5.02	10.02	0.02
12.00	6.00	-6.02	12.02	0.02
14.00	6.98	-7.00	13.98	-0.02
16.00	7.98	-8.00	15.98	-0.02
18.00	8.98	-9.00	17.98	-0.02
20.00	9.98	-10.00	19.98	-0.02
22.00	11.00	-11.02	22.02	0.02
24.00	12.00	-12.02	24.02	0.02
26.00	13.00	-13.04	26.04	0.04
28.00	14.00	-14.04	28.04	0.04
30.00	15.00	-15.02	30.02	0.02
32.00	16.00	-16.02	32.02	0.02
34.00	16.96	-17.00	33.96	-0.04
35.80	17.96	-18.00	35.96	0.16

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

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

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## CALIBRATION CERTIFICATE

Certificate No. : L202210260-001  
Date Issued : 07-Nov-22

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

Equipment : Mass Flow Meter

Manufacturer : Alicat Scientific

Model : MB-SSCCM-D/5M

Serial No. : 57730

ID No./Tag No. : UAE.EMA2.169/2553

Date Received : 31-Oct-22

Date Calibrated : 05-Nov-22

Calibrated by : Mr. Jame Khaothong

### Calibration Method or Calibration Procedure Used

In-house method : CP-34 by comparison against mass flow calibrator.

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

### Result of Calibration

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

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Approved by : Sorayuth T.  
( Mr. Sarayuth Tochua )



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Certificate No. : L202210260-001

Environment : Ambient temperature : ( 23 ± 2 ) °C  
Relative humidity : ( 50 ± 15 ) % RH

Capacity Range : 5 ml/min

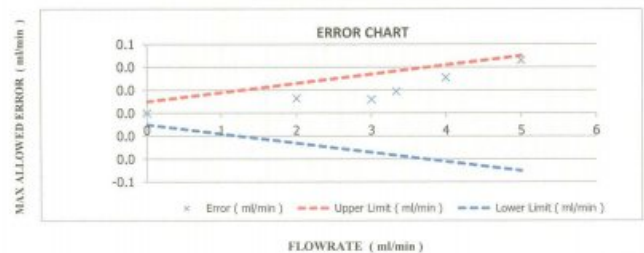
Calibration Media : Air

Type : Mass Flowmeter

Unit Under Calibration Reference Condition :					Pressure 101.325 kPa(abs) , 25 °C , Air
Temperature ( °C )	Pressure ( kPa )	UUC Reading ( ml/min )	STD Reading ( ml/min )	Error ( ml/min )	Uncertainty ( ± ml/min )
25.73	101.45	0.000	0.000 *	0.000	0.063
25.37	104.90	2.001	1.988	0.013	0.068
25.12	106.63	3.001	2.989	0.012	0.11
24.66	107.15	3.330	3.311	0.019	0.12
24.23	108.36	4.001	3.970	0.031	0.14
24.17	110.09	5.00	4.954	0.046	0.17

Error = Unit Under Calibration - Standard

Marked \* are not included in the NSC-ONSC accreditation schedule for our laboratory.



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Note : The actual flow rate is determined by the equation :

$$Q_{Mass} = Q_{Ref} \times \frac{P_{Ref}}{P_{Mass}} \times \frac{T_{Mass}}{T_{Ref}}$$

; Q = Flow rate  
 ; P = Absolute pressure  
 ; T = Absolute temperature  
 ; Subscript "Mass" = Measurement condition  
 ; Subscript "Ref" = Reference condition

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Traceability of Certificate :

The International System of Units (SI) through

NIMT Certificate No. MW-0013-22 for Mass Flow Calibrator (20 SCCM) Serial No. G500971G20, Due 22-Feb-24

End of Certificate

Page 3 of 3

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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. 0-2717-3500-34 FAX. 0-2719-0484



## Certificate of Calibration

Certificate No. : 23P1855  
Page : 1 of 2

Equipment : Aneroid Barometer

Manufacturer : Barigo

Model : -

Serial No. : -

ID No. : UAE.ANV.122/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 02 June 2023

Reference: 2305-0919WBC

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1007 mbar

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

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

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

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

## Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505048	MP-0094-23	03 May 2024
2. This instrument was installed in vertical orientation and center of the dial was used as the reference level.				
3. This result of calibration was made on requested at the point specified by customer.				
4. This result of calibration instrument was in absolute pressure.				
5. This instrument was used clean air as pressure media.				
6. The certificate is valid only to the item calibrated on date and place of calibration.				
7. This Certification is traceable to the International System of Unit maintained through:-				
-National Institute of Metrology Thailand (NIMT)				

Calibrated by : Suksan Khonkaew  
Issue Date : 08 June 2023

Approved Signatory : Attapol R.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
[x] Attapol Panurach

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Cert.No. : 23P1855  
Page: 2 of 2

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

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

Increasing Pressure

Applied Pressure (hPa)	958.50	969.59	980.35	990.39	1001.01	1011.15	1020.94	1031.45
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	1.50	0.41	-0.35	-0.39	-1.01	-1.15	-0.94	-1.45

Decreasing Pressure

Applied Pressure (hPa)	1031.45	1021.61	1012.16	1002.38	992.17	982.20	970.69	959.32
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.45	-1.61	-2.16	-2.38	-2.17	-2.20	-0.69	0.68

The uncertainty of measurement was ± 0.30 hPa

\* UUC = Unit Under Calibration

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

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Attapol R.

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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. 0-2717-3500-34 FAX. 0-2719-0484



## Certificate of Calibration

Certificate No. : 23H1200  
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer

Manufacturer : Barigo

Model : -

Serial No. : -

ID No. : UAE.ANV.130/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023 to 06 June 2023

Reference: 2305-0919WBC

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

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

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

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

## Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23105	15 Mar 2024
2. The certificate is valid only to the item calibrated on date and place of calibration.				
3. This Certification is traceable to the International System of Unit maintained through:-				
-National Institute of Standards and Technology (NIST) , The United States of America				
-Technology Promotion Association (Thailand-Japan), NSQ-ONSC Accredited No. Calibration 0008				

Calibrated by : Somchai Dumroo  
Issue Date : 07 June 2023

Approved Signatory : [x] Chakrit Waewwanjua  
[ ] Ponthippa Tameyskul  
[ ] Viporn Tantiyawuti

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

**Result of Calibration:-**

Before Adjustment				
Function: Humidity Measurement				
Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	48	7.9	1.8
25.0	60.0	63	3.0	1.7
25.0	80.0	76	-4.0	1.9

**Result of Calibration:-**

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

**Result of Calibration:-**

<u>Result of Calibration:</u>		Without Adjustment
Function:	Temperature Measurement	
	Standard	UUC*
	<u>Temperature</u>	<u>Reading</u>
	(°C)	(°C)
	19.987	20.0
	30.016	30.0
	39.944	39.5

UUC\* : Unit Under Calibration

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

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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.useconsultant.com E-mail: use@useconsultant.com

**MULTI-POINT GAS TEST REPORT**

Test Date : Mar 22, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 421  
Manufacturer : Thermo Scientific Serial Number : CM22387036

**Standard Gas Concentration**

Standard Gas Concentration	Diluter Detail
Sulphur Dioxide (SO <sub>2</sub> ) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 1461
Methane (CH <sub>4</sub> ) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 21, 2024	

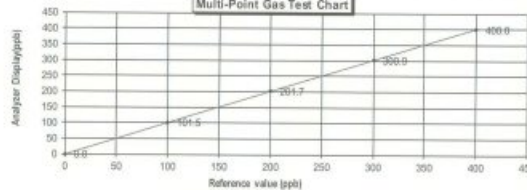
**Multi-point gas test data**

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	101.5	1.50	1.48
Level 3	40.00%	200.0	201.7	1.70	0.84
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb  
Acceptable Limit ± 5%

Average Difference (%) 0.52

**Multi-Point Gas Test Chart**



Calculate by

Aphivat K.  
22, 3, 66

Approve by

Phakorn W.  
22, Mar, 2023

Page 1 of 1

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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.useconsultant.com E-mail: use@useconsultant.com

**MULTI-POINT GAS TEST REPORT**

Test Date : Mar 28, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 421  
Manufacturer : Thermo Scientific Serial Number : CM22387038

**Standard Gas Concentration**

Standard Gas Concentration	Diluter Detail
Sulphur Dioxide (SO <sub>2</sub> ) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 1461
Methane (CH <sub>4</sub> ) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 21, 2024	

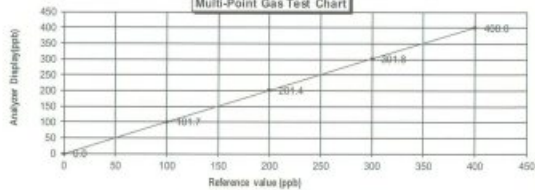
**Multi-point gas test data**

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	101.7	1.70	1.67
Level 3	40.00%	200.0	201.4	1.40	0.70
Level 4	60.00%	300.0	301.8	1.80	0.60
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb  
Acceptable Limit ± 5%

Average Difference (%) 0.59

**Multi-Point Gas Test Chart**



Calculate by

Wichan C.  
28, 3, 66

Approve by

Phakorn W.  
28, Mar, 2023

Page 1 of 1

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

Part Number: E04N9WE15401CS Bulk case Number: 122-402193187-  
Cylinder Number: EDC143262 Cylinder Volume: 44.4 L  
Label: 24 - Duram (SAP) - NO Cylinder F Weight: 2015 PM1  
PGV Number: B2202 Valve Check: 330  
Gas Code: CFC NO, COX SO2, H2, N2 Calibration Date: Jun 21, 2022  
Expiration Date: Jun 21, 2024

This document is a certificate of analysis for the product described above. It is issued by the manufacturer and is valid only for the product and the test method specified. It is not valid for any other product or test method. The certificate is issued for the product and the test method specified. It is not valid for any other product or test method. The certificate is issued for the product and the test method specified. It is not valid for any other product or test method.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO <sub>2</sub>	45.01 ppm	45.96 ppm	61	± 1.6% (1.5% systematic, 0.1% random)	05/14/2022, 05/24/2022
NO	45.94 ppm	45.94 ppm	61	± 1.4% (1.3% systematic, 0.1% random)	05/14/2022, 05/24/2022
CARBON MONOXIDE	40.00 ppm	44.00 ppm	61	± 1.0% (0.8% systematic, 0.2% random)	05/14/2022, 05/24/2022
METHANE	100.00 ppm	100.00 ppm	61	± 1.0% (0.8% systematic, 0.2% random)	05/14/2022, 05/24/2022

Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
IPRM	10.00.173	00000000	45.02 ppm Nitrogen Oxide (NO <sub>2</sub> )	± 1.5%	1.00.00.2023
IPRM	10.00.173	00000000	45.02 ppm Nitrogen Oxide (NO)	± 1.5%	1.00.00.2023
IPRM	10.00.173	00000000	45.02 ppm Carbon Monoxide (CO)	± 1.5%	1.00.00.2023
IPRM	10.00.173	00000000	45.02 ppm Methane (CH <sub>4</sub> )	± 1.5%	1.00.00.2023

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
NO <sub>2</sub> 6700 A (ThermoFisher)	FIR	1.00.00.2023
NO 6700 A (ThermoFisher)	FIR	1.00.00.2023
CO 6700 A (ThermoFisher)	FIR	1.00.00.2023
CH <sub>4</sub> 6700 A (ThermoFisher)	FIR	1.00.00.2023

Test Date: As above Upon Request

Customer: 157-00000000  
City: 157-00000000  
NET WT: 4.7 kg



This analytical test result is reported on this certificate only. It is not valid for any other product or test method. The certificate is issued for the product and the test method specified. It is not valid for any other product or test method.

Approved for Release



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### MULTI-POINT GAS TEST REPORT

Test Date : May 3, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Environmental Instruments Serial Number : 43C-62236-334

#### Standard Gas Concentration

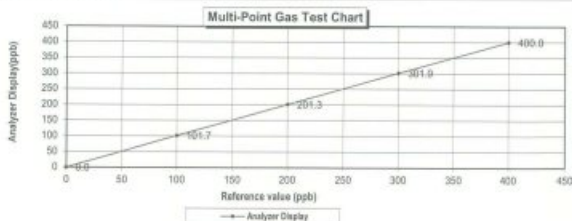
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### Dilutor Detail

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

#### Multi-point gas test data

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	1.70	1.67	1.67
Level 3	40.00%	200.0	201.3	1.30	0.65
Level 4	60.00%	300.0	301.9	1.90	0.63
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)	0.59



Calculate by

Aphivat K.  
3 May 2023

Approve by

Phon N.  
3 May 2023

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### MULTI-POINT GAS TEST REPORT

Test Date : Apr 25, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Environmental Instruments Serial Number : 43C-76465-383

#### Standard Gas Concentration

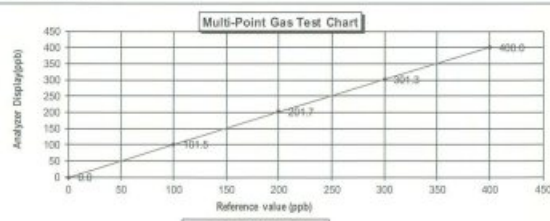
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### Dilutor Detail

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

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.5	1.50	1.48	1.48
Level 3	40.00%	200.0	201.7	1.70	0.84	0.84
Level 4	60.00%	300.0	301.3	1.30	0.43	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.55



Calculate by

Aphivat K.  
25 Apr 2023

Approve by

Phon N.  
25 Apr 2023

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Thaiunique Co.,Ltd

Open Lab Service for Reliability



THAI UNIQUE OPEN LAB SERVICE

OPERATIONAL QUALIFICATION REPORT (OQ)

#### Equipment Operational Qualification Report

Report No. SV2305/21210  
Equipment GC-MS  
System Model SQ  
System ID GQS1203F021  
Equipment Details Bruker  
Test Protocol Scion OQ Protocol  
Protocol Rev. A  
Date 23-May-23  
Report Type Report  
Org. Name United Analyst and Engineering Consultant Co.,Ltd  
Org. Location 3 Soi Udomsuk 41 Sukhumvit Rd.  
Bangchak Phrakhanong Bagkok  
Thailand 10260



บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawat@thaiunique.com, Website : www.thaiunique.com

### CERTIFICATE OF CALIBRATION

### GAS CHROMATOGRAPH MASS SPECTROMETER

Certificate No.: SV2305/21210

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

Address: 3 Soi Udomsuk 41 Sukhumvit Rd. Bangkok Phrakhanong Bangkok Thailand 10260

Instruments Model: MS Scion-SQ S/N GQS1203F021  
GC 451-GC S/N BR1203M099  
AUTO SAMPLER CP8400 S/N BR1203M331

Standard Reference Number: 393065201

Procedure Document Number: 394207000

#### System Test

PM perform and Diagnostic Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Air Water Check Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Tune Test EI	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Signal to Noise Test (EI) SCAN	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Injection EI Area Precision Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Injection EI RT Precision Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
User Demonstration	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL



Engineer Somchai P.  
Somchai Pohongkam

Date 23 May 2023



Thai Unique Co., Ltd.

Service Division

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SCION™

## Operational Qualification Protocol

For SCION Instrument

Name and Model:

Serial Number:

System ID Number:

Publication no. 394207000

Revision A

November 2011

## Contact

Scion Customer Service and Support uses a Customer Relationship Management (CRM) system. The interaction with this system offers the Customer immediate benefits including the contact center or help desk.

Scion worldwide service & support offices can be found from Scion website:



[www.scion.com/support.html](http://www.scion.com/support.html)

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## 1.0 Revision History

This qualification protocol is updated as necessary, which includes the event of any regulatory changes to Title 21 of the Code of Federal Regulations (21 CFR) Parts 210 and 211 (if applicable), any software or hardware changes, or updates that may impact on regulatory compliance.

Issue Number	Date	Comments

## 2.0 Qualification Representative and Reviewer Details


### 2.1 Qualification Representative Details


Each person responsible for executing any part of this Protocol must complete the table below, providing a sample of their signature and initials, and recording the date the Qualification was performed.

Qualification representatives are nominated to execute and verify the completeness of the test protocol and correctness of all entries.

All testing must be performed in accordance with procedures outlined in this manual. The representative must be trained and qualified to perform the procedures outlined in this document.

A copy of their appropriate qualifications is to be inserted into "Qualification Representative Details" on page 30.

Name (Print)	SOMCHAI POHTONGKAM
Title	ENGINEER
Signature	
Initials	SOMCHAI
Date	23 MAY 23



Name (Print)	
Title	
Signature	
Initials	
Date	

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## 2.2 Reviewer Details


Each representative responsible for reviewing any part of this protocol must record their details in the following tables, providing a sample of their signature and initials, and recording the date the qualification was performed.

An employee or designee of the company operating the instrument must review these qualification procedures. All calculations and data will be checked by the reviewer. Data review must be performed in accordance with the qualification guidelines "Qualification Guidelines and GMP Documentation" on page 10 and in compliance with current Good Manufacturing Practice (cGMP) as specified by 21 CFR Parts 210 and 211.

Documentation supporting training in the area of data review and cGMP must be carefully maintained and reviewed by the instrument owner.

Reviewer representatives are responsible for reviewing the completeness of the qualification protocol and accuracy of all entries.

Name (Print)	CHANA CHANSRI
Title	ENGINEER
Signature	
Initials	
Date	23 MAY 2023



Name (Print)	
Title	
Signature	
Initials	
Date	

## 2.3 Quality Assurance/Control Details

As Quality Assurance/Control (QA/QC), who is empowered to approve instrument compliance documents, I approve the procedures in the SCION Operational Qualification Protocol, which I may have amended, I accept the qualification of the Qualification Representative, and I will review and initial the results.

Name (Print)	
Title	
Signature	
Initials	
Date	

Name (Print)	
Title	
Signature	
Initials	
Date	

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### 3.0 Customer Responsibilities

The customer shall ensure that the Preventive Maintenance (PM) or Installation Qualification (IQ) up to point 9.11 is completed. A customer representative should be available at all times during the Operational Qualification Protocol.

**Note** The Operational Qualification Protocol test procedure should be performed after significant repairs, and at least once a year.

Qualification Rep. Initials	<i>Sahil P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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### 4.0 Qualification Guidelines and GMP Documentation

#### 4.1 Qualification Summary

At the end of qualification execution, all tables and data entry fields must be completed and all test results, where specified, must be printed and attached to the protocol.

The Qualification Representative and the Reviewer must sign (signature or initials) and date each page that has a signature field. This represents agreement and acceptance of all data and information on the signed page.

**Note** Scion does not provide instructions for full Qualification of the personal computer (PC) used to operate the SCION. If further qualification of the PC is required the end-user must contact the PC manufacturer.

**Note** Scion does not provide full qualification instructions for non-Scion manufactured accessories. Limited instructions may be supplied. If qualification of a non-Scion accessory is required, the end user must contact the accessory manufacturer.

#### 4.2 Qualification Guidelines

The following are general guidelines for performing the qualification tests in accordance with cGMP for the Manufacturing, Processing, Packaging, or Holding of Drugs per 21CFR Parts 210 and 211. Additional local requirements may also apply.

- Read the guidelines before starting the qualification.
- Perform all tests exactly as written.
- Use a pen with permanent blue or black ink unless otherwise specified by company policy.
- Neatly strike out any incorrect words or numbers, made while writing comments or recording results, information or data within this Protocol, with a single line. The word(s) crossed out must remain legible. Write the correction as close as possible to the original entry. Write a brief description of the error. For example, write 'Transcription error' or 'Re-written for clarity'. Initial and date the change.
- Entering initials where a signature is requested, and vice versa is permitted. The exception to this is in 2.0 : Qualification Representative and Reviewer Details on page 6, where examples of each person's signature and initials are required.
- Use the date format dd Mon yyyy (e.g. 08 Mar 2011) unless otherwise specified by company policy.

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- Complete all tables and data fields to comply with this protocol. Blank fields are not permitted. For items that are not applicable, draw a line through the field, and write 'N/A' (Not Applicable). If entire tables or sections of tables are not applicable, strike a line either through the entire table or the specific area and enter 'N/A'. Complete the signature fields on the page.
- Write 'Pass', 'Fail' or 'N/A' as applicable to the test requirement or outcome.
- Ensure that results and/or specific documents are printed and attached to the specified appendix.
- The Qualification Representative and Reviewer must both sign (signature or initials) and date the signature fields on each page. This represents agreement and acceptance of all data and information on the page.

#### 4.3 Page Numbering of Appendices

Each page that is inserted after the appendix is numbered with the letter of the appendix and a sequential number. The appendix page number must be initialed and dated by both the Qualification Representative and the Reviewer.

For example, pages inserted after Appendix C are numbered

C-1, C-2, C-3...etc. along with the initials and date.

If the reverse of each appendix page is left blank, it should be marked 'N/A' and signed and dated.

When the IQ is complete the total number of pages inserted after each appendix is written on the front page of the respective appendix sheet.

Qualification Rep. Initials	<i>Sahil P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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#### 4.4 Exception Reports

An exception to the protocol occurs when the observed result differs from the acceptance criteria or expected result.

All exceptions to the protocol must be documented in the Exception Report. The Exception Report includes a detailed description of the exception and resolution by the Qualification Representative.

Each Exception Report shall be issued with a unique identification number in the form ERID-XX-X. This number is generated by the page number on which the exception occurred followed by a sequential number indicating each exception found on the page.

For example, if an exception occurs on page 34, the Exception Report shall be identified as 'ERID-34-1'. If another exception occurs on page 34, the second report shall be identified as 'ERID-34-2'. This identification number should be recorded in the 'Pass / Fail / N/A' field after each test.

Each Exception Report must be signed by the Qualification Representative and the Reviewer as evidence of approval.

The Exception Report is inserted in the appropriately named appendix and numbered as per Section 4.3 of this protocol.

Qualification Rep. Initials	<i>Sahil P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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#### 4.5 Reference Documents

The following documents are relevant to this Qualification:

- Installation Qualification Protocol
- Completed service report from Preventative Maintenance (PM) schedule

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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#### 4.6 Required Materials

The following stock solutions are required:

- 100 fg/μL OFN 394204200
- 1 pg/μL OFN 393065201
- 100 pg/μL OFN 393110101
- 10 pg/μL BZP 93065301
- 100 pg/μL BZP 394206200

The above solutions will be used to prepare the following working solutions which will be required to execute this OQ:

**Note** Refer to Appendix 1 for the preparation of the standard solutions.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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#### 4.7 General Guidelines

The following are general cGMP guidelines.

- Perform each procedure exactly as written.
- Fill in each item on the form or mark it Not Applicable (N/A).
- If an item is marked N/A, initial it and date it.
- The Reviewer reviews and initials all entries recorded by the Qualification Representative.
- Keep all raw data. The Qualification Representative and the Reviewer will initial it, and date it.
- Do not destroy raw data.
- Attach raw data from an instrument, such as the SCION, as an Addendum using the instructions in the following Addendums section.
- If several instruments are qualified simultaneously, reference shared information, such as standard preparation and chemical information, to the document containing the original information by its model and instrument identification number.
- Label all reference standards as required by local regulations.
- Record the time each reference standard was opened.
- Use reference standards within 24 hours of preparation.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

#### 4.8 Specific Instructions for Documentation

The Reviewer designates specific documentation instructions as follows.

Permanent Ink Color	Blue
Preferred Date Format	23 MAY 23

If more instructions are required: Use an addendum sheet, write the addendum number, and a brief description.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

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#### 4.9 Documentation Corrections

**Note** All original entries must remain legible after corrections are made.

1. Draw a line through the incorrect information.
2. Write the correction as close as possible to the original entry, or enter a footnote.
3. Write a brief description of the error. For example, write "transcription error," "rewritten for clarity," or "correcting wrong entry".
4. Initial and date the change.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

#### 4.10 Marking Procedures Not Applicable

Some sections may not be relevant for the qualification. To indicate that a procedure or part of a form is unnecessary and that it was not forgotten or inadvertently overlooked:

1. Draw a line through the portion that is not applicable. Write the letters N/A (for not applicable), your initials, and the date near the diagonal line.
2. If a procedural step is unnecessary, select N/A if it is indicated, or write a comment in an Addendum. The Qualification Representative and the Reviewer enter their initials and the date near the line.

**Note** The Qualification Representative and Reviewer must sign and date all forms, even when part or all of the form is marked N/A.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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## 4.11 Addendums

The following are reasons to complete an addendum sheet:

- A deviation needs documentation.
- Additional information or data needs to be recorded.
- Insufficient space to include the correction on the sheet where the error was made.

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

## 4.12 Addendum Example

The following is an example of using an addendum sheet to document a deviation.

If some of the items on the sales order were not present, you could do the following:

- Use an addendum sheet.
- Write Instrument Delivery on the Procedure line.
- Write the addendum page number followed by a letter. For example: page 12A, where 12 is the page and A represents the first addendum on that page.
- Write the plan to obtain the missing items, which may be the following:
  - Scion notified that Part Number XXXXX and XXXX are missing.
  - Scion replied that the parts are in stock and will be sent overnight. While waiting for the parts to arrive, I will continue to set up the instrument.
- Review the plan with the Reviewer and make the necessary modifications.
- Document the arrival of the parts and write that this addendum is resolved. Attach a copy of delivery documents and create addendum pages as required.

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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## 5.0 Operational Qualification

This chapter contains the tests to be completed to perform an Operational Qualification for the SCION.

### 5.1 OQ Preparation

The following must be done before starting the OQ:

- Preventative Maintenance must have been completed and signed off by the Qualification Representative, Reviewer, and QA/QC person, and attach a copy of the service report and add an addendum number.

Addendum P.M. Protocol

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

- OQ must have been completed and signed off by the Qualification Representative, Reviewer, and QA/QC person.

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

- The QA/QC person must review, approve, append (if necessary), and sign the Pre-execution Approval.

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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- The Qualification Representative and the Reviewer must sign and date the Pre-execution Approval.

Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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## 5.2 System Description

### 5.2.1 SCION Description

Installation Date:	2015	Principal Operator:		Phone Number:	
<b>Company Information</b>					
Company: United Analyst and Engineering			Installation Site: LAB		
Name:			Building:		
Address: 361 Udomsuk 41			Address/Location: Sukhumvit Rd.		
City/State: Bangkok Prachabong			City/State: Bangkok		
Zip/Country: Thailand			Zip/Country: 10260		
<b>System Description</b>					
SCION	SA	Serial Number:	GQS1203F021		
Sales Order Number:		Sales Order Addendum Number:			
GC					
Module Type:	Scion 451	Serial Number:	BR1203M099		
<b>AutoSampler</b>					
Module Type:	dp 8400	Serial Number:	BR1203M311		
<b>MS Workstation</b>					
Version:	MSWS 8.2.1	Serial Number:	04106-6711-882-4502		
<b>Computer Operating System</b>					
Operating System:	Windows 7	Version:	Pro	Serial No.:	00366-150-436-158 Pack:
<b>Computer</b>					
Make:	Dell	Model:	Optiplex	Serial No.:	DNNYH5I
Addendum Number(s):	2. System description				
Qualification Rep. Initials	<i>Sukh' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 May 23	Date		Date	



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### 5.3 Data Sheet Specifications

Run these tests after the instrument has pumped down and is leak free. Use the factory methods. Follow the Installation Procedure; complete this section and the appropriate line of the OQ Summary. Print out the methods and results and attach as addendums. Use the factory test column Br-5ms 15m X 250lm X 0.25lm.

Table 5-1 TQ Specification

Mode	Concentration	Scan Range	Result †	N/A	Pass	Fail	Addendum
EI Full Scan	1 pg OFN	50-300	S/N ≥500:1				
EI MRM	100 fg OFN	272-222	S/N ≥5000:1				
PCI Full Scan‡	10 pg BZP	80-230	S/N ≥50:1				
NCI Full Scan‡	1 pg OFN	200-300	S/N ≥4000:1				

† The Signal-to-Noise ratio S/N values are based on RMS noise figure.

‡ CI tests use methane gas as reagent gas.

For any tests that did not pass, complete an Addendum for each, write the Addendum number and a brief description.

Qualification Rep. Initials	<i>Schul P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

Table 5-2 SQ Specification

Mode	Concentration	Scan Range	Result †	N/A	Pass	Fail	Addendum
EI Full Scan	1 pg OFN	50-300	S/N ≥600:1		✓		
PCI Full Scan‡	100 pg BZP	80-230	S/N ≥600:1	✓			
NCI Full Scan‡	200 fg OFN	200-300	S/N ≥1000:1	✓			

Qualification Rep. Initials	<i>Schul P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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### 5.4 EI Precision Test TQ

The following precision tests are for systems with autosamplers only. The test solution is 1 pg/μL OFN test mix part number 393065201.

The following is the required precision for 10 consecutive injections:

Injection	Retention Time	Peak Area
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
% RSD		

As an alternative, a % RSD summary report from MSWS can be added as an addendum.

Addendum N/A

	N/A	Pass	Fail	Addendum
Observed Mass is between 271.6 m/z to 272.4 m/z, which is ± 0.4 of the expected m/z.	✓			
Retention Time ≤ 1% Relative Standard Deviation (RSD).	✓			
Peak Area ≤ 10% Relative Standard Deviation (RSD).	✓			

To complete this section use the factory MRM method on the system CD. Print a copy of the method and add as an addendum.

Addendum N/A

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If the hardware is not the same as the factory method, then note this in the addendum and how the hardware available has been configured to compensate. The most common variation here is the sampler, where the Combi Pal has been used instead of the 8400. This will have no impact on results and can be tracked and recorded in the addendum.

### 5.5 EI Precision Test SQ

The following precision tests are for systems with autosamplers only. The test solution is 1 pg/μL OFN test mix part number 393065201.

The following is the required precision for 10 consecutive injections:

Injection	Retention Time	Peak Area
1	3.680	75060
2	3.681	77980
3	3.680	70959
4	3.680	75512
5	3.680	65015
6	3.682	73959
7	3.680	82551
8	3.682	65509
9	3.679	72852
10	3.679	76104
% RSD	0.028	4.39

As an alternative, a % RSD summary report from MSWS can be added as an addendum.

Addendum \_\_\_\_\_

	N/A	Pass	Fail	Addendum
Observed Mass is between 271.6 m/z to 272.4 m/z, which is ± 0.4 of the expected m/z.		✓		
Retention Time ≤ 1% Relative Standard Deviation (RSD).		✓		
Peak Area ≤ 10% Relative Standard Deviation (RSD).		✓		

เอกสารไม่ควบคุม

To complete this section use the factory Scan method on the system CD. Print a copy of the method and add as an addendum.

Addendum N/A

If the hardware is not the same as the factory method, then note this in the addendum and how the hardware available has been configured to compensate. The most common variation here is the sampler, where the Combi Pal has been used instead of the 8400. This will have no impact on results and can be tracked and recorded in the addendum.

Addendum N/A

เอกสารไม่ควบคุม

## 5.6 Final Evaluation

	N/A	Pass	Fail	Addendum
Is the equipment in normal operation condition?		✓		
Have all of the OQ requirements been completed?		✓		

Qualification Rep. Initials	<i>Sukon P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

## 6.0 Protocol Approval

## 6.1 Protocol Acceptance / Approval by Customer

I agree that the procedures and information referenced in this document are applicable.

Instrument(s): *Scion 451 SA with CP 8400*Serial Number(s): *GQS 1203 F021*

Sales Order Number:

Company Name: *United Analyst and Engineering Consultant Co., Ltd.*

I agree that the Operational Qualification Protocol has been satisfactorily completed.	<input checked="" type="checkbox"/>
I confirm that the Operational Qualification Protocol has not been completed, because of these failed (non-passed) items	<input type="checkbox"/>

## Authorized Customer Representative

Name (Print)	
Title	
Signature	
Initials	
Date	

เอกสารไม่ควบคุม

## 6.2 Operational Qualification Protocol Assignment

This Operational Qualification Protocol document is used for:

Operational Qualification Protocol as final test at Scion	<input type="checkbox"/>
Operational Qualification Protocol after Installation Qualification	<input type="checkbox"/>
Operational Qualification Protocol after Preventive Maintenance and OQ completion.	<input checked="" type="checkbox"/>

## 6.3 Protocol Acceptance / Protocol Approval by Scion

I agree that the procedures and information referenced in this document are applicable.

Instrument(s): *Scion 451 SA with CP 8400*Serial Number(s): *GQS 1203 F021*

Sales Order Number:

Company Name: *United Analyst and Engineering Consultant Co., Ltd.*

เอกสารไม่ควบคุม

## Scion Certified Engineer

Name (Print)	<i>SOMCHAI POHTONGKAM</i>
Title	<i>ENGINEER</i>
Signature	<i>Sukon P.</i>
Initials	<i>SOMCHAI</i>
Date	



## 6.4 Remarks

เอกสารไม่ควบคุม



## Appendices

Each page that is inserted after the appendix is numbered with the letter of the appendix and a sequential number. The appendix page number must be initialed and dated by both the Qualification Representative and the Reviewer.

For example, pages inserted after Appendix C are numbered C-1, C-2, C-3... etc along with the initials and date.

If the reverse of each appendix page is left blank it should be marked NA and signed and dated.

When the OQ is complete the total number of pages inserted after each appendix is written on the front page of the respective appendix sheet.

### A.1 Qualification Representative Details

The Qualification Representative is to insert a copy of their appropriate qualification(s) after this page.

No. of Pages Inserted	
-----------------------	--

*This area is intentionally left blank.*

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

### B.1 Exceptions

Each Exception Report shall be issued with a unique identification number in the form of ERID-XX-X. This number is generated by the page number on which the exception occurred followed by a sequential number indicating each exception found on the page.

For example, if an exception occurs on page 34, it shall be identified as Exception Report 'ERID-34-1'. If another exception occurs on page 34, the second exception shall be identified as 'ERID-34-2'. This identification number should be recorded in the pass/fail field after each test.

Insert Exception Reports (if any) after this page.

No. of Pages Inserted	N/A
-----------------------	-----

*This area is intentionally left blank.*

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



## Certificate

It is hereby certified that

**Mr. Somchai Pohtongkam**

Has successfully completed the Service & Application Training for

**Scion Chromatography Products**

Training Contents were:

**Hardware Operation, Software operation, Data analysis and Installation, & Troubleshooting of Model:**

**SCION GC, GCMS SQ, GCMS TQ**

At Techcomp Singapore  
By Mr. Michael Mei (Service Manager)

On 11<sup>th</sup>-15<sup>th</sup> July 2016

Hans van den Heuvel  
Commercial Director  
Scion Instruments

Date: 19 July 2016

Cert. No.: TSG-SCIONGC-15011602

Addendum Procedure: P.M. Protocol Page Number: 1

บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipat Rd., Bangkokhuphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawan@thaiunique.com, Website : www.thaiunique.com

## PREVENTIVE MAINTENANCE PROTOCOL

## FOR GAS CHROMATOGRAPH MASS SPECTROMETER

Model & Serial Number: SCQ SIN QXS 1203 F021Customer: United Analyst and Engineers' ng Anusorn Mont Co., Ltd.Date: 23 MAY 2023

## GC System

- ☒ Clean all system
- ☒ Check circuit board connector and cable
- ☒ Check column oven heater feed - through, fan motor, mount and bearings
- ☒ Check all LED's and readout display
- ☒ Check operation of all heated zones
- ☒ Check flow rates, filters and gases
- ☒ Verify flow controller operation

## MS System

- ☒ Check fan motor MS
- ☒ Check circuit board connector and cable
- ☒ Run electronic Diagnostics
- ☒ Check Gas Clean Filter
- ☒ Check for leak system
- ☒ Check turbo pump ( system status )
- ☒ Check vacuum oil
- ☒ Check temperature zone
- ☒ Check air/water ( mass 18.19; 28 )
- ☒ Check HMN
- ☒ Clean Trap ( Saturn, MS200, 4000 Series ) or Ion source ( 1200L, 300, SQ, TQ Series )
- ☒ Check Electron multiplier ( If close to 2,000 Volts, Change the multiplier )
- ☒ Check Cal Gas ( FC-43 )
- ☒ Sensitivity ( EI Scan Mode S/N Ratio with for OFN )
- ☒ Check %RSD of Area (EI Scan Mode, for OFN )
- ☒ Check %RSD of RT (EI Scan Mode, for OFN )

SIGN :

Engineer :

SANCHAI PONGTUNGKAM

Customer :

( )

Qualification Rep. Initials	<u>Sanchai P.</u>	Reviewer Initials		QA/QC Initials	
Date	<u>23 MAY 23</u>	Date		Date	



Publication no. 394207000, Revision A, November 2011

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เอกสารไม่ควบคุม



เอกสารไม่ควบคุม



เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Version information

About 451-GC Details

Auxiliary EFCs:

Software Version

Front: 0.0

Middle: 0.0

Rear: 0.0

Serial number

Front: 0

Middle: 0

Rear: 0

Ok

Version information

About 451-GC Details

Autosampler:

CP84xxMBus: 2.0

CP84xxTS1: 1.0

CP84xxTS6: 1.20

CP84xxTray: 1.20

CP84xxTower: 1.20

CP84xxSyringe: 1.21

CP84xxPlunger: 1.20

GC Application build info:

Ok

เอกสารไม่ควบคุม

Version information

About 451-GC Details

Injector EFCs:

Software Version

Front: 1.35

Middle: 1.35

Rear: 0.0

Serial number

Front: 26254

Middle: 26256

Rear: -1

Ok

Version information

About 451-GC Details

Detector EFCs:

Software Version

Front: 0.0

Middle: 0.0

Rear: 0.0

Serial number

Front: -1

Middle: -1

Rear: -1

Ok

เอกสารไม่ควบคุม

Version information

About 451-GC Details

Software Version: 5.09

Hostname: GC\_123 (IP 10.190.65.10)

Mac Address: 00:e0:4b:34:f5:0d

Software Version: 4.05

GC\_Application: 27267

LUI\_Application: 0

Ok

Version information

About 451-GC Details

Hardware:

Mainboard: 14

Mainboard SerialNr: 200048

Option Board: 0

Option Board SerialNr: 0

Firmware:

I/O Controller: 2.2

I/O Extender: 1.3

Option Board Controller: 0.0

Ok

เอกสารไม่ควบคุม

SCION Operational Qualification Protocol

Addendum Procedure: 2. System description Page Number: 5

Qualification Rep. Initials	<i>Sakun P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

Addendum Procedure: 2 Test Result Page Number: 30

Qualification Rep. Initials	<i>Sahai P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 May 23	Date		Date	



Publication no. 39420700, Revision A, November 2011

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เอกสารไม่ควบคุม

\*\*\*\*\*  
SCION MS system hardware test

Test date 5-23-2023

Main module test

Passed -&gt; Power supply test

Passed -&gt; Main user analog out test

CIDV module test

5-23-2023

vent valve can only be tested when vented

pressure sensor and pneumatics not tested in single quad system

Passed -&gt; cidv module test

env module test

5-23-2023

Passed -&gt; env module test

Det module test

5-23-2023

\*\*\*\*\*  
Detector module test

Passed -> Power supply test  
 Passed -> HV Power supply Type test  
 Passed -> HV Power supply Revision test  
 Passed -> Detector accelerator test  
 Passed -> Detector baseline dac test  
 Passed -> Detector Noise test  
 Passed -> Detector multiplier dac test  
 Passed -> Detector module test  
 Q0 module test

5-23-2023

Passed -&gt; Q0 module test

Q1 module test

5-23-2023

Passed -&gt; Q1 module test

EI module test

5-23-2023

Passed -> EI High voltage DC rail test  
 Passed -> EI Lens 1 test  
 Passed -> Lens 2 test  
 Passed -> Repeller test  
 Passed -> Electron energy test  
 Passed -> EI Source test

เอกสารไม่ควบคุม

Main module test

5-23-2023

Passed -&gt; LED Test

Passed -&gt; Speaker Test

Passed -&gt; Power supply test

Passed -&gt; Main user analog out test

Passed -&gt; Main module test

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

CIDV module test

5-23-2023

Passed -> CIDV Power supply test

Passed -> Turbo control test

vent valve can only be tested when vented

pressure sensor and pneumatics not tested in single quad system

Passed -> cidv module test

env module test

5-23-2023

Passed -> Power supply test

Passed -> temp sensor test

Passed -> Valve current test

Passed -> env fan test

Passed -> heater current test

Passed -> env module test

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Det module test

5-23-2023

Passed -> Power supply test

Passed -> HV Power supply Type test

Passed -> HV Power supply Revision test

Passed -> Detector accelerator test

Passed -> Detector baseline dac test

Passed -> Detector Noise test

Passed -> Detector multiplier dac test

Passed -> Detector module test

Q0 module test

5-23-2023

Passed -> Power supply test

Passed -> Q0 High voltage DC rail test

Passed -> Q0 DAC test

Passed -> Quad offset test

Passed -> RF detector test

Passed -> RF modulator test

Passed -> RF current test

Passed -> heater current test

Passed -> Q0 module test

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



Q1 module test

5-23-2023

Passed -> Power supply test  
 Passed -> q1\_hvdc\_rail\_test  
 Passed -> DAC test  
 Passed -> AMP test  
 Passed -> RF detector test  
 Passed -> RF modulator test  
 Passed -> RF current test  
 Passed -> Q1 RF detector temperature test

Passed -> Q1 module test.

EI module test

5-23-2023

Passed -> EI Power supply test  
 Passed -> EI High voltage DC-rail test  
 Passed -> EI Lens 1 test  
 Passed -> Lens 2 test  
 Passed -> Repeller test  
 Passed -> Electron energy test  
 Passed -> AMP test  
 Passed -> EI Filament test  
 Check maximum heater current and heater wattage  
 Mix Heater Current = 1.31 Wattage = 30.35  
 Source heater wattage measures OK  
 Passed -> EI Heater test  
 Passed -> EI Source test

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Print Date: 23 May 2023 12:57:09

Target Compound Report for #1 from ofn1pg.xmls

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 11:53	Data File:	...23/op2023/ofn1pg.xmls
Calculation Date:	23/5/2566 12:55	Method:	e:\tu\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

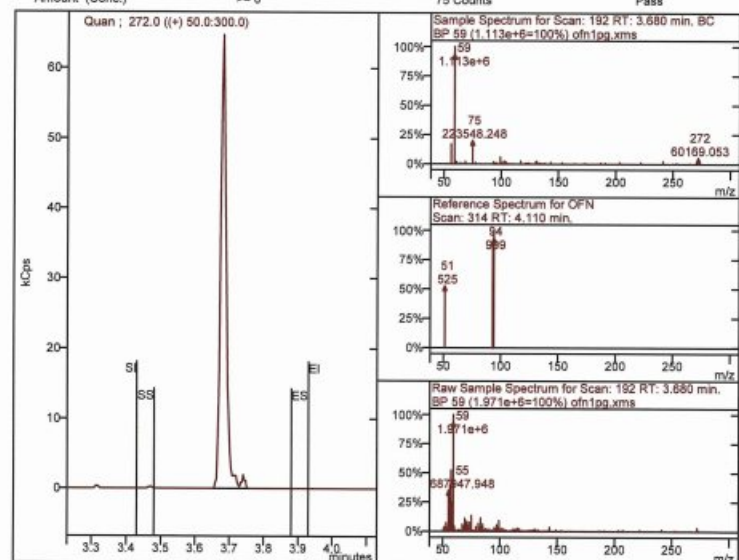
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.680 min.	Pass
Match Result	>=10	N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quan Ions	272.0		
Calibration Equation	Average		
Area	>=10	75060	Pass
Height		64731	
Amount (Conc.)	>= 0	75 Counts	Pass



เอกสารไม่ควบคุม

Print Date: 23 May 2023 12:56:56

Target Compound Report for #1 from ofn1pg001.xmls

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 12:06	Data File:	...op2023/ofn1pg001.xmls
Calculation Date:	23/5/2566 12:55	Method:	e:\tu\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

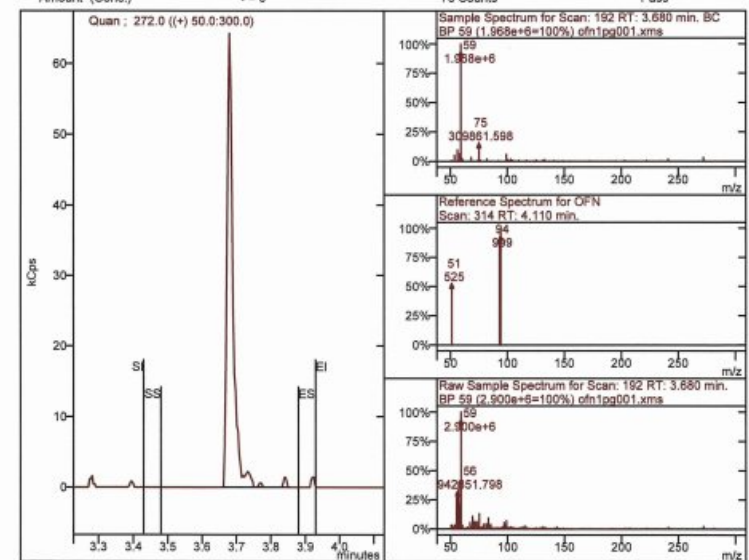
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.681 min.	Pass
Match Result	>=10	N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quan Ions	272.0		
Calibration Equation	Average		
Area	>=10	77980	Pass
Height		64295	
Amount (Conc.)	>= 0	78 Counts	Pass



เอกสารไม่ควบคุม

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Brucker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 12:19	Data File:	...op2023\ofn1pg002.xms
Calculation Date:	23/5/2566 12:55	Method:	e:\u\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

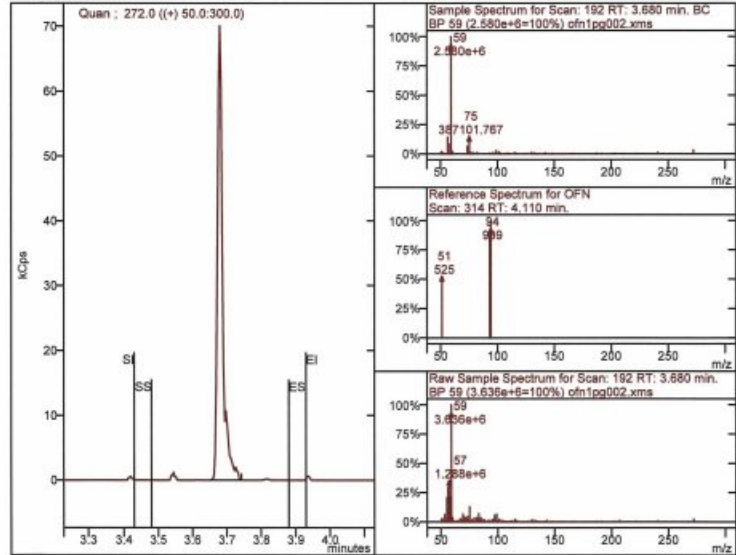
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.680 min.	Pass
Match Result		N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quant Ions	272.0		
Calibration Equation	Average	74859	Pass
Area	>=10	70070	
Height		75 Counts	Pass
Amount (Conc.)	>= 0		



เอกสารไม่ควบคุม

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Brucker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 12:32	Data File:	...op2023\ofn1pg003.xms
Calculation Date:	23/5/2566 12:55	Method:	e:\u\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

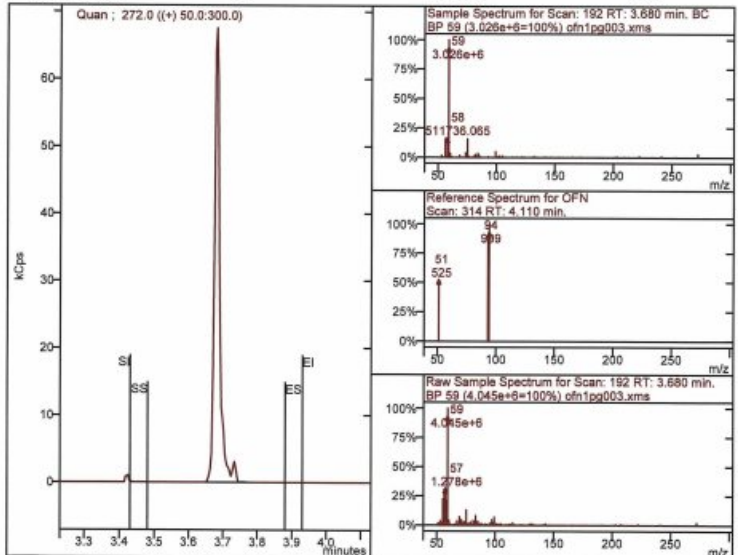
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.680 min.	Pass
Match Result		N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quant Ions	272.0		
Calibration Equation	Average	75512	Pass
Area	>=10	67577	
Height		78 Counts	Pass
Amount (Conc.)	>= 0		



เอกสารไม่ควบคุม

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Brucker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 12:46	Data File:	...op2023\ofn1pg004.xms
Calculation Date:	23/5/2566 12:55	Method:	e:\u\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

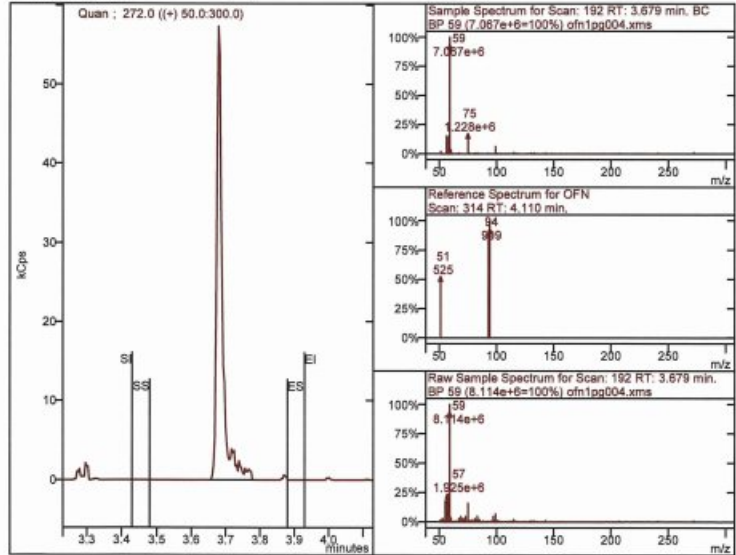
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.680 min.	Pass
Match Result		N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quant Ions	272.0		
Calibration Equation	Average	65015	Pass
Area	>=10	57346	
Height		65 Counts	Pass
Amount (Conc.)	>= 0		



เอกสารไม่ควบคุม

Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Brucker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 12:59	Data File:	...op2023\ofn1pg005.xms
Calculation Date:	23/5/2566 14:04	Method:	e:\u\pm2023\fs_ptv.mth
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

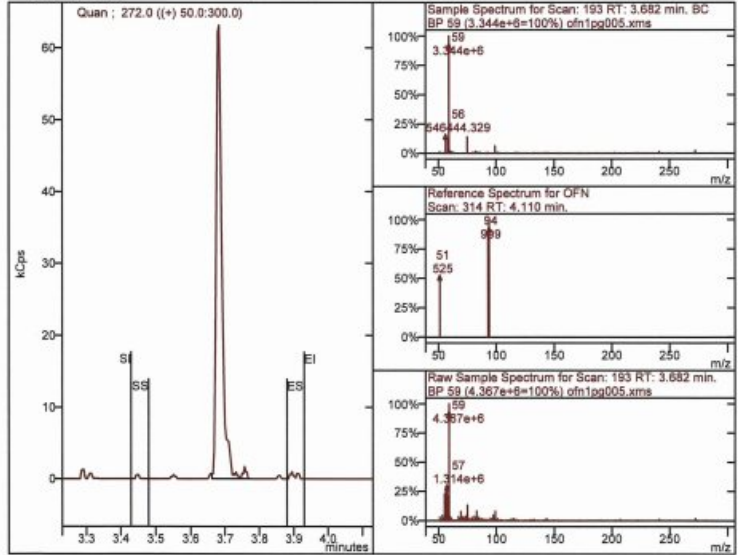
Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						

Identification

Parameter	Specification	Actual	Status
Search Type	Highest		
Retention Time	3.680 +/- 0.200	3.682 min.	Pass
Match Result		N/A	

Integration and Quantitation

Parameter	Specification	Actual	Status
Quant Ions	272.0		
Calibration Equation	Average	73959	Pass
Area	>=10	63142	
Height		74 Counts	Pass
Amount (Conc.)	>= 0		



เอกสารไม่ควบคุม

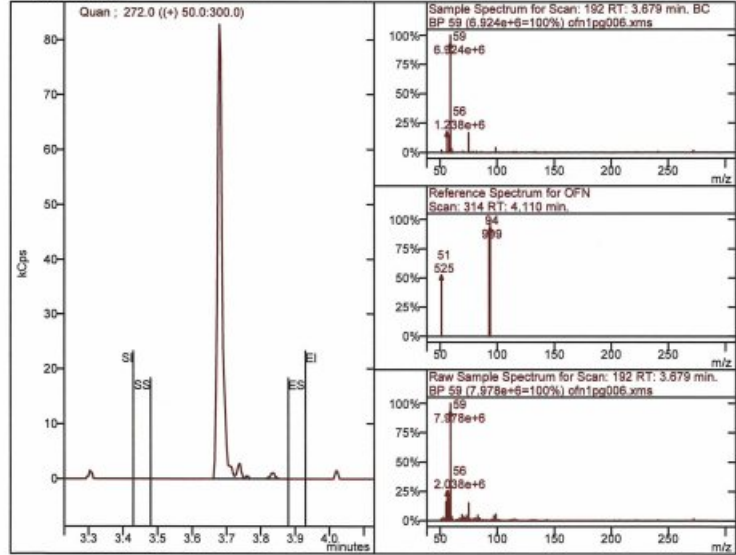
Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 13:12	Data File:	...op2023\ofn1pg006.xms
Calculation Date:	23/5/2566 14:04	Method:	e:\u\pm2023\fs_ptv.mh
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						
Identification							
Parameter	Specification	Actual	Status				
Search Type	Highest						
Retention Time	3.680 +/- 0.200	3.680 min.	Pass				
Match Result		N/A					

Integration and Quantitation

Parameter	Specification	Actual	Status				
Quan Ions	272.0						
Calibration Equation	Average						
Area	>=10	83551	Pass				
Height		82828					
Amount (Conc.)	>= 0	84 Counts	Pass				



เอกสารไม่ควบคุม

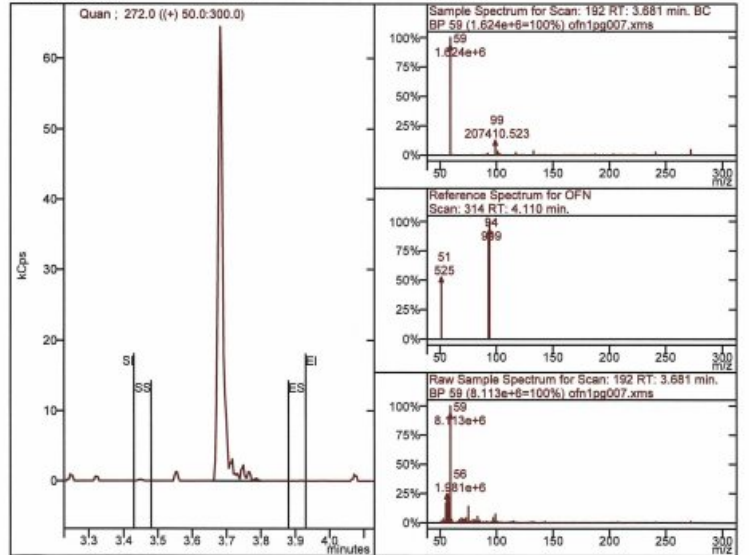
Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 13:25	Data File:	...op2023\ofn1pg007.xms
Calculation Date:	23/5/2566 14:04	Method:	e:\u\pm2023\fs_ptv.mh
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						
Identification							
Parameter	Specification	Actual	Status				
Search Type	Highest						
Retention Time	3.680 +/- 0.200	3.682 min.	Pass				
Match Result		N/A					

Integration and Quantitation

Parameter	Specification	Actual	Status				
Quan Ions	272.0						
Calibration Equation	Average						
Area	>=10	65509	Pass				
Height		64484					
Amount (Conc.)	>= 0	66 Counts	Pass				



เอกสารไม่ควบคุม

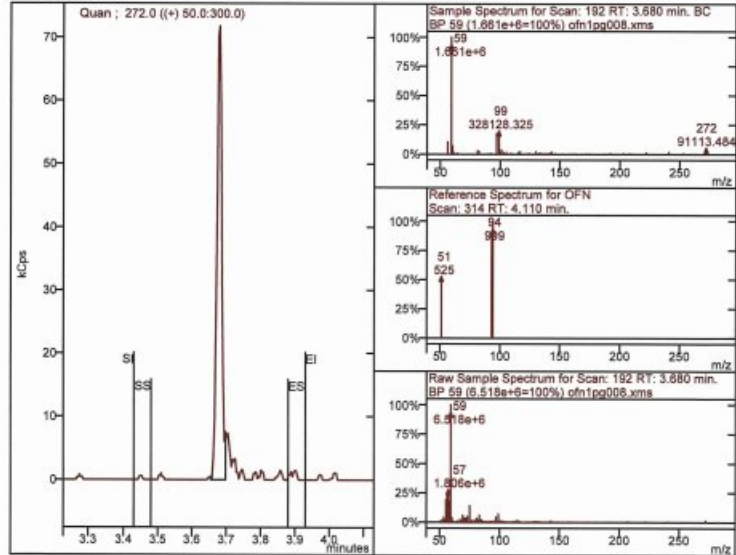
Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 13:38	Data File:	...op2023\ofn1pg008.xms
Calculation Date:	23/5/2566 14:04	Method:	e:\u\pm2023\fs_ptv.mh
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						
Identification							
Parameter	Specification	Actual	Status				
Search Type	Highest						
Retention Time	3.680 +/- 0.200	3.679 min.	Pass				
Match Result		N/A					

Integration and Quantitation

Parameter	Specification	Actual	Status				
Quan Ions	272.0						
Calibration Equation	Average						
Area	>=10	72852	Pass				
Height		71827					
Amount (Conc.)	>= 0	73 Counts	Pass				



เอกสารไม่ควบคุม

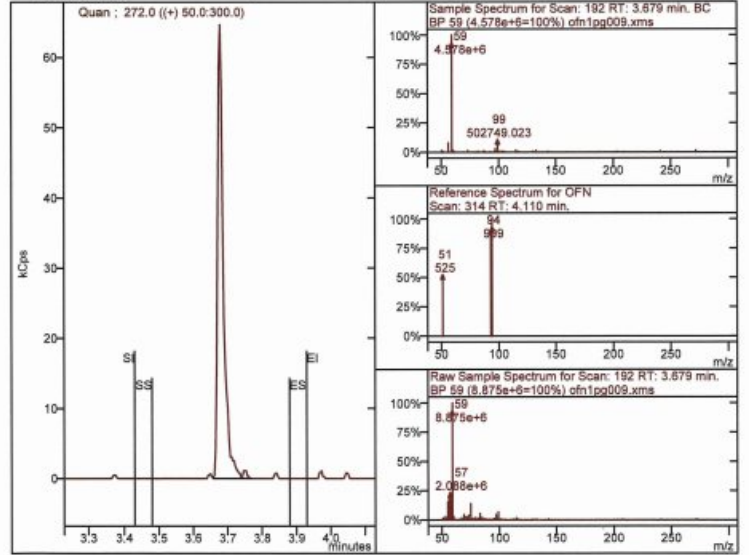
Sample ID:	ofn1pg	Operator:	TU
Instrument ID:	Bruker GC/MS #1	Last Calibration:	26/11/2557 15:55
Measurement Type:	Area	Calibration Type:	External Standard
Acquisition Date:	23/5/2566 13:51	Data File:	...op2023\ofn1pg009.xms
Calculation Date:	23/5/2566 14:04	Method:	e:\u\pm2023\fs_ptv.mh
Sample Type:	Analysis		
Inj. Sample Notes:	None		

Compound Information

Peak Name:	OFN	Compound Number:	1	CAS Number:	None	Identified	
Result Index:	1						
Identification							
Parameter	Specification	Actual	Status				
Search Type	Highest						
Retention Time	3.680 +/- 0.200	3.679 min.	Pass				
Match Result		N/A					

Integration and Quantitation

Parameter	Specification	Actual	Status				
Quan Ions	272.0						
Calibration Equation	Average						
Area	>=10	76104	Pass				
Height		64695					
Amount (Conc.)	>= 0	76 Counts	Pass				



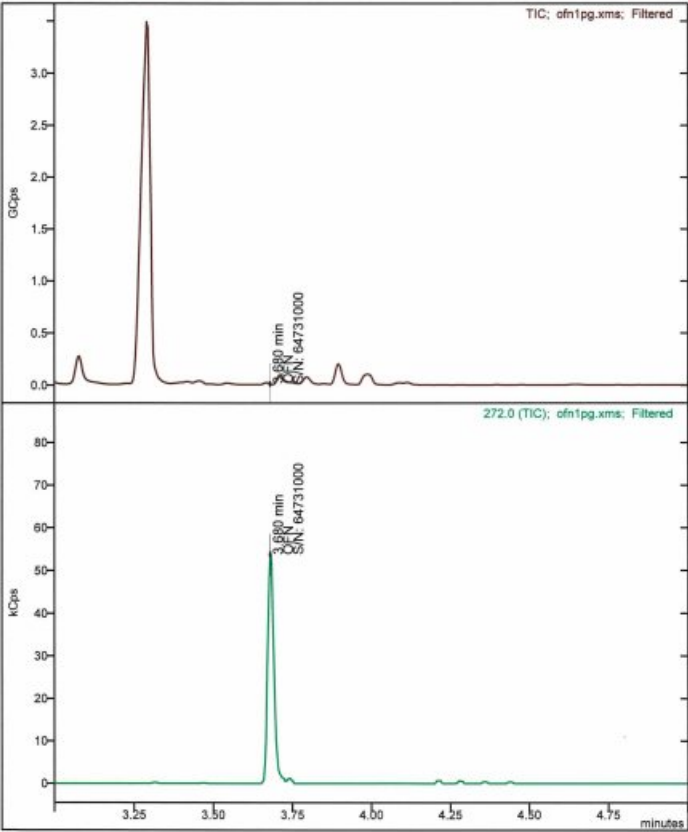
เอกสารไม่ควบคุม



Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 11:53

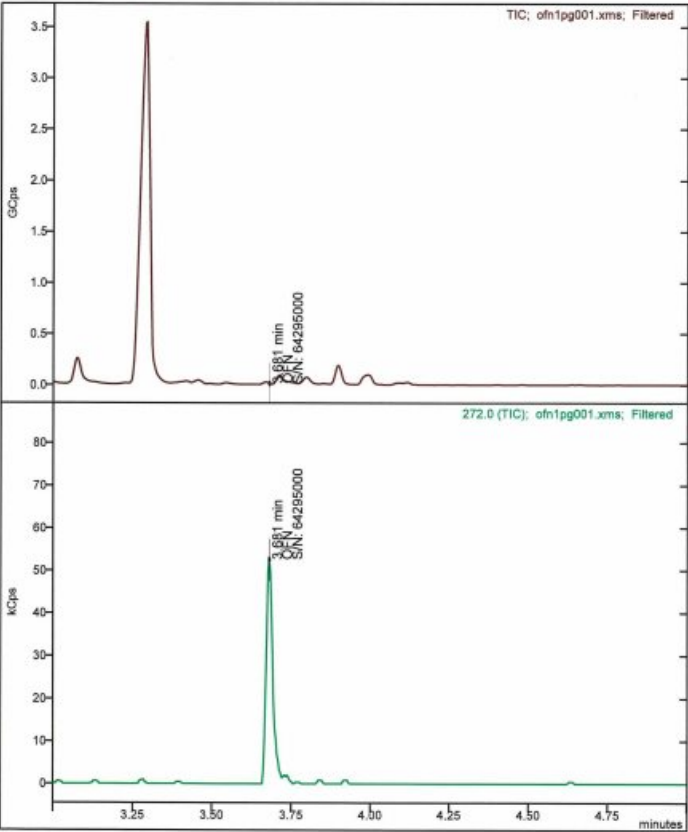


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg001.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 12:06

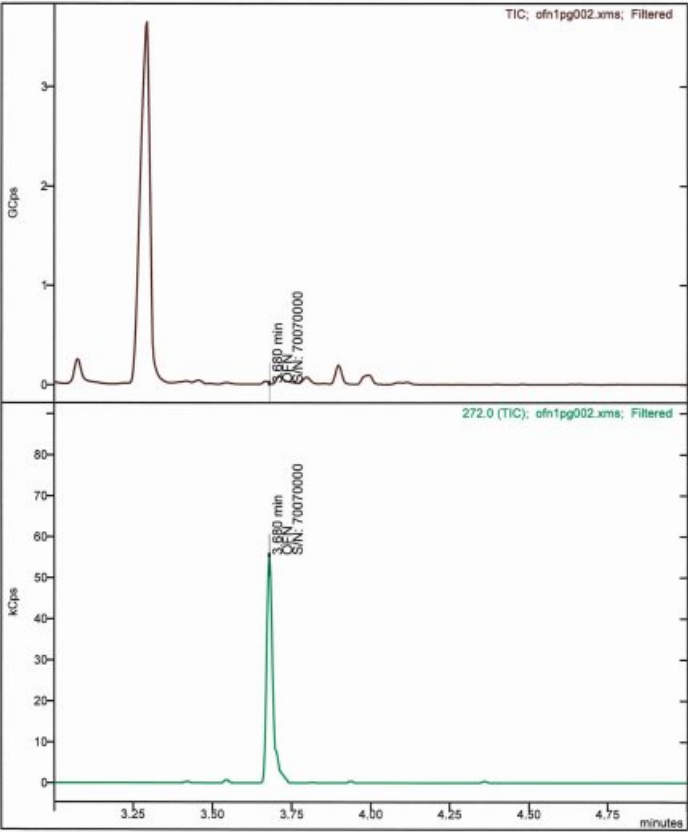


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg002.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 12:19

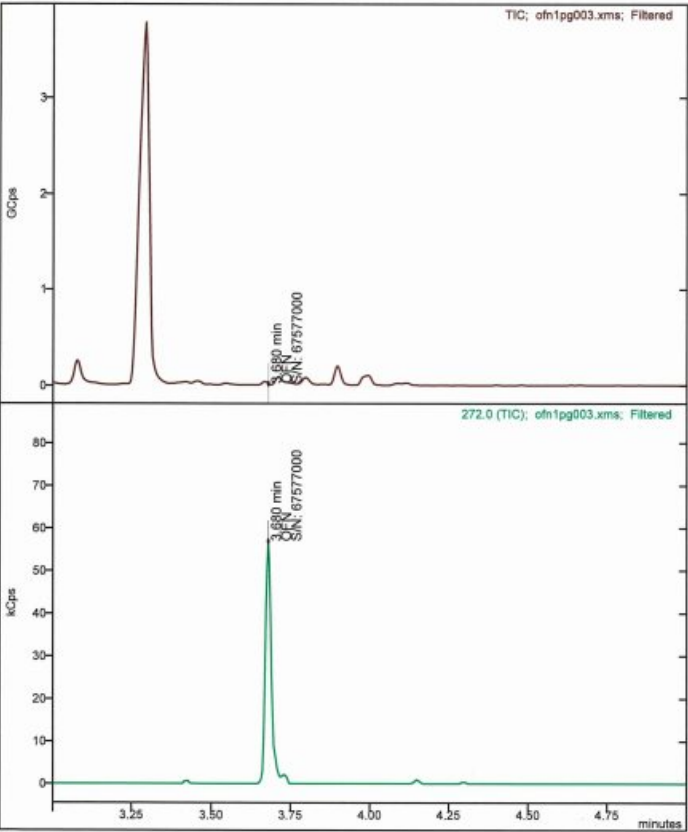


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Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg003.xms  
Sample: ofn1pg  
Scan Range: 1 - 564 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 12:32

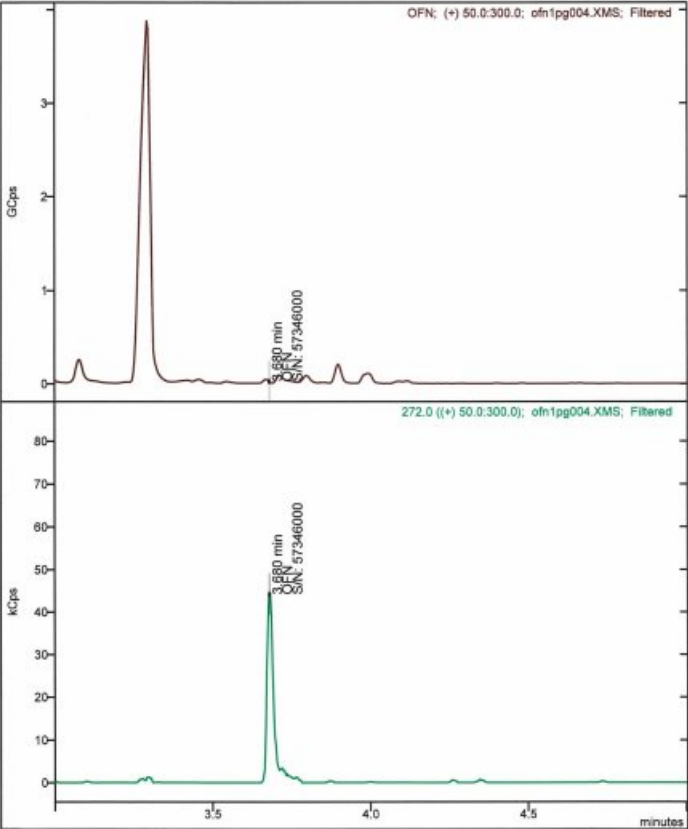


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg004.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 12:46

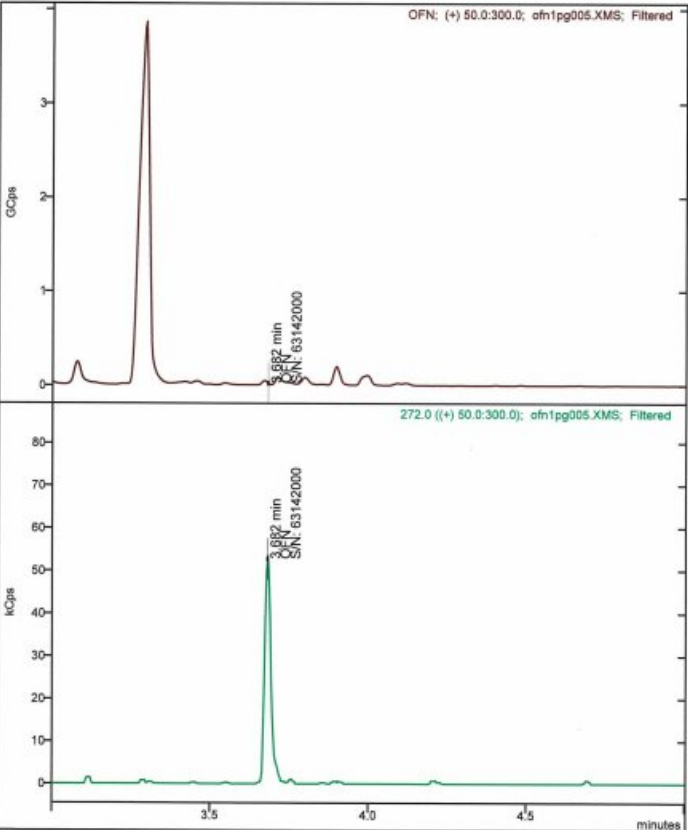


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg005.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 12:59

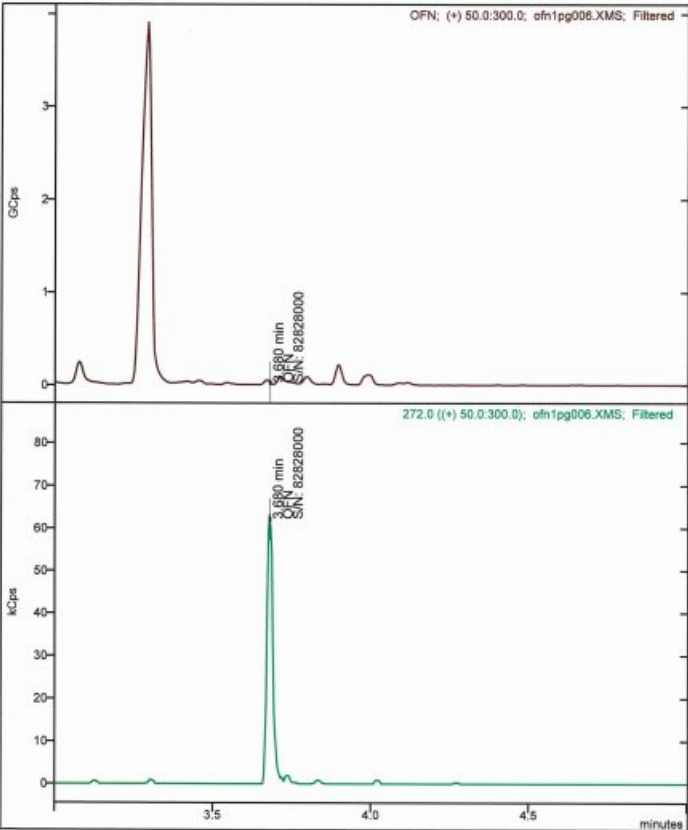


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg006.xms  
Sample: ofn1pg  
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 13:12

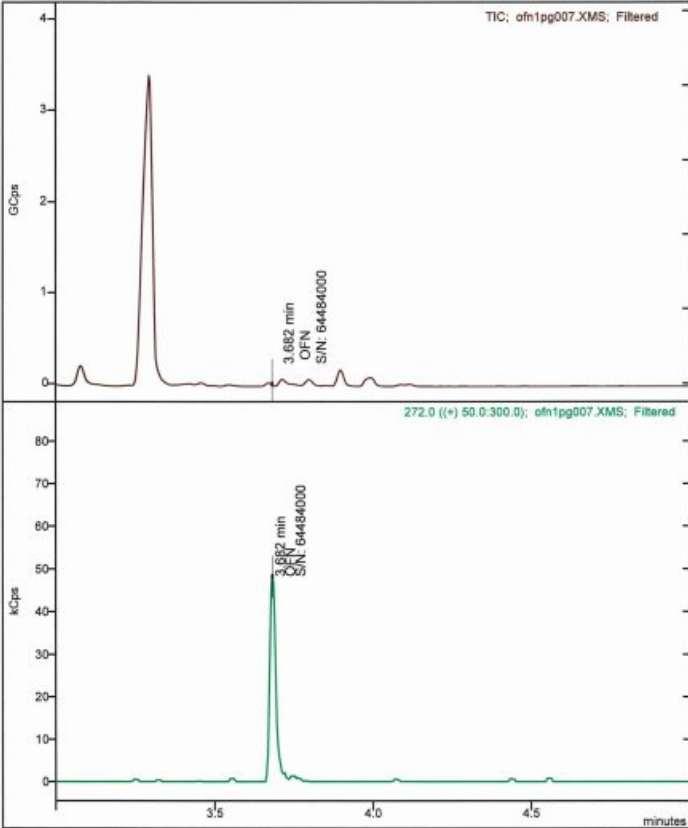


เอกสารไม่ควบคุม

Chromatogram Plots

File: e:\tu\pm2023\op2023\ofn1pg007.xms  
Sample: ofn1pg  
Scan Range: 1 - 564 Time Range: 3.00 - 5.00 min.

Operator: TU  
Date: 23/5/2566 13:25



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### Chromatogram Plots

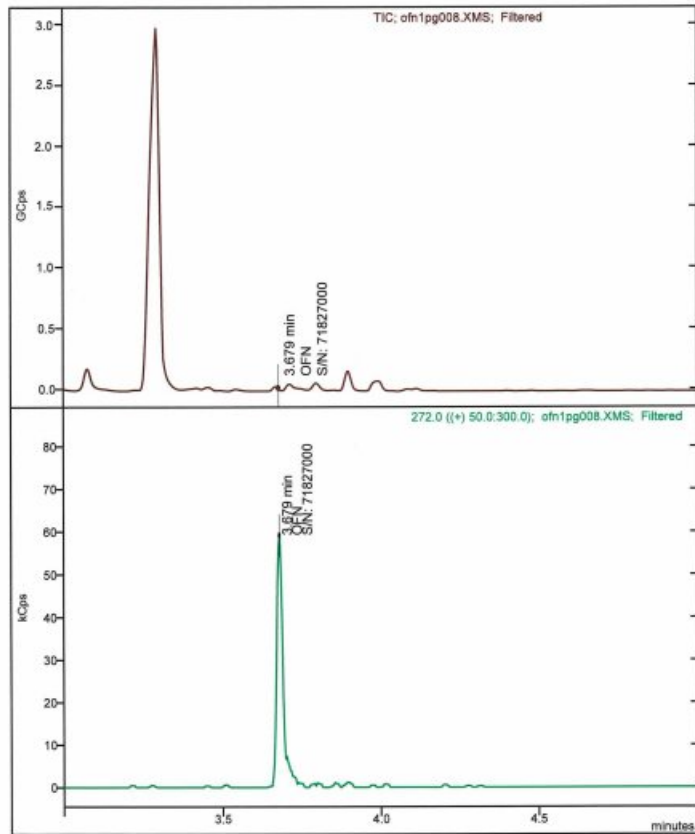
File: e:\tu\pm2023\op2023\ofn1pg008.xms

Sample: ofn1pg

Scan Range: 1 - 564 Time Range: 3.00 - 5.00 min.

Operator: TU

Date: 23/5/2566 13:38



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### Chromatogram Plots

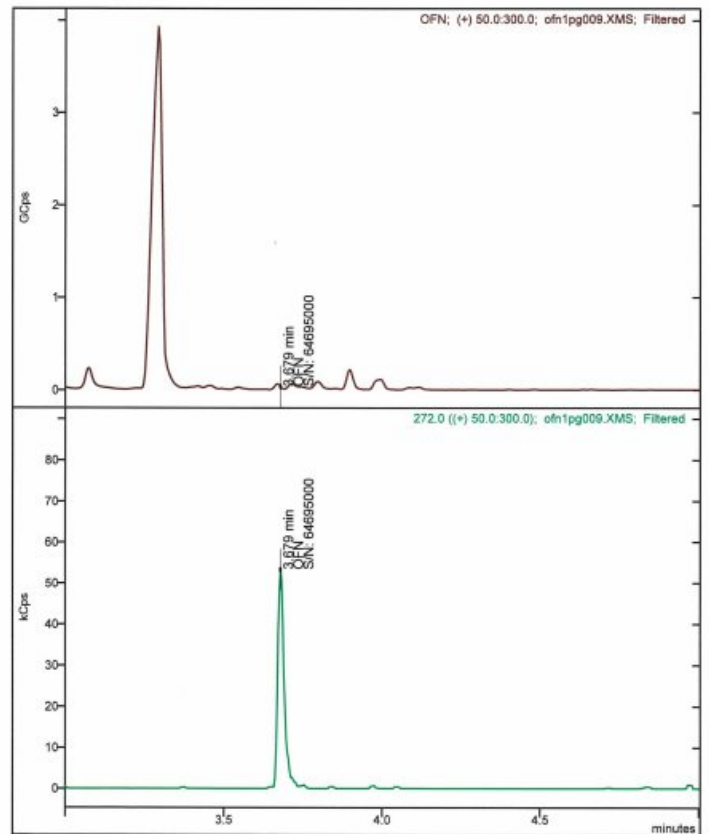
File: e:\tu\pm2023\op2023\ofn1pg009.xms

Sample: ofn1pg

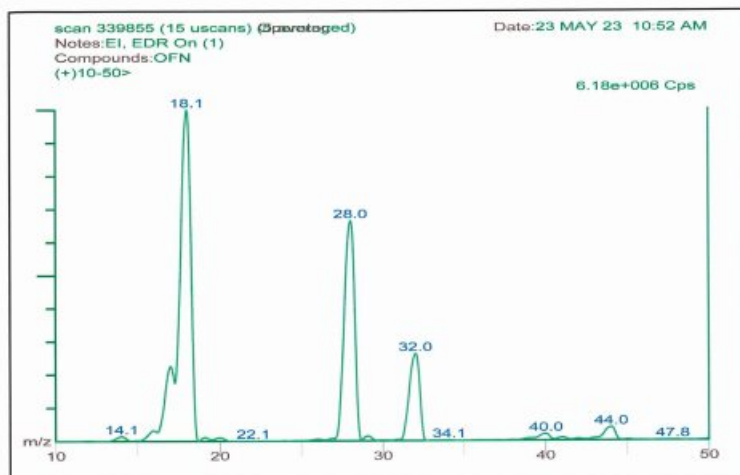
Scan Range: 1 - 565 Time Range: 3.00 - 5.00 min.

Operator: TU

Date: 23/5/2566 13:51



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28 absolute size (cps)

- Normal < 9.0e7
- Measured 4.05e6

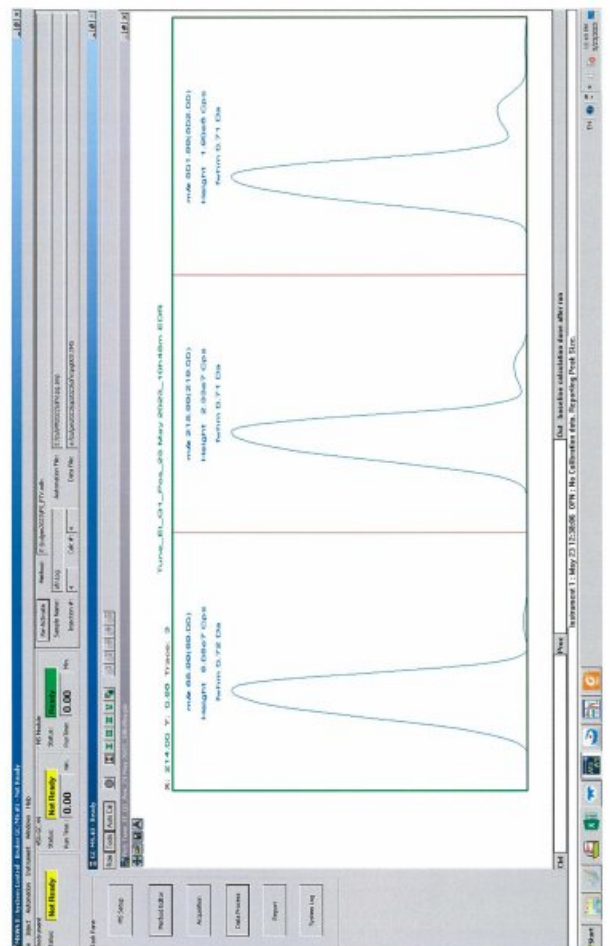
28/32 Ratio

- Normal < 2.8:1 or > 4.2:1
- Measured 2.5:1

28/18 Ratio

- Normal < 2.0:1
- Measured 0.7:1

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Addendum Procedure: A. Certificate Page Number: 1

## Operational Qualification Protocol Certification

for  
**SCION**

with the serial number

GQS1203F021has successfully completed all criteria for hardware Operational Qualification Protocol  
as detailed in this document.

Scion Certified Engineer

SOMCHAI POHTONGKAM  
Name (please print)Sachin P.  
Signature23 MAY 23  
Date

Authorized Customer Representative

Name / Function (please print)

Signature

Date

Customer Address

United Analyst and Engineering Consultant Co., Ltd.

Qualification Rep. Initials	<u>Sachin P.</u>	Reviewer Initials		QA/QC Initials	
Date	<u>23 MAY 23</u>	Date		Date	



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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/en-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.

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Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist

## System Information

Instrument system name and ID	<u>ICP 5110 VDV</u>
Instrument system site and location	<u>UAE / 3rd Floor Laboratory</u>
List system component product numbers	List the serial numbers of each component
1. <u>G2015A</u>	1. <u>MY18030001</u>
2. <u>G2015A</u>	2. <u>1801-01928</u>
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 <u>OneNeb</u> other
Spray Chamber	Cyclonic Single Pass   <u>Cyclonic Double Pass</u>   other
Torch	Radial   <u>Dual View</u>   other
Injector Diameter	2.4mm   <u>1.8mm</u>   1.4mm   0.8mm   other
Injector Material	Quartz   <u>Ceramic</u>   other

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**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. *W/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. *W/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.

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

- ☒ 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	29.7

\* 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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**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**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	227.973	VAC
Mains Current	0.204	A	0.104	A
Instrument Temperature	22.8	°C	22.7	°C
RF Air Flow (sensor speed)	15.0	Hz	13.0	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	671.34	kPa	627.33	kPa
Purge Gas Supply Pressure*1	674.30	kPa	643.40	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		184.660	V

\*1 If option installed

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

### ICP-OES Parts List Table

Part description	Part Number	Product / Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Cooling Fluid	G3292-80010	G8481A	
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-88002	All	1
High Capacity Air Filter	G8010-60180	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineers stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	8710049000	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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## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

- ☒ 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 6005625287 Date service completed 30 Nov 2022

Agilent signature Woravit T. Customer signature Jim

Document part number: G8014-90075

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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 Test Before PM  
Test Completed On 11/30/2022 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	6.82
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 (208.158 nm)	≤ 13.40	9.04
Zn (213.857 nm)	≤ 8.70	6.82
Pb (220.353 nm)	≤ 9.50	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	18.98
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	29.47
Ar (675.283 nm)	≤ 74.00	59.62
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	159.5
Pb (220.353 nm)	≥ 46.0	SRBR	192.5	2808.6	185.7
Mn (257.610 nm)	≥ 3518.0	SRBR	11064.7	264165.0	567.8
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	3865.1	271.6
Zn (206.200 nm)	≥ 234.0	SRBR	1306.5	15850.4	144.5
Zn (213.857 nm)	≥ 1743.0	SRBR	8364.0	183037.8	476.4
Cd (214.439 nm)	≥ 4227.0	SRBR	7718.5	143240.2	342.6
Pb (220.353 nm)	≥ 320.0	SRBR	576.3	14465.2	580.4
Mn (257.610 nm)	≥ 10625.0	SRBR	31642.1	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	52518.8
K (766.491 nm)	≥ 24.0	SBR	36.8	1922163.4	50658.1

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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	0.55
Pb (220.353 nm)	≤ 1.50	0.62
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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Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9907	
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	1.06	18.51

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Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	163.37	2.00	1.99	109.49
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		

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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	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

	Radial	Axial
Intensity	5674608	5823476
Wavelength	737.212	737.212

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# Resolution Test

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)	≤ 6.20	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 (260.566 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	33.66
Sr (460.733 nm)	≤ 36.00	17.51
Ba (493.408 nm)	≤ 36.00	25.56
Ba (614.171 nm)	≤ 42.00	24.96
Ar (675.283 nm)	≤ 74.00	59.38
K (766.491 nm)	≤ 80.00	65.93

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# Sensitivity Test

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	285591.3	496.0
Al (396.152 nm)	≥ 3.4	SBR	9.9	52888.6	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

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 (206.200 nm)	≥ 234.0	SRBR	1128.6	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	125984.2	321.6
Pb (220.353 nm)	≥ 320.0	SRBR	536.3	12909.3	532.6
Mn (257.610 nm)	≥ 10625.0	SRBR	30846.2	1287989.0	1738.8
Cr (267.716 nm)	≥ 1048.0	SRBR	4396.0	187335.6	1424.4
Cu (324.754 nm)	≥ 19.0	SBR	52.1	373690.7	7033.1
Al (396.152 nm)	≥ 6.0	SBR	16.8	268357.7	15112.4
Ba (493.408 nm)	≥ 60.0	SBR	225.2	10173441.5	44971.7
K (766.491 nm)	≥ 24.0	SBR	39.7	1874136.2	46055.7

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# Precision Test

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	0.26
Ba (493.408 nm)	≤ 1.50	0.59
K (766.491 nm)	≤ 1.50	0.23

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.71
Se (196.026 nm)	≤ 1.50	0.43
Zn (206.200 nm)	≤ 1.50	0.46
Zn (213.857 nm)	≤ 1.50	0.37
Cd (214.439 nm)	≤ 1.50	0.48
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	0.81
K (766.491 nm)	≤ 1.50	0.84

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Request No. 25-65 / 0398

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## 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. P2-ME675610  
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)


REFERENCE MATERIAL : Traceable to NIST "Agilent Technologies", "Carlo Erba"  
Cadmium Lot No. 0108047046, Chromium Lot No. 0106315418, Copper Lot No. 0107480530, Iron Lot No. 0104697566,  
Lead Lot No. 0104659473, Manganese Lot No. T109228A, Nickel Lot No. 0104978044, Zinc Lot No. 0100792297

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

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 60 %

The Atomic Absorption Spectrophotometer set 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   
( Mrs. Thippaya Junjee Fortune )  
Director of Analytical Chemistry Laboratory  
Ref. 2025265020400522001  
Calibration Date : 3 February 2022

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## CALIBRATION DATA

## 1. Noise Level in term of standard deviation

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
Absorbance	-0.0004	0.0002	0.0007	0.0002	-0.0016	-0.0001	-0.0004	-0.0001
	0.0002	-0.0005	0.0010	0.0007	0.0000	-0.0003	0.0007	-0.0014
	-0.0002	0.0001	0.0008	0.0000	-0.0001	-0.0003	-0.0012	-0.0006
	0.0000	-0.0007	0.0007	0.0000	-0.0005	-0.0004	-0.0004	-0.0012
	0.0001	0.0004	0.0013	0.0014	-0.0001	-0.0001	0.0003	-0.0008
	0.0000	-0.0004	0.0003	-0.0012	-0.0005	-0.0007	-0.0004	-0.0008
	0.0000	-0.0009	0.0009	-0.0002	-0.0010	-0.0008	0.0007	-0.0003
	-0.0004	-0.0003	0.0015	0.0010	-0.0005	-0.0003	-0.0002	-0.0004
	0.0004	0.0008	0.0014	-0.0004	-0.0014	-0.0005	-0.0006	-0.0003
	-0.0006	-0.0013	0.0012	-0.0006	-0.0006	-0.0006	-0.0007	-0.0007
	0.0005	-0.0003	0.0014	-0.0004	-0.0008	-0.0003	-0.0006	-0.0011
	-0.0007	-0.0014	0.0004	-0.0001	-0.0001	0.0000	0.0000	-0.0003
	0.0008	0.0004	0.0005	-0.0006	-0.0008	0.0000	-0.0005	-0.0009
	0.0011	0.0002	0.0005	0.0017	-0.0016	-0.0008	0.0004	-0.0005
	0.0002	0.0010	0.0014	-0.0002	-0.0010	-0.0010	0.0002	-0.0001
	0.0001	-0.0011	0.0011	-0.0003	-0.0011	-0.0003	-0.0008	-0.0012
	0.0000	-0.0015	0.0009	-0.0010	-0.0011	-0.0013	0.0000	-0.0004
	0.0015	-0.0012	0.0005	0.0002	-0.0017	-0.0001	0.0005	-0.0002
	0.0006	0.0014	0.0010	0.0002	-0.0003	0.0001	-0.0006	-0.0010
	0.0001	0.0003	0.0003	-0.0001	-0.0004	-0.0002	-0.0001	-0.0001
Average Absorbance	0.000	0.000	0.001	0.000	-0.001	0.000	0.000	-0.001
Standard Deviation	0.0005	0.0008	0.0004	0.0007	0.0005	0.0004	0.0005	0.0004

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## 2. Precision

Element	Conc. (mg/l)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0074	0.0062	0.0065	0.0062	0.0070	0.0068	0.0070	0.0065	0.0065	0.0069	0.007	0.0004	5.76
	0.30	0.0952	0.0959	0.0951	0.0957	0.0952	0.0950	0.0952	0.0948	0.0956	0.0943	0.095	0.0005	0.49
	0.70	0.2213	0.2180	0.2203	0.2208	0.2234	0.2211	0.2196	0.2219	0.2201	0.2194	0.221	0.0015	0.67
Cr	0.10	0.0096	0.0098	0.0097	0.0102	0.0106	0.0097	0.0098	0.0099	0.0103	0.0093	0.010	0.0004	3.83
	0.30	0.0309	0.0302	0.0300	0.0316	0.0306	0.0299	0.0309	0.0297	0.0311	0.0296	0.030	0.0007	2.20
	0.70	0.0659	0.0667	0.0664	0.0648	0.0656	0.0662	0.0658	0.0638	0.0638	0.0669	0.066	0.0011	1.70
Cu	0.05	0.0080	0.0075	0.0078	0.0075	0.0077	0.0081	0.0080	0.0075	0.0074	0.0076	0.008	0.0003	3.26
	0.30	0.0417	0.0419	0.0412	0.0421	0.0424	0.0420	0.0423	0.0403	0.0418	0.0415	0.042	0.0006	1.47
	0.70	0.0969	0.0965	0.0972	0.0957	0.0961	0.0958	0.0961	0.0963	0.0959	0.0972	0.096	0.0006	0.58
Fe	0.10	0.0090	0.0105	0.0078	0.0099	0.0091	0.0093	0.0096	0.0094	0.0093	0.0084	0.009	0.0007	8.11
	0.50	0.0462	0.0470	0.0464	0.0464	0.0467	0.0462	0.0467	0.0460	0.0468	0.0466	0.047	0.0003	0.67
	1.00	0.0867	0.0886	0.0910	0.0892	0.0897	0.0873	0.0892	0.0885	0.0888	0.0874	0.089	0.0013	1.43
Pb	0.20	0.0091	0.0095	0.0088	0.0087	0.0082	0.0094	0.0090	0.0087	0.0082	0.0090	0.009	0.0004	4.94
	0.70	0.0322	0.0321	0.0324	0.0318	0.0335	0.0326	0.0327	0.0315	0.0336	0.0321	0.032	0.0007	2.09
	1.50	0.0653	0.0645	0.0663	0.0664	0.0652	0.0671	0.0662	0.0666	0.0657	0.0648	0.066	0.0008	1.28
Mn	0.05	0.0092	0.0092	0.0097	0.0087	0.0085	0.0079	0.0096	0.0085	0.0084	0.0099	0.009	0.0007	7.33
	0.30	0.0616	0.0630	0.0632	0.0633	0.0634	0.0628	0.0640	0.0633	0.0640	0.0629	0.063	0.0007	1.08
	0.70	0.1396	0.1366	0.1386	0.1377	0.1386	0.1386	0.1396	0.1380	0.1374	0.1383	0.138	0.0009	0.67
Ni	0.10	0.0102	0.0092	0.0097	0.0104	0.0091	0.0105	0.0105	0.0095	0.0098	0.0102	0.010	0.0005	5.22
	0.50	0.0488	0.0489	0.0489	0.0495	0.0484	0.0490	0.0481	0.0492	0.0495	0.0492	0.049	0.0004	0.91
	1.00	0.0976	0.0979	0.0975	0.0992	0.0977	0.0973	0.0986	0.0962	0.0985	0.0982	0.098	0.0008	0.85
Zn	0.05	0.0340	0.0349	0.0340	0.0352	0.0337	0.0351	0.0344	0.0346	0.0349	0.0343	0.035	0.0005	1.49
	0.30	0.1669	0.1653	0.1628	0.1642	0.1657	0.1637	0.1659	0.1652	0.1654	0.1657	0.165	0.0012	0.72
	0.70	0.3456	0.3467	0.3405	0.3430	0.3422	0.3444	0.3437	0.3438	0.3435	0.3438	0.344	0.0013	0.37

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## 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	0.02004	0.019	-0.001	5.19	± 0.004
	0.30060	0.291	-0.010	3.19	± 0.006
	0.70140	0.678	-0.023	3.34	± 0.012

## 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	0.1002	0.101	0.001	0.80	± 0.007
	0.3006	0.298	-0.003	0.86	± 0.012
	0.7014	0.635	-0.066	9.47	± 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	0.0502	0.046	-0.004	8.37	± 0.004
	0.3012	0.295	-0.006	2.06	± 0.010
	0.7028	0.694	-0.009	1.25	± 0.021

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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	0.1003	0.106	0.006	5.68	± 0.008
	0.5015	0.522	0.021	4.09	± 0.017
	1.0030	0.993	-0.010	1.00	± 0.032

## 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	0.1988	0.197	-0.002	0.91	± 0.014
	0.6958	0.722	0.026	3.77	± 0.022
	1.4910	1.463	-0.028	1.88	± 0.041

## 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	0.04955	0.054	0.004	8.98	± 0.004
	0.29730	0.317	0.0197	6.63	± 0.006
	0.69370	0.682	-0.0117	1.69	± 0.012

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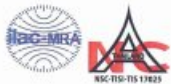
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Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
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Office/Laboratory  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail: mtg@tistr.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail: sumalee@tistr.or.th

เอกสารไม่ควบคุม

SPC Calibration Center

  
Part of DKSH Group


## Certificate of Calibration

Equipment: CONDUCTIVITY METER  
Model: Lab855  
Serial No. (or ID.): 16300356  
Manufacturer: SI Analytics  
Electrode Serial No. 16070067  
Condition: In Condition

Certificate No.: C24220084  
Issued Date: 22 March 2022  
Job No.: KSPR2203267  
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, SPC RT Co., Ltd.  
1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,  
Bangchak, Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Wasan Nuchanee  
Calibration Date: 22 March 2022  
The Method used: In house method, SPCC-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. 794135, 794136, 776264

(Mr. Wasan Nuchanee)

Person in charge

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 SPC RT Co., Ltd.

  
บริษัท เอสพีซี อาร์ที จำกัด  
SPC RT Co., Ltd.
(Mr. Dumrong Boonsopon)  
Authorized signatory

เอกสารไม่ควบคุม

SPCC-FM-C24-06: 23 Nov 2020



Request No. 25-65 / 0398

5 / 5

MTC. ACL. No. 486 / 65

## 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	0.099	0.102	0.003	3.03	± 0.007
	0.495	0.489	-0.006	1.21	± 0.010
	0.990	0.975	-0.015	1.52	± 0.020

## 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	0.050	0.000	0.00	± 0.012
	0.300	0.307	0.007	2.33	± 0.011
	0.700	0.660	-0.040	5.71	± 0.015

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

Calibrated by:   
(Mr. Danai Srihongkum)

Approved by:   
(Mrs. Thippaya Junvee Fortune)  
Director of Analytical Chemistry Laboratory  
Calibration date : 3 February 2022

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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SPC Calibration Center

  
Part of DKSH Group

Certificate No.: C24220084

Page: 2 of 2

## Calibration Results:

## Before Adjustment

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	25.9 µS/cm	-0.900 µS/cm	2.00	0.22 µS/cm
1413.0 µS/cm	1444 µS/cm	-31.0 µS/cm	2.00	8.9 µS/cm
111.3 mS/cm	107.9 mS/cm	3.40 mS/cm	2.00	0.66 mS/cm

## After Adjustment ; at 1413 µS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	25.0 µS/cm	0.000 µS/cm	2.00	0.22 µS/cm
1413.0 µS/cm	1413 µS/cm	0.0 µS/cm	2.00	8.9 µS/cm
111.3 mS/cm	107.2 mS/cm	4.10 mS/cm	2.00	0.66 mS/cm

The End of Certificate

เอกสารไม่ควบคุม

SPCC-FM-C24-06: 23 Nov 2020

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2203267

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ตั้ง)		หมายเหตุ
22 Mar 2022			22 Mar 2022		
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 ( ของใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิทช์ ปิด - เปิด 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. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (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. แสงอัลตราไวโอเล็ต (UV < 3,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็น (Visible < 5,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (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. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ฐานอิเล็กโทรด (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. ระดับการส่องสว่างของแสง (>= 2.5 ไมล์ 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ 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"/>	ระบบจ่ายยาและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ: Electrode วัดอุณหภูมิได้ 24.9 °C โดย Control Waterbath ที่ 25.0 ±0.1 °C

Mr. Wasan Nuchabae

Service Engineer

เอกสารไม่ควบคุม

SPCC-FM-R31-02: 23 Nov 2020

บริษัท เอสพี ซีจี จำกัด  
SPC PT CO., LTD.  
สาขาที่ 00003 : 1154 ซอยสุขุมวิทซอย 37 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
Branch 00003 : 1154 Soi Sukhumvit 37, Sukhumvit 37/1 Road, Bangkok, Prakhong, Bangkok 10260 Thailand  
Tel : 0 2165 4333 Ext. 3330-3339 Fax : 0 2165 4424 E-mail : info.spc@spcc.com Website : www.spcc.com



National Food Institute, Ministry of Industry, Thailand

2008 Soi 36, Aun Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand  
Tel : +66 (0) 2-422 8688 Fax : +66 (0) 2-422 8558 Website : www.nfi.or.th E-mail : cal@nfi.or.th



## Calibration Certificate

Certificate No.: 2201793-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udumsuk 41, Sukhumvit Road, Bangchack, Prakhong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter  
Manufacturer: METTLER TOLEDO  
Model: SevenEasy pH  
Serial No.: 1231155210  
ID No.: UAE.WAT.010/2553  
Order No.: 2201793  
Operation No.: 2201793-001  
Date of Receipt: 21 February 2022  
Date of Calibration: 1 March 2022

Calibrated by Mr. Pheraphat Tuanjit Scientist  
Approved by (Mr. Nutapol Niyomchart) (Signature)  
Specialist, Division of Measurement Laboratory  
Responsible for the Technical Management Team  
Date of Issue: 1 March 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 capability to recognize 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: 00 Date: 14-12-61

เอกสารไม่ควบคุม



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## Calibration Report

Certificate No.: 2201793-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: METTLER TOLEDO  
Model: SevenEasy pH  
Serial No.: 1231155210  
Type: Bench top  
ID No.: UAE.WAT.010/2553  
Date of Calibration: 1 March 2022  
Location: Chemical Calibration Laboratory, NATIONAL FOOD INSTITUTE  
Ambient Temperature: ( 23.5 ± 0.5 ) °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  
2.1 DC Voltage Calibrator  
2.2 Digital Thermometer  
2.3 Thermo-Hygro Meter  
Certified Reference Material  
2.4 pH buffer 4.008 (Primary pH buffer Solution)  
2.5 pH buffer 6.865 (Primary pH buffer Solution)  
2.6 pH buffer 10.01 (Primary pH buffer Solution)  
2.7 pH buffer 7.00 (Standard pH buffer Solution)  
3. This certification is traceable to The International System of Unit (SI Unit)  
3.1 Instruments No.2.1  
3.2 Instruments No.2.2  
3.3 Instruments No.2.3  
3.4 Certified Reference Material No. 2.4 to 2.6  
3.5 Certified Reference Material No. 2.7  
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.

(Signature)  
1 March 2022

เอกสารไม่ควบคุม

F-CS-012 Revision: 00 Date: 14-12-61

## Calibration Report

Certificate No.: 2201793-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: METTLER TOLEDO  
Model: SevenEasy pH  
Serial No.: 1231155210  
Type: Bench top  
ID No.: UAE.WAT.010/2553  
Date of Calibration: 1 March 2022  
Calibration Results:  
1. Calibration of pH Meter  
( Manual Temperature Compensation at 25 °C )  
2. Calibration of pH Meter with Electrode  
( Manual Temperature Compensation at 25 °C )  
Equipment: pH Electrode  
Manufacturer: METTLER TOLEDO  
Serial No.: 1156882  
Type: Combined Electrode  
Model: InLabSolve  
ID No. N/A  
Performance of Electrode system  
(Three-Point Calibration at pH4, pH7 and pH10)  
Table 1: Nominal pH vs DC Voltage Standard (mV) vs Average Indicator Reading (mV) vs Uncertainty (± mV) vs Coverage Factor (k)  
Table 2: Certified Value (pH) vs Average Indicator Reading (pH) vs Relative Slope (%) vs Uncertainty (± pH) vs Coverage Factor (k)

(Signature)  
1 March 2022

เอกสารไม่ควบคุม

F-CS-012 Revision: 00 Date: 14-12-61



## Calibration Report

Certificate No.: 2201793-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: SevenEasy pH  
Serial No.: 1231156210 ID No.: UAE.WAT.0102553  
Manufacturer: METTLER TOLEDO  
Date of Calibration: 1 March 2022 Page 4 of 5

Location: Chemical Calibration Laboratory, NATIONAL FOOD INSTITUTE  
Environment Condition: Ambient Temperature 24 °C ± 1 °C  
Relative Humidity 55 % ± 2 %

### 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	1523	2118154	PSL-T 0851/64	03-Jun-22	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

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

- 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.

### 6. Condition of Calibrated item :

Good

### 7. Result of Calibration :

☒ Without adjustment

☐ After adjustment

F-CS-012 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม

## Calibration Report

Certificate No.: 2201793-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: SevenEasy pH  
Serial No.: 1231156210 ID No.: UAE.WAT.0102553  
Manufacturer: METTLER TOLEDO  
Date of Calibration: 1 March 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 100 mm.
- Description of probe, model : N/A SN : N/A
- Dimension of probe : Diameter 4 mm., Length 100 mm.,
- Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.006	-0.1	0.009
25.1	25.004	-0.1	0.009
35.1	35.003	-0.1	0.009

### 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: 00 Date: 14-12-61

เอกสารไม่ควบคุม

## Calibration Certificate

Certificate No.: 2202097-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address: 3 Soi Udomauk 41, Sukhumvit Road, Bangchack, Prakhonong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter  
Manufacturer: HANNA INSTRUMENTS  
Model: HI 2211  
Serial No.: 08165345  
ID No.: UAE.WAT.0042556

Order No.: 2202097  
Operation No.: 2202097-001  
Date of Receipt: 11 March 2022  
Date of Calibration: 16 March 2022

Calibrated by Mr.Manas Somsak Specialist Approved by (Mr.Pheraphat Tuanjit) Manager, Division of Calibration Laboratory  
Date of Issue: 21 March 2022 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: 00 Date: 14-12-61

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## Calibration Report

Certificate No.: 2202097-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 0.1 mV  
Manufacturer: HANNA INSTRUMENTS Model: HI 2211  
Serial No.: 08165345 Type: Bench top  
ID No.: UAE.WAT.0042556

Date of Calibration: 16 March 2022 Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute  
Environment Condition: Ambient Temperature: ( 23.0 ± 1.5 ) °C Relative Humidity: ( 49.5 ± 5 ) %  
Condition of Equipment: Good Condition

### Condition of this Results of Calibration

- Calibration Method : In house method : W-CC-052 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)
- Reference Standards / Certified Reference Material

Instrument	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fuke	SCL-21F-0987	24 June 2022
2.2 Digital Thermometer	2709007	Fuke	CC-640599-01	30 October 2022
2.3 Thermo-Hygro Meter	ana.41.BTH.00558	PONPE	QR21-2787	15 November 2022

Certified Reference Material	Lot No.	Manufacturer	Ref. N	Expiry Date
2.4 pH buffer 4.006 (Primary pH buffer Solution)	790012	CPAchem	PH216.L5	21 November 2023
2.5 pH buffer 6.865 (Primary pH buffer Solution)	790013	CPAchem	PH217.L5	21 November 2023
2.6 pH buffer 10.01 (Primary pH buffer Solution)	790015	CPAchem	PH220.L5	21 November 2022
2.7 pH buffer 7.00 (Standard pH buffer Solution)	776840	CPAchem	PH107.L5	8 November 2022

- The certification is traceable to The International System of Unit (SI Unit)
  - Instruments No.2.1 through NSG-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0075
  - Instruments No.2.2 through NSG-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
  - Instruments No.2.3 through NSG-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0292
  - Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Hanna Ltd. using calibrated thermometer, barometer, and rainoutmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
  - Certified Reference Material No. 2.7 traceable to BSM RefN HI-7 Loth 30.04.2020; BSM RefN HI-9 Loth 28.05.2020; BSM RefN HI-8 Loth 30.04.2020; BSM RefN HI-10 Loth 28.05.2020. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

- This certificate was certified only for the instrument we calibrated.
- The result of calibration was found accurate as shown on date and place of calibration only.

F-CS-012 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม



## Calibration Report

Certificate No.: 2202097-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 0.1 mV  
Manufacturer: HANNA INSTRUMENTS Model: HI 2211  
Serial No.: 08165345 Type: Benchtop  
ID No.: UAE.WAT.0042556  
Date of Calibration: 16 March 2022 Page 3 of 5

### Calibration Results:

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (mV)	Coverage Factor (k)
		mV	pH		
0	414.117	414	0.00	0.58	2.00
3	295.611	295.7	3.00	0.063	2.00
4	177.462	177.4	4.00	0.063	2.00
6	55.159	55.2	6.00	0.063	2.00
7	-0.001	0.1	7.00	0.063	2.00
8	-59.159	-59.1	8.00	0.063	2.00
10	-177.463	-177.3	10.00	0.063	2.00
12	-295.612	-295.6	12.00	0.063	2.00
14	-414.115	-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: LE420  
Serial No.: 1142902 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	4.01	180.5	99.3	0.0071	2.00
6.899	6.87	12.5	-	0.0074	2.00
10.015	10.01	-171.5	99.1	0.0060	2.00
6.993	6.98	5.2	-	0.0062	2.00

F-CS-012 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม

## Calibration Report

Certificate No.: 2202097-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: HI 2211  
Serial No.: 08165345 ID No.: UAE.WAT.0042556  
Manufacturer: HANNA INSTRUMENTS  
Date of Calibration: 16 March 2022 Page 4 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature ( 23.0 ± 1.0 ) °C  
Relative Humidity ( 50 ± 4 ) %

### Condition of this results of Calibration:

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

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0851/64	24-Jun-22	TSTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (SOCAL-6), Model: Europa-6 Plus Basic, S/N: 3410522

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

F-CS-012 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม

## Calibration Report

Certificate No.: 2202097-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: HI 2211  
Serial No.: 08165345 ID No.: UAE.WAT.0042556  
Manufacturer: HANNA INSTRUMENTS  
Date of Calibration: 16 March 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 100 mm.

- Description of probe, model : N/A S/N : N/A

Dimension of probe : Diameter 3.5 mm, Length 100 mm,

Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.0	15.001	0.0	0.099
25.0	25.002	0.0	0.099
35.0	35.002	0.0	0.099

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: 00 Date: 14-12-61

เอกสารไม่ควบคุม

## Calibration Certificate

Certificate No.: 2203120-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonong, Bangkok 10260

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: AB204-S/FACT

Serial No.: 1129361010

ID No.: UAE.WAS.002/2552

Order No.: 2203120

Operation No.: 2203120-001

Date of Receipt: 1 June 2022

Date of Calibration: 1 June 2022

Calibrated by Mr.Taveesak Seilee  
Scientist

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

The uncertainties are for a confidence probability of approximately 95%

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

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

เอกสารไม่ควบคุม

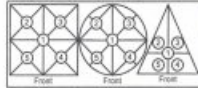






Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2204-0542OC-1

Cert.No.: 22MM210  
Page: 3 of 3



Maximum difference between off-center and central loading (g)  
0.0002

### 3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.016	2.13
0.05	0.05001	-0.00001	0.016	2.13
0.1	0.10001	-0.00001	0.017	2.11
1	1.00002	-0.00002	0.019	2.05
5	5.00003	-0.00003	0.026	2.00
20	20.00008	-0.00008	0.049	2.00
50	50.00010	-0.00010	0.080	2.00
80	80.00014	-0.00014	0.15	2.00
100	100.0001	-0.0001	0.21	2.00
150	150.0001	-0.0001	0.29	2.00
200	200.0001	-0.0001	0.35	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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
554/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-4844



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 Sol 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 Hiahb

Approved by :   
Approved Signatory

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

Issue Date : 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0046800



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0575OC-1

Cert. No.: 22TM1490  
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 ) 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.

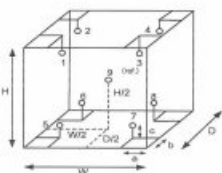
3. This certification is traceable to the International System of Unit.

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



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 m³

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

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เอกสารไม่ควบคุม

a 1133252



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0575OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM1490  
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
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

Calibration Point ( °C )	Measured Temperature ( °C )								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.287	178.643	179.753	181.011	180.093	179.496	179.743	181.278

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

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

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation UUC\* : Unit Under Calibration

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

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

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เอกสารไม่ควบคุม

a 1133251







Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2205-0003OC-3  
Procedure Used :-

Cert. No.: 22TM672  
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	34970A	MY44067817	21LM10	20 Jul 2022

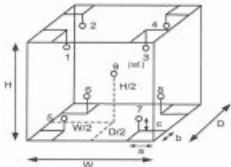
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 = 5.0 cm  
b = 5.0 cm  
c = 5.0 cm  
Dimension of Chamber :  
D = 0.50 m  
W = 0.60 m  
H = 0.80 m  
Capacity = 0.24 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	23
REL.Humid. ( % )	62	57
AC Supply ( Volt )	221	221

Position :	Ref. Std. ID No.:
1	19-15RTD-01
2	19-15RTD-02
3	19-15RTD-03
4	19-15RTD-04
5	19-15RTD-05
6	21-15RTD-06
7	19-15RTD-07
8	19-15RTD-08
9 (ref.)	19-15RTD-09

เอกสารไม่ควบคุม



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2205-0003OC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 22TM672  
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
25.0	25.0	25.0	0.021	0.18	0.33	0.30	2
36.0	36.0	36.0	0.077	0.96	1.8	0.33	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
25.0	1	2	3	4	5	6	7	8	9 (ref.)
25.0	25.221	25.146	25.127	25.113	24.968	24.986	24.933	25.017	25.047
36.0	35.637	35.238	36.130	36.515	36.928	36.845	36.630	36.761	36.113

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 & 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.: 22TM333  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 14  
Serial No. : L416.0606  
ID No. : UAE.MIC.002/2560  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Sol Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory  
Received Order : 17 February 2022  
Calibration Date : 17 February 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Suwit Imjai  
Approved by :  
( / ) Ponthippa Tameyakul  
( / ) Malee Butkruea  
Issue Date : 22 February 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.

เอกสารไม่ควบคุม



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2202-0444OC-3  
Procedure Used :-

Cert. No.: 22TM333  
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	34970A	MY44067817	21LM10	20 Jul 2022

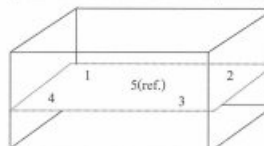
2. This certificate is valid only to the item calibrated on date and place of calibration.

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	21	65	229
Finished of Calibration	22	58	230



Front

Position :	Ref. Std. ID No.:
1	70RC143
2	70RC144
3	70RC145
4	70RC146
5(ref.)	70RC147

เอกสารไม่ควบคุม





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2202-0444OC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM333  
Page.: 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.498	44.491	44.482	44.518	44.534

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.13	0.057	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 & 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.: 22TM334  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 14  
Serial No. : L416.0812  
ID No. : UAE.MIC.003/2560  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udonsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory  
Received Order : 17 February 2022  
Calibration Date : 17 February 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Suwit Imjai

Approved by :   
Approved Signatory

( / ) Pomsippa Tameyakul  
( / ) Malee Butkruea

Issue Date : 22 February 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.

เอกสารไม่ควบคุม

A 0038095



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2202-0444OC-4  
Procedure Used :-

Cert. No.: 22TM334  
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	34970A	MY44067817	21LM10	20 Jul 2022

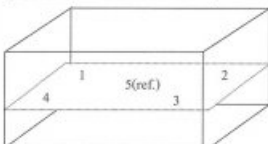
2. This certificate is valid only to the item calibrated on date and place of calibration.

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	21	65	229
Finished of Calibration	22	57	230



Front

Position :	Ref. Std. ID No.:
1	70RC143
2	70RC144
3	70RC145
4	70RC146
5 (ref.)	70RC147

เอกสารไม่ควบคุม

a 1096055



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2202-0444OC-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM334  
Page.: 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.572	44.514	44.507	44.530	44.585

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.10	0.042	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

a 1096054



Mettler-Toledo (Thailand) Ltd.  
848/4 - 848/5 Lassaie Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH.ServiceSupport@mt.com



## Accuracy Calibration Certificate

### Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Prata Khanong Contact: Suret Chotnok  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number: 

### Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument  
Model: MS603S/01 Asset Number: UAE.MTC.0062553  
Serial No.: B007010311 Terminal Model: N/A  
Building: N/A Terminal Serial No.: N/A  
Floor: 2 Terminal Asset No.: N/A  
Room: Balance Room (206)

Range	Max. Capacity	Readability (d)
1	620 g	0.001 g

### Procedure

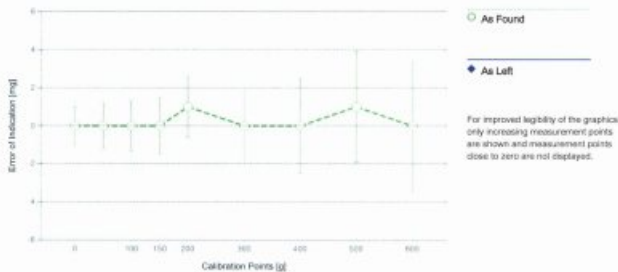
Calibration Guideline: EURAMET cg-16 v. 4.0 (11/2015)  
METTLER TOLEDO Work Instruction: CPW002/20  
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.  
The sensitivity span of the weighing instrument was adjusted before calibration with a built-in weight.  
In accordance with EURAMET cg-16 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature	Humidity
As Found	Start: 22.8 °C End: 23.0 °C	Start: 49.9 % End: 58.3 %

As Found Calibration Date: 07-Apr-2022 Calibrator:   
As Left Calibration Date: N/A  
Issue Date: 08-Apr-2022  
Approved Signatory:   
☒ Katsakorn Tassanacharsakul  
☐ Santi Jitnirorn  
☐ Sureshwar Sukkate

### Error of Indication

As Found	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.000 g	0.000 g	0.000 g	1.0 mg	2
2	0.500 g	0.500 g	0.000 g	1.2 mg	2
3	1.000 g	1.000 g	0.000 g	1.2 mg	2
4	50.000 g	50.000 g	0.000 g	1.2 mg	2
5	100.000 g	100.000 g	0.000 g	1.3 mg	2
6	150.000 g	150.000 g	0.000 g	1.5 mg	2
7	200.000 g	200.001 g	0.001 g	1.6 mg	2
8	300.001 g	300.001 g	0.000 g	2.0 mg	2
9	400.001 g	400.001 g	0.000 g	2.5 mg	2
10	500.001 g	500.002 g	0.001 g	2.9 mg	2
11	600.001 g	600.001 g	0.000 g	3.4 mg	2



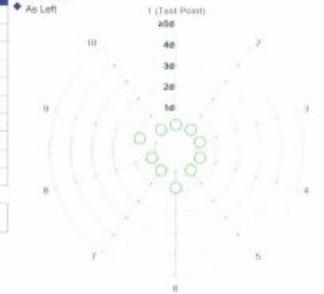
The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-16. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

## Measurement Results

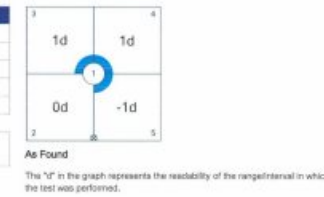
### Repeatability

Test Load: 200 g	As Found	As Left
1	200.001 g	N/A
2	200.001 g	N/A
3	200.001 g	N/A
4	200.001 g	N/A
5	200.001 g	N/A
6	200.000 g	N/A
7	200.001 g	N/A
8	200.001 g	N/A
9	200.000 g	N/A
10	200.001 g	N/A
Standard Deviation	0.0004 g	N/A



### Eccentricity

Test Load: 200 g	Position	As Found	As Left
1	1	200.001 g	N/A
2	2	200.001 g	N/A
3	3	200.002 g	N/A
4	4	200.002 g	N/A
5	5	200.000 g	N/A
Maximum Deviation		0.001 g	N/A



### Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

<b>Weight Set 1: OIML F1</b>		
Weight Set No.:	WS55	Date of Issue:
Certificate Number:	CCM-0137-21-C	Calibration Due Date:
<b>Weight Set 2: OIML E2</b>		
Weight Set No.:	WS80	Date of Issue:
Certificate Number:	C208581631	Calibration Due Date:
<b>Thermo Hygrometer</b>		
Equipment No.:	IN161	Date of Issue:
Certificate Number:	21H1220	Calibration Due Date:

### Remarks

FACT adjustment functionality activated  
Equipment condition: Good  
Next calibration according to customer's procedure  
Calibration date not decide by calibration laboratory

### End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with  $k=2$  in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / K$   
Temperature range on site for the evaluation of the measurement uncertainty in use:  $3 K$

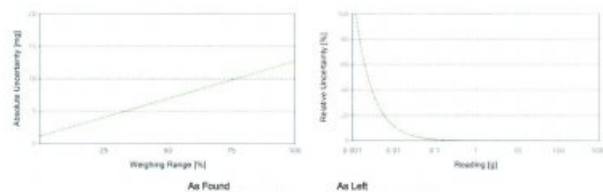
Linearization of Uncertainty Equation

Range	Max	As Found	As Left
1	0.001 g	520 g	
		$U_1 = 1.2 \text{ mg} + 0.0185 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found	As Left
0.002 g	1.2 mg	1.9%
0.020 g	1.2 mg	0.20%
0.200 g	1.3 mg	0.031%
0.200 g	2.4 mg	0.0038%
0.200 g	13 mg	0.0021%



เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-3000-27 FAX: 0-2719-9484



Cert. No.: 22TM681  
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 May 2022  
Calibration Date : 27 May 2022  
Ambient Temperature :  $(26 \pm 10) ^\circ C$   
Relative Humidity :  $(50 \pm 30) \%$   
Calibrated by : Preecha Hiahit  
Approved by :   
( ) Ponthippa Tameyakul  
( ) Malee Butkrues  
( ) Suwit Injai

Issue Date : 2 June 2022

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2205-0764OC-2  
Procedure Used :-

Cert. No.: 22TM681  
Page.: 2 of 3

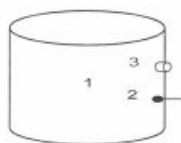
Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T  
The temperature scale used was based on ITS-90.

Condition of this result of calibration

- Reference standard instrument:-
- 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	56	220
Finished of Calibration	27	59	221

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

เอกสารไม่ควบคุม



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2205-0764OC-2  
Result of Calibration :- ( \* ) Without Adjustment

Cert. No.: 22TM681  
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	115.553	0.4	0.08	0.82	2
		2	115.582				
		3	115.325				

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
121.0	121.0	1	121.484	0.21	1.1	0.75	2
		2	121.581				
		3	121.311				

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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เอกสารไม่ควบคุม

## 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
<b>Ambient</b>									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Tisch Environmental, Inc.	TE-5025A 3540	Jiranatee Associates Co., Ltd.	CL-011-65	31 Oct 22	30 Oct 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)	23P1403	9 May 23	8 May 24	-
3	Mass Flow Meter	BTEXs	Alicat Scientific, Inc.	MB-5SCCM-D/5M 57730	Miracle International Technology Co., Ltd.	L202210260-001	5 Nov 22	4 Nov 23	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) BTEXs	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1855	2 Jun 23	1 Jun 24	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) BTEXs	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1200	5 Jun 23	5 Jun 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387036	UAE Consultant Co., Ltd.	22032023	22 Mar 23	21 Mar 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387038	UAE Consultant Co., Ltd.	28032023	28 Mar 23	27 Mar 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-62236-334	UAE Consultant Co., Ltd.	03052023	3 May 23	2 May 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-76465-383	UAE Consultant Co., Ltd.	25042023	25 Apr 23	24 Apr 24	-
11	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-



## List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
12	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1182920019	UAE Consultant Co.,Ltd.	03042023	3 Apr 23	2 Apr 24	-
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1182920020	UAE Consultant Co.,Ltd.	21022023	21 Feb 23	20 Feb 24	-
14	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
15	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0116	Thai Meteorological Department	164/23	17 Apr 23	16 Apr 24	-
16	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2301DR0024	Thai Meteorological Department	176/23	10 Apr 23	9 Apr 24	-

## List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Water</b>									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0078	Technology Promotion Association (Thailand-Japan)	23CH281	1 Mar 23	28 Feb 24	-
2	Conductivity Meter	Conductivity	YSI	Pro30 17B101802	Technology Promotion Association (Thailand-Japan)	23CH809	27 Jun 23	26 Jun 24	-

## List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Workplace</b>									
1	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	SvanteK	SV35A 73249	Innovative Instrument Co.,Ltd.	23-ACT-111	27 Jun 23	26 Jun 24	-
2	Noise Dosimeter	Noise Dosimeter	SvanteK	SV 104 91923	Innovative Instrument Co.,Ltd.	23-NDM-012	24 Jan 23	23 Jan 24	-
3	Noise Dosimeter	Noise Dosimeter	SvanteK	SV 104 91924	Innovative Instrument Co.,Ltd.	23-NDM-010	24 Jan 23	23 Jan 24	-
4	Noise Dosimeter	Noise Dosimeter	SvanteK	SV 104 117689	Innovative Instrument Co.,Ltd.	23-NDM-129	25 May 23	24 May 24	-
5	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ , $L_{Amax}$	Rion, Japan	NL-42 01010785	Sithiporn Associates Co., Ltd.	ACL23181	8 Jun 23	7 Jun 24	-
6	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ , $L_{Amax}$	Rion, Japan	NL-42 00709656	Sithiporn Associates Co., Ltd.	ACL23132	26 Apr 23	25 Apr 24	-
7	Thermal Environment Monitor	Heat Meter	3M	QuesTemp 32 TPS030007	Innovative Instrument Co.,Ltd.	23-TPM-052	25 Jan 23	24 Jan 24	-
8	Thermal Environment Monitor	Heat Meter	3M	QuesTemp 32 TPS030005	Innovative Instrument Co.,Ltd.	23-TPM-050	25 Jan 23	24 Jan 24	-
9	Thermal Environment Monitor	Heat Meter	TSI QUEST	QuesTemp 32 TPW020005	Innovative Instrument Co.,Ltd.	23-TPM-193	3 Apr 23	2 Apr 24	-
10	Thermal Environment Monitor	Heat Meter	Quest Technologies, Inc	QuesTemp 34 TEB060015	Innovative Instrument Co.,Ltd.	23-TPM-371	7 Aug 23	6 Aug 24	-



## CERTIFICATE OF CALIBRATION

Certificate No. : CL-003-65

Page 1 of 2 Pages

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

: Top Load Office  
: Tach Environmental, Inc.  
: TE-5025A  
: 3185  
: UAE.FPM.063/2560  
: Used Item  
: United Analyst and Engineering Consultant Co., Ltd.  
: 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,  
: Bangkok 10260

**RECEIVED DATE**  
**MEASUREMENT DATE**  
**ISSUE DATE**

: 15 Jul 2022  
: 25 Jul 2022  
: 26 Jul 2022

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH  
Atmospheric Pressure :  $1010 \pm 5.0$  hPa

### CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.  
Measurement Condition : The average values during measurement are 24.8 °C and 55.1 %RH.

### TABULATION OF RESULTS:

The table on next page give the measured values.

**Calibration procedure:**  
The Office gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model GGS/MC/W2-2p. The WGL-004 was used as a calibration guideline.

**Traceability:**  
This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: 0222381.

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

Calibrated by:  
☐ Mr. Suwatt Thachalad  
☐ Miss Jiraporn Lertsomphol



Approved signatory:  
Mr. Pinyai Booncharoen  
Calibration Department Manager

## MULTI-POINT GAS TEST REPORT

**Test Date** : Mar 1, 2023

**Equipment** : Gas Analyzer (SO<sub>2</sub>)  
**Manufacturer** : Thermo SCIENTIFIC  
**Model** : 43i  
**Serial Number** : 1182920014

### 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

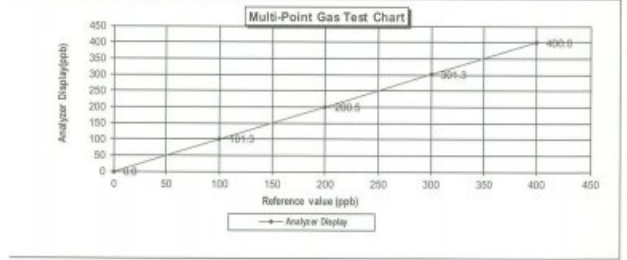
### Diluter Detail

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	0.00	0.00	0.00
Level 2	20.00%	100.0	1.30	1.28	1.28
Level 3	40.00%	200.0	0.50	0.25	0.25
Level 4	60.00%	300.0	1.30	0.43	0.43
Level 5	80.00%	400.0	0.00	0.00	0.00

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



Calculate by  
Srinuan Sangsri  
11/3/2023

Approve by  
Pinyai Booncharoen  
11/3/2023

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

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Page 1 of 1

เอกสารไม่ควบคุม

Continuation of Certificate of Calibration Number CL-003-65

Page 2 of 2 Pages

### MEASUREMENT RESULTS:

The Office gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The humid air was used as a medium in the system. The standard conditions are 25 °C (78.15 °F) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of Q Standard calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Ap_meter mmHg	Ap_Office inH <sub>2</sub> O	F	Standard Flow [Qs] m <sup>3</sup> /min
1	0.697	754.265	24.640	23.960	55.399	1.699	1.299	0.643
2	1.000	754.236	24.950	24.350	62.172	3.444	1.849	0.913
3	1.118	754.323	24.730	24.210	41.925	4.582	2.153	1.051
4	1.169	754.212	24.640	24.100	31.045	5.150	2.262	1.116
5	1.416	754.175	24.680	24.210	30.117	7.629	2.754	1.353

Slope (a): 2.04804  
Intercept (b): -0.01939  
Correlation coefficient (r): 0.99982  
Uncertainty (u=2): 0.011 m<sup>3</sup>/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Ap_meter mmHg	Ap_Office inH <sub>2</sub> O	F	Standard Flow [Qs] m <sup>3</sup> /min
1	0.697	754.265	24.640	23.960	55.399	1.699	0.819	0.647
2	1.000	754.236	24.950	24.350	62.172	3.444	1.167	0.919
3	1.118	754.323	24.730	24.210	41.925	4.582	1.345	1.058
4	1.169	754.212	24.640	24.100	31.045	5.150	1.426	1.123
5	1.416	754.175	24.680	24.210	30.117	7.629	1.735	1.361

Slope (a): 1.28277  
Intercept (b): -0.01223  
Correlation coefficient (r): 0.99982  
Uncertainty (u=2): 0.012 m<sup>3</sup>/min

\*\*\*End of Certificate of Calibration\*\*\*



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

## Certificate of Calibration

Certificate No. : 23P1398  
Page : 1 of 2

**Equipment** : U Tube Manometer

**Manufacturer** : Dwyer

**Model** : 1221-36-W/M

**Serial No.** : -

**ID No.** : UAE.EMA2.095/2555

**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

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

**Procedure used** : The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-PO4, 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 requested at the point specified by customer.

3. Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

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

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

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

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

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

- National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussamee  
Issue Date : 11 May 2023

Approved Signatory : Atkapol P.  
[ ] Phatinee Pratsapal  
[ ] Sura Suwannasri  
[x] Atkapol Panurach

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Cert.No.: 23P1398  
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)

UUC Indication					
Applied Pressure (inH <sub>2</sub> O)	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)	ΔP (inH <sub>2</sub> O)	Error (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	0.02	
10.00	5.00	-5.00	10.00	0.02	
12.00	6.00	-6.00	12.00	0.02	
14.00	7.00	-7.00	14.00	0.00	
16.00	8.00	-8.00	16.00	0.00	
18.00	9.00	-9.00	18.00	0.00	
20.00	10.00	-10.00	20.00	0.00	
22.00	11.00	-11.00	22.00	0.02	
24.00	12.00	-12.00	24.00	0.02	
26.00	13.00	-13.00	26.00	0.02	
28.00	14.00	-14.00	28.00	0.00	
30.00	15.00	-15.00	30.00	0.04	
32.00	16.00	-16.00	32.00	0.04	
34.00	17.00	-17.00	34.00	0.00	
35.80	17.96	-18.00	35.86	0.16	

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

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

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Atsapol P.

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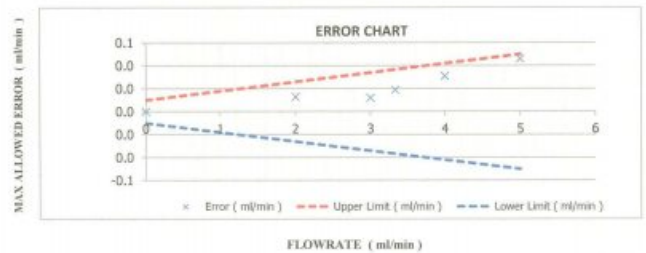
Certificate No.: L202210260-001

Environment : Ambient temperature : ( 23 ± 2 ) °C  
Relative humidity : ( 50 ± 15 ) % RH  
Capacity Range : 5 ml/min  
Calibration Media : Air  
Type : Mass Flowmeter

Unit Under Calibration Reference Condition : Pressure 101.325 kPa(abs) , 25 °C , Air					
Temperature ( °C )	Pressure ( kPa )	UUC Reading ( ml/min )	STD Reading ( ml/min )	Error ( ml/min )	Uncertainty ( ± ml/min )
25.73	101.45	0.000	0.000 *	0.000	0.063
25.37	104.90	2.001	1.988	0.013	0.068
25.12	106.63	3.001	2.989	0.012	0.11
24.66	107.15	3.330	3.311	0.019	0.12
24.23	108.36	4.001	3.970	0.031	0.14
24.17	110.09	5.00	4.954	0.046	0.17

Error = Unit Under Calibration - Standard

Marked \* are not included in the NSC-ONSC accreditation schedule for our laboratory.



Page 2 of 3



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD.  
214 Bangwaek Rd. Bangpai Bangkok 10160  
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 http://www.mit.in.th



## CALIBRATION CERTIFICATE

Certificate No.: L202210260-001  
Date Issued : 07-Nov-22

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

Equipment : Mass Flow Meter

Manufacturer : Alicat Scientific  
Model : MB-SSCCM-D/5M  
Serial No. : 57730  
ID No./Tag No. : UAE.EMA2.169/2553  
Date Received : 31-Oct-22  
Date Calibrated : 05-Nov-22

Calibrated by : Mr. Jame Khaothong

Calibration Method or Calibration Procedure Used

In-house method : CP-34 by comparison against mass flow calibrator.

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

### Result of Calibration

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

This certificate may not be reproduced other than in full except with the prior written approval of the Miracle International Technology Company Limited.

Approved by:   
( Mr. Sarayuth Tochua )



Page 1 of 3

เอกสารไม่ควบคุม

Certificate No.: L202210260-001

Note : The actual flow rate is determined by the equation :

$$Q_{Meas} = Q_{Ref} \times \frac{P_{Ref}}{P_{Meas}} \times \frac{T_{Meas}}{T_{Ref}}$$

; Q = Flow rate  
 ; P = Absolute pressure  
 ; T = Absolute temperature  
 ; Subscript "Meas" = Measurement condition  
 ; Subscript "Ref" = Reference condition

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Traceability of Certificate :

The International System of Units (SI) through

NIMT Certificate No. MW-0013-22 for Mass Flow Calibrator (20 SCCM) Serial No. G500971G20, Due 22-Feb-24

End of Certificate

Page 3 of 3

เอกสารไม่ควบคุม





## Certificate of Calibration

Certificate No.: 23P1855  
Page: 1 of 2

Equipment: Aneroid Barometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE/ANV.122/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 02 June 2023

Reference: 2305-0919WSC

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1007 mbar

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

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

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments  
Standard according to in-house calibration procedure CP-P10, using "DKD-R 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	DPH42	1422505048	MP-0094-23	03 May 2024

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

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Sukson Khankaw  
Issue Date: 08 June 2023

Approved Signatory: *Attapol P.*  
| | Phalinee Prabpaipal  
| | Sura Suwannasri  
| | Attapol Panurach

เอกสารไม่ควบคุม  
B 0316955



## Certificate of Calibration

Certificate No.: 23H1200  
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE/ANV.130/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023

Reference: 2305-0919WSC

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

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

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

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

### Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23105	15 Mar 2024

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

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

-National Institute of Standards and Technology (NIST), The United States of America

-Technology Promotion Association (Thailand-Japan), NSO-ONSC Accredited No. Calibration 0008

Calibrated by: Somchai Dumwor  
Issue Date: 07 June 2023

Approved Signatory: *Chakrit Waewwanja*  
| | Chakrit Waewwanja  
| | Ponthippa Tameyskul  
| | Viporn Tantiyawutti

เอกสารไม่ควบคุม  
B 0316274



Cert.No.: 23P1855  
Page: 2 of 2

### Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range: 960 hPa to 1030 hPa

Scale Interval: 1 hPa ( The Fifth Estimate )

Increasing Pressure

Applied Pressure (hPa)	955.50	959.59	980.35	990.39	1001.01	1011.15	1020.94	1031.45
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	1.50	0.41	-0.35	-0.39	-1.01	-1.15	-0.94	-1.45

Decreasing Pressure

Applied Pressure (hPa)	1031.45	1021.61	1012.16	1002.38	992.17	982.20	970.69	959.32
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.45	-1.61	-2.16	-2.38	-2.17	-2.20	-0.69	0.68

The uncertainty of measurement was ± 0.30 hPa

\* UUC = Unit Under Calibration

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

-000-

Attapol P.

เอกสารไม่ควบคุม  
B 1165504



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

### Result of Calibration:-

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	48	7.9	1.6
25.0	60.0	63	3.0	1.7
25.0	80.0	76	-4.0	1.9

### Result of Calibration:-

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	44	3.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	75	-5.0	1.9

### Result of Calibration:-

Function: Temperature Measurement

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

UUC\* : Unit Under Calibration

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

-000-

*Chakrit Waewwanja*

เอกสารไม่ควบคุม  
B 1165295



**MULTI-POINT GAS TEST REPORT**

Test Date : Apr 7, 2023

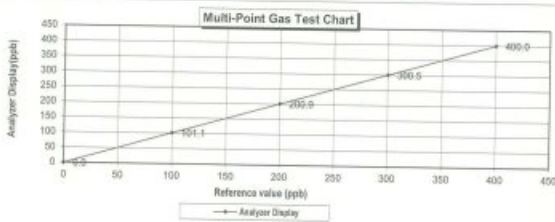
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : 1201778110

**Standard Gas Concentration**

Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Diluter Detail
Nitric Oxide (NO)	45.94	PPM	Manufacturer : Thermo Scientific
Methane (CH <sub>4</sub> )	-	PPM	Model : 146i
Carbon Monoxide (CO)	984.8	PPM	Serial Number : 1180540071
Cylinder No. :	EB0143262		
Expiration Date :	Jun 21, 2024		

**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	101.1	1.10	1.09
Level 3	40.00%	200.0	200.9	0.90	0.45
Level 4	60.00%	300.0	300.5	0.50	0.17
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.34	
Acceptable Limit $\pm 5\%$					



Calculate by  
Aphiwat K.  
21/4/23

Approve by  
Aphiwat K.  
21/4/23

เอกสารไม่ควบคุม

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

Part Number: E04N09E15A0103 Reference Number: 122-492136167-1  
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG  
PGVP Number: B22021 Valve Outlet: 680  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gasoline Calibration Standards (May 2012) pursuant EPA 800/9-12031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant interferences which affect the use of this calibration measure. All concentrations are on a nitrogen basis unless otherwise noted.

Certified Gas This Cylinder below 100 ppm, i.e. 0.7 megapascals

**ANALYTICAL RESULTS**

Component	Required Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.36 PPM	G1	$\pm 1.4\%$ MST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.34 PPM	G1	$\pm 1.4\%$ MST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	$\pm 1.0\%$ MST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ MST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance				06/14/2021

**CALIBRATION STANDARDS**

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	30081120	CC78098	45.00 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 02, 2025
PRM	12380	D685029	9.01 PPM NITROGEN DIOXIDE/AIR	$\pm 2.0\%$	Feb 03, 2020
GWS	40142363/102	CC050581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1\%$	Feb 18, 2023
NTRM	16011040	CC473277	45.00 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Jun 17, 2022
NTRM	14060119	CC434277	990.0 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.8\%$	Nov 16, 2025

**ANALYTICAL EQUIPMENT**

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Model 8700 AHR0001333 CO	FTIR	Jun 03, 2021
Model 8700 AHR0001333 NO	FTIR	Jun 03, 2021
Model 8700 AHR0001333 NO2	FTIR	Jun 03, 2021
Model 8700 AHR0001333 SO2	FTIR	Jun 03, 2021

Test Data Available Upon Request

NOTE: 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



เอกสารไม่ควบคุม

**MULTI-POINT GAS TEST REPORT**

Test Date : Mar 28, 2023

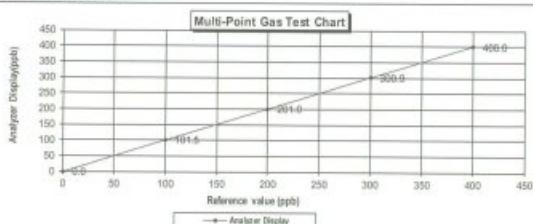
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : 1200636462

**Standard Gas Concentration**

Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Diluter Detail
Nitric Oxide (NO)	45.94	PPM	Manufacturer : Thermo Scientific
Methane (CH <sub>4</sub> )	-	PPM	Model : 146i
Carbon Monoxide (CO)	984.8	PPM	Serial Number : 1180540071
Cylinder No. :	EB0143262		
Expiration Date :	Jun 21, 2024		

**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	101.5	1.50	1.48
Level 3	40.00%	200.0	201.0	1.00	0.50
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.45	
Acceptable Limit $\pm 5\%$					



Calculate by  
Srinakorn Gungwan  
28/3/23

Approve by  
Aphiwat K.  
28/3/23

เอกสารไม่ควบคุม

**MULTI-POINT GAS TEST REPORT**

Test Date : Mar 1, 2023

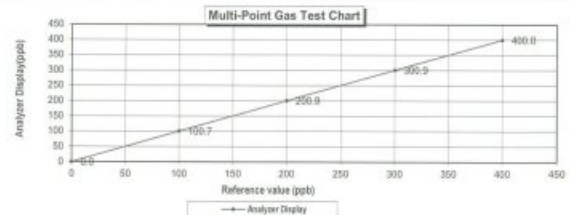
Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43i  
Manufacturer : Thermo Scientific Serial Number : 1182920013

**Standard Gas Concentration**

Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Diluter Detail
Nitric Oxide (NO)	45.94	PPM	Manufacturer : Thermo Scientific
Methane (CH <sub>4</sub> )	-	PPM	Model : 146i
Carbon Monoxide (CO)	984.8	PPM	Serial Number : 1180540071
Cylinder No. :	EB0143262		
Expiration Date :	Jun 24, 2024		

**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	100.7	0.70	0.70
Level 3	40.00%	200.0	200.9	0.90	0.45
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.29	
Acceptable Limit $\pm 5\%$					



Calculate by  
Aphiwat K.  
1/3/23

Approve by  
Aphiwat K.  
1/3/23

เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A0103 Reference Number: 122-402135167-1  
Cylinder Number: E00143282 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG  
PGVP Number: B22021 Valve Outlet: 66G  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Toxicology Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA-600/5-12-031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant interferences which affect the use of the calibration mixture. All concentrations are on a molar basis unless otherwise noted.  
Do Not Use This Cylinder before 100 ppb, i.e. 0.1 megapascals

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
NOX	45.00 PPM	45.36 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.34 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.94 PPM	G1	+/- 1.0% NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1009 PPM	984.4 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021, 09/21/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20001120	CD70006	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Feb 02, 2025
PRM	12380	DB85025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.5%	Feb 25, 2020
GMIS	401432820102	DC905581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 19, 2023
NTRM	10211043	CD473277	49.52 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14280119	CD434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 8700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTE: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.79kg



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

Approved for Release



เอกสารไม่ควบคุม



## THAI METEOROLOGICAL DEPARTMENT

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

### The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	6.9	0.14
9.02	-	-	-	9.0	0.02
11.02	-	-	-	10.9	0.12
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

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

Calibrated by:

Mr. Watcharapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



## THAI METEOROLOGICAL DEPARTMENT

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

### Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 31 March, 2023

Certification No. 143/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21

WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2111DR0041

WIND SENSOR : 2111DT0041

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

81 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1009.2 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 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: testo, testo 645 Serial No. 02948067 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB330 No. V1220015

Digital Barometer Vaisala Type PTB330 No. V1220015

Calibrated by:

Mr. Watcharapol Subwat

Mr. Paoon Promsot

(Authorized Signatory)

For the Chief

Sub-Standard

เอกสารไม่ควบคุม



## THAI METEOROLOGICAL DEPARTMENT

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

### The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1014.29	1014	0.29
1014.02	1014	0.02
1011.47	1012	-0.53
1011.25	1011	0.25
1011.11	1011	0.11
1011.38	1012	-0.62
1011.71	1012	-0.29
1013.48	1014	-0.52
1013.81	1014	-0.19
1014.02	1014	0.02
1013.73	1013	0.73
1013.32	1013	0.32
1014.62	1016	-0.08
1014.75	1016	-0.25
1014.38	1014	0.38
1014.21	1014	0.21
1013.57	1013	0.57
1013.01	1013	0.01
1011.26	1011	0.26
1011.89	1012	-0.41

Average

Calibrated by:

Mr. Watcharapol Subwat  
Mechanical Engineer

Calibration & Test Section  
Meteorological Instruments Bureau

เอกสารไม่ควบคุม





# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
760.76	761	-0.22
760.56	761	-0.42
758.86	759	-0.34
758.50	758	0.50
758.39	758	0.39
758.60	759	-0.40
758.84	759	-0.16
760.17	760	0.17
760.42	760	0.42
760.58	761	-0.42
760.36	760	0.36
760.05	760	0.05
761.25	761	0.25
761.12	761	0.12
760.85	761	-0.15
760.72	761	-0.28
760.24	760	0.24
759.82	760	-0.18
758.51	759	-0.49
758.75	759	-0.25

Average

Calibrated by:

Mr. Watchapol Subwat

Mechanical Engineer



เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 10 April, 2023

Certification No. : 178/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21

WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2111DR0052

WIND SENSOR : 2111DT0052

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

81 Soi Udornsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1006.9 hPa

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

: HOOK GAGE NO 1425 : Wind Aloit Plotting Board

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

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-80AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8380/94 Wet No. 8389/94

: Testo, testo 645 Serial No. 02848057 : ThermoSchneider No. 918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB320 No. 1320015

: Digital Barometer Vaisala Type PTB330 No. 13200101

Calibrated by:

Mr. Watchapol Subwat

Mechanical Engineer

Signed:

Mr. Pichod Promsit

(Authorized Signatory)

for the Chief

Sub-Standard Instrument

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# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 5 of 5

Standard	Temperature Sensor Reading	
	Reading	Correction
Temp. °C	°C	°C
45.24	45.4	-0.16
32.16	32.3	-0.14
16.48	16.5	-0.02

Calibrated by:

Mr. Watchapol Subwat

Mechanical Engineer



เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 178/23

10 April, 2023

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	hPa/100	hPa/100	m/sec	m/sec	m/sec
m/sec					
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.02	-	-	-	10.9	0.12
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

Wind Aloit 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

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# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 178/23

10 April, 2023

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1013.17	1013	0.17
1013.43	1014	-0.57
1014.15	1014	0.15
1014.22	1014	0.22
1009.63	1009	0.63
1009.71	1010	-0.29
1009.95	1010	-0.05
1010.31	1010	0.31
1010.72	1011	-0.28
1010.80	1011	-0.20
1011.47	1011	0.47
1011.21	1011	0.21
1011.33	1011	0.33
1011.59	1012	-0.41
1011.89	1012	-0.11
1012.40	1012	0.40
1008.64	1009	-0.36
1008.80	1009	-0.20
1009.25	1009	0.25
1009.45	1009	0.45

Average

0.06

Calibrated by :   
Mr. Watcharapol Subwat  
Mechanical Engineer



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# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 178/23

10 April, 2023

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.15	45.3	-0.15
31.05	31.1	-0.05
15.32	15.5	-0.18

Calibrated by :

Mr. Watcharapol Subwat  
Mechanical Engineer



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# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 178/23

10 April, 2023

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
759.94	760	-0.06
760.13	760	0.13
760.67	761	-0.33
760.73	761	-0.27
757.28	757	0.28
757.34	757	0.34
757.52	758	-0.48
757.79	758	-0.21
758.10	758	0.10
758.16	758	0.16
758.66	759	-0.34
758.47	758	0.47
758.56	758	0.56
758.75	759	-0.25
758.96	759	-0.02
759.36	759	0.36
756.54	757	-0.46
756.66	757	-0.34
757.00	757	0.00
757.15	757	0.15

Average

0.15

Calibrated by :   
Mr. Watcharapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม



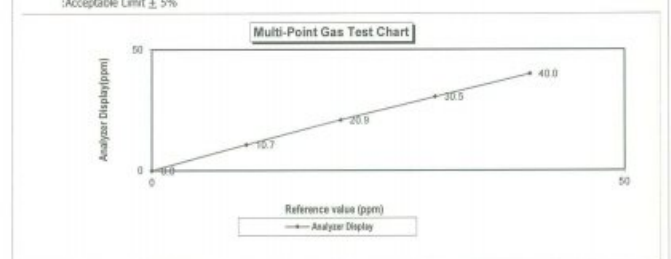
United Analyst and Engineering Consultant Co., Ltd.

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

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

MULTI-POINT GAS TEST REPORT					
Test Date : Mar 14, 2023					
Equipment : Gas Analyzer (CO)		Model : 48C			
Manufacturer : Thermo Environmental Instruments		Serial Number : 48C-71185-368			
Standard Gas Concentration			Dilutor Detail		
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	45.94	PPM	Model :	1461	
Methane (CH <sub>4</sub> )	-	PPM	Serial Number :	1180540071	
Carbon Monoxide (CO)	984.8	PPM			
Cylinder No. :	EB0143262				
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	10.7	0.7	6.5
Level 3	40.00%	20.0	20.9	0.9	4.3
Level 4	60.00%	30.0	30.5	0.5	1.6
Level 5	80.00%	40.0	40.0	0.0	0.0
Remark : Measuring Range			Average Difference (%)		
: Acceptable Limit $\pm 5\%$			2.50		



Calculate by   
11, 03, 66

Approve by   
14, Mar, 2023

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

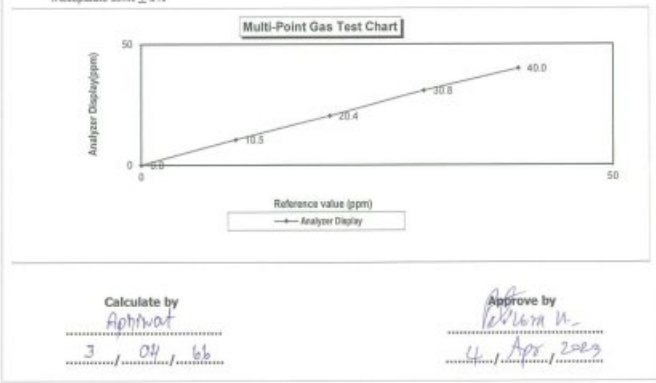
Test Date : Apr 3, 2023

Equipment : Gas Analyzer (CO)
Model : 481

Manufacturer : Thermo Scientific
Serial Number : 1200536464

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model : 1461
Methane (CH <sub>4</sub> )	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	984.8	PPM	
Cylinder No. :	EB0143262		
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	0.0
Level 2	20.00%	10.0	10.5	0.5	4.8	4.8
Level 3	40.00%	20.0	20.4	0.4	2.0	2.0
Level 4	60.00%	30.0	30.8	0.8	2.6	2.6
Level 5	80.00%	40.0	40.0	0.0	0.0	0.0
Remark : Measuring Range			50.0 ppm	Average Difference (%)		1.86





Cert.No.: 23CH281  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Horiba  
Model : LAQUA-PH210  
Serial No. : HA0D0078  
ID No. : UAE.EFM.073/2564(EFM.pH.06/64)  
Condition As-Received: Used Item  
Received Date : 27 February 2023  
Calibration Date : 01 March 2023  
Reference : 2302-0942WSC-4  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagtrakul

Approved by :   
Approved Signatory

( / ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagtrakul

Issue Date : 7 March 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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A 0051728



Cert.No.: 23CH281  
Page.: 3 of 3

## Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.7)(7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 992H0385	4.008	4.01	166.8	0.0079	2.00
	6.987	6.99	-7.1	0.011	2.00
	9.987	9.99	-6.5	0.011	2.00
	10.010	10.02	-165.4	0.0096	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652  
- Serial No. : 992H0385  
Dimension of probe;  
- Length : 110 mm.  
- Diameter : 16 mm.  
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.004	25.0	-0.004	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.001	35.0	-0.001	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1150711



## 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	22I1306	27 Oct 2023

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

2. Certified Reference Materials : 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	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 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 Fluke at pH (4.7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: HA0D0078	4.00	177.48	177.4	4.01	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00

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a 1150712



Cert.No.: 23CH809  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Conductivity Meter  
Manufacturer : YSI  
Model : Pro 30  
Serial No. : 17B101802  
ID No. : UAE EFM 122/2560(ENV.SCT. 02/60)  
Condition As-Received: Used Item  
Received Date : 26 June 2023  
Calibration Date : 27 June 2023  
Reference : 2306-0829WSC-1  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH6 by direct measurement  
with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Walalak Sirilthean

Approved by :   
Approved Signatory

( / ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagtrakul

Issue Date : 28 June 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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Cert.No.: 23CH809

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	2211306	27 Oct 2023

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

- Traceable to National Institute of Metrology (Thailand), NIMT

## 2. Certified Reference Materials :-

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

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 $\mu\text{S/cm}$	CPA Chem	885122	28 Mar 2024
12.880 $\text{mS/cm}$	CPA Chem	885123	28 Mar 2024

- Control Conductivity calibration solution temperature by Water bath ( $25 \pm 0.1$ )  $^{\circ}\text{C}$

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  $\mu\text{S/cm}$ 

Conductivity Electrode Serial No.: 18L100008

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
1413.0 $\mu\text{S/cm}$	1420 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12.880 $\text{mS/cm}$	12.70 $\text{mS/cm}$	12.63 $\text{mS/cm}$	0.086 $\text{mS/cm}$	2.00

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

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Cert.No.: 23CH809

Page.: 3 of 3

**Calibration Results****Function : Temperature Measurement**

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : PRO 30 COND-T  
- Serial No.: 18L100008

Dimension of probe;

- Length : 8 mm  
- Diameter : 2 mm  
- Immersion Depth : 90 mm

Calibration Point ( $^{\circ}\text{C}$ )	Standard Temperature ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Error ( $^{\circ}\text{C}$ )	Uncertainty of Measurement ( $\pm$ $^{\circ}\text{C}$ )	Coverage factor k
25.0	25.001	24.7	-0.301	0.13	2.00
30.0	30.000	29.7	-0.300	0.13	2.00
35.0	35.001	34.7	-0.301	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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## Page 1 of 2

ID : UAE\_EFM.105/2561

Class : 1  
Range : 94, 114 dB / 1000 Hz  
Instrument Status : Used

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

Approved By : Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 27 June 2023

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

## Page: 1/4

#### Calibration Environment and Details

Microphone Class : 2  
Microphone Model : SV2  
Microphone S/N : 9660  
Preamplifier Model : -  
Preamplifier S/N : -  
Intrument Status : Used

Temperature	: 23 °C $\pm$ 2 °C
Humidity	: 50 %RH $\pm$ 20 %RH
Barometric Pressure	: 101.3 hPa $\pm$ 10 hPa
Received Date	: 10 January 2023
Calibrated Date	: 24 January 2023
Calibration Procedure	: In-house method CP-NDM-01 based on IEC 61252 : 2013
Location of Calibration	: Lab Acoustic

Instrument	Brand	Model	S/N.	Date calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Svaztek	Svaz401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	24 March 2023	TPA

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. P. M. Mahaveen  
Mr. P. M. Mahaveen  
Calibration Engineer Supervisor  
Issue Date : 24 January 2023

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

## Page: 2/4

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-100	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(%)	(%)	(%)
1000 Hz 114 dB	120.00	120	3.19	3.20	+0.31	3.0	-21, +26

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN: 18079

Frequency Weighting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerance
UIC Setting	A	C		Limit
FAST / 55-140			( $\pm$ dB)	( $\pm$ dB)
STD Setting	(dB)	(dB)		
60 Hz	0.5	0.5	0.40	2.0
125 Hz	0.2	0.2	0.40	1.5
250 Hz	0.1	0.0	0.40	1.5
500 Hz	0.1	0.0	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.7	-0.7	0.40	2.0
4000 Hz	-0.3	-0.5	0.40	3.0
8000 Hz	-1.7	-1.8	0.40	5.0

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

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A. Sound exposure meter, linearity of response for changes of input sinusoidal signal level											
UVC Setting		FAST / A / High									
1000 Hz	Ref	[dB]	55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0
	Level A	[dB]	54.6	80.5	90.2	100.1	110.1	114.0	120.1	130.1	140.1
	Error	[dB]	-0.4	0.5	0.2	0.1	0.1	0.0	0.1	0.1	0.1
8000 Hz	Ref	[dB]			88.9	96.9	108.9	112.9	118.9	128.9	138.9
	Level A	[dB]			88.9	96.9	108.9	112.9	118.9	128.6	138.6
	Error	[dB]			0.0	0.0	0.0	0.0	0.0	-0.1	-0.3
63 Hz	Ref	[dB]						87.8	93.8	103.8	113.8
	Level A	[dB]						87.8	93.8	103.8	113.8
	Error	[dB]						0.0	0.0	0.0	0.0
Tolerances Limit		(±dB)							1.0		
UNCERTAINTY		(±dB)							0.27		

EUC Setting		Time		Exposure Measurement			UNCERTAINTY	Tolerance Limit (%)
PAST / A / SS-140		Ref	UUC	Ref (Pa h)	UUC (Pa h)	Error (%)		
Calibrator Setting		(s)	(s)				(%)	
1000 Hz 110 dB		27	27	0.30	0.31	+3.33	4.3	-21, -26
1000 Hz 110 dB		45	45	0.50	0.51	+2.00		
1000 Hz 110 dB		90	90	1.00	1.01	+1.00		
1000 Hz 110 dB		180	180	2.00	2.02	+1.00		
1000 Hz 120 dB		36	36	4.00	4.03	+0.75	3.8	
1000 Hz 120 dB		72	72	8.00	8.05	+0.63		
1000 Hz 120 dB		90	90	10.00	10.13	+1.30		
1000 Hz 120 dB		180	180	20.00	20.22	+1.10		
1000 Hz 120 dB		360	360	40.00	40.34	+0.85		
1000 Hz 120 dB		720	720	80.00	80.49	+0.61		

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

Certificate No : 23-NDM-012  
Request No : Req-2023-0056

4. Response to short duration  
a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error	Limit	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)		
4000 Hz 95 dB	2846	2846	1.00	0.98	-0.02	0.01	-0.29 - 0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error	Limit	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(%)		
Burst 1 ms, 95 dB	2846	2846	1.00	0.98	-2.00	3.0	-21 - +26
Burst 1 ms, 100 dB	900	900	1.00	0.98	-2.00		-21 - +41
Burst 1 ms, 106 dB	143	143	1.00	0.99	-1.00		-21 - +41

5. Response to unipolar pulse

UUC Setting	Time	Exposure Measurement		UNCERTAINTY	Tolerances
FAST / A / 55-140	UUC	UUC	Different	Limit	Limit
Calibrator Setting	(s)	(Pa <sup>2</sup> /h)	(%)		
Continuous Rectangle +	7	10.86	0.00	2.4	-21 - +26
Continuous Rectangle -		10.86			

\* 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 Issuing Authority.

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Certificate of Calibration

Customer

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

Certificate No : 23-NDM-010  
Request No : Req-2023-0054

Unit Under Calibration Details

Measurement item : Noise dosimeter  
Manufacturer : SVANTEK  
Model : SV104  
Serial Number : 91924  
ID : -  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : SV27  
Microphone S/N : 96600  
Preamplifier Model : -  
Preamplifier S/N : -  
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 : 10 January 2023  
Calibrated Date : 24 January 2023  
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017  
Location of Calibration : Lab Acoustic

Instrument	Brand	Model	SN.	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSE
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Size Generator	SvanteK	Svan401	131	12 October 2023	WK Electric
Timer	EXTech	-	65-ACT	24 March 2023	TPA

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. Nopadol Luangrat  
Calibration Officer

Approved By :   
Mr. Pait Mithavorn  
Calibration Engineer Supervisor  
Issue Date : 24 January 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-010  
Request No : Req-2023-0054

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error	Limit	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(%)		
1000 Hz 114 dB	120.00	120	3.19	3.20	+0.51	3.0	-21, +26

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 55A, SN, 58079

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
FAST / 55-140	A	C	(± dB)	Limit
STD Setting	(dB)	(dB)		
*63 Hz	0.4	0.4	0.40	2.0
125 Hz	0.1	0.1	0.40	1.5
250 Hz	-0.1	-0.2	0.40	1.5
500 Hz	-0.1	-0.2	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	0.1	0.1	0.40	2.0
4000 Hz	0.9	0.7	0.40	3.0
8000 Hz	-1.8	-1.9	0.40	5.0

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

เอกสารไม่ควบคุม

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	FAST / A / High											
1000 Hz	Ref	(dB)	55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
	Level A	(dB)	54.7	80.2	90.2	100.1	110.1	114.0	120.0	130.0	140.0	
	Error	(dB)	-0.3	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	
8000 Hz	Ref	(dB)			88.9	94.9	108.9	112.9	118.9	128.9	138.9	
	Level A	(dB)			88.9	99.0	108.9	112.9	118.9	128.9	138.8	
	Error	(dB)				0.0	0.1	0.0	0.0	0.0	-0.1	
63 Hz	Ref	(dB)						87.6	93.8	103.8	113.8	
	Level A	(dB)						87.8	93.8	103.8	113.8	
	Error	(dB)							0.0	0.0	0.0	
Tolerances Limit		(±dB)	1.0									
UNCERTAINTY		(±dB)	0.27									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error		Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> /h)	(Pa <sup>2</sup> /h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00	4.3	-21, +26
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00		
1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
1000 Hz 120 dB	36	36	4.00	3.94	-1.50		
1000 Hz 120 dB	72	72	8.00	7.87	-1.63	3.8	
1000 Hz 120 dB	90	90	10.00	9.90	-1.00		
1000 Hz 120 dB	180	180	20.00	19.76	-1.20		
1000 Hz 120 dB	360	360	40.00	39.42	-1.45		
1000 Hz 120 dB	720	720	80.00	78.66	-1.68		

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

เอกสารไม่ควบคุม



Certificate No : 23-NDM-010  
Request No : Req-2023-0054

4. Response to short duration  
a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	Limit
4000 Hz 95 dB	2846	2846	1.00	0.98	-0.02	0.01	-0.29 ~ 0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	(%)	Limit
Burst 1 ms, 95 dB	2846	2846	1.00	0.98	-2.00	3.0	-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	0.98	-2.00		-21 ~ +41
Burst 1 ms, 108 dB	143	143	1.00	0.99	-1.00		-21 ~ +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement		UNCERTAINTY	Tolerances
	Ref	UUC	UUC	Different		
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(%)	(%)	(%)
Continuous Rectangle +	7		10.86	0.00	2.4	-21 ~ +26
Continuous Rectangle -			10.86			

\* 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.  
เอกสารไม่ควบคุม

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 : 23-NDM-129  
Request No : Req-2023-1046

Unit Under Calibration Details

Measurement item : Noise Dosimeter  
Manufacturer : SVANTEK  
Model : SV 104  
Serial Number : 117689  
ID : -  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : SV 27  
Microphone S/N : 112934  
Preamplifier Model : -  
Preamplifier S/N : -  
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 : 15 May 2023  
Calibrated Date : 25 May 2023  
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017  
Location of Calibration : Lab Acoustic  
Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSE
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	SvanteK	Svan401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	20 March 2024	TPA

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  
Calibration Officer  
Approved By :   
Mr. Pait Mahavassum  
Calibration Engineer Supervisor  
Issue Date : 25 May 2023

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

Certificate No : 23-NDM-129  
Request No : Req-2023-1046

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	(%)	Limit
1000 Hz 114 dB	120	120	3.19	3.13	-1.88	3.1	-21, +26

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 55A, SN. 58679

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
STD Setting	(dB)	(dB)	(± dB)	(± dB)
*63 Hz	0.0	0.1	0.40	2.0
125 Hz	-0.1	-0.1	0.40	1.5
250 Hz	-0.1	-0.1	0.40	1.5
500 Hz	-0.1	0.0	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.1	0.3	0.40	2.0
4000 Hz	1.8	1.9	0.40	3.0
8000 Hz	-2.4	-2.6	0.40	5.0

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

Certificate No : 23-NDM-129  
Request No : Req-2023-1046

3. Linearity of response to steady signals  
a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting		FAST / A / High									
1000 Hz	Ref	(dB)	95.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0
	Level A	(dB)	54.4	80.2	90.2	100.1	110.1	114.0	120.0	130.0	140.0
	Error	(dB)	-0.6	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0
8000 Hz	Ref	(dB)			88.9	98.9	108.9	112.9	118.9	128.9	138.9
	Level A	(dB)			89.0	98.9	108.9	112.9	118.9	128.8	138.8
	Error	(dB)			0.1	0.0	0.0	0.0	0.0	-0.1	-0.1
63 Hz	Ref	(dB)						87.8	93.8	103.8	113.8
	Level A	(dB)						87.8	93.8	103.8	113.8
	Error	(dB)						0.0	0.0	0.0	0.0
Tolerances Limit		(±dB)	1.0								
UNCERTAINTY		(±dB)	0.3								

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.31	+3.33	5.6	-21, +26
1000 Hz 110 dB	45	45	0.50	0.51	+2.00		
1000 Hz 110 dB	90	90	1.00	1.01	+1.00		
1000 Hz 110 dB	180	180	2.00	2.02	+1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63	5.6	-21, +26
1000 Hz 120 dB	90	90	10.00	10.13	+1.30		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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 : 21-NDM-129  
Request No : Req-2023-1046

#### 4. Response to short duration

##### a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error	(Pa <sup>2</sup> h)	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)
4000 Hz 95 dB	2846	2846	1.00	0.98	-0.02	0.052	-0.29 ~ +0.41

##### b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error	(%)	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	(%)	(%)
Burst 1 ms, 95 dB	2846	2846	1.00	0.98	-2.00	5.6	-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	0.98	-2.00		-29 ~ +41
Burst 1 ms, 108 dB	143	143	1.00	0.99	-1.00		-29 ~ +41

#### 5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Different	(%)	Limit
Calibrator Setting	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)	(%)	(%)	(%)
Continuous Rectangle +			10.37		0.00	3.7	-21 ~ +26
Continuous Rectangle -	29		10.37				

\* Indicates non accredited

End of Certificate

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

Cert. No. : ACL23181  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01010785 / 194540 / 14663  
ID No.: UAE.EFM.088/2565

Condition As Found : GOOD

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

Location : -  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 29 MAY 2023  
Calibration Date : 07-08 JUNE 2023  
Date of Issue : 09 JUNE 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurai*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

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### Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

#### Calibration Method :

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

#### Condition of this result of calibration :

##### 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL_BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

### Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 3 of 8

#### Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.



## Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.98)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
15.1

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	18.2
Flat	23.9

## 3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Retch.

## Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.1	0.1	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Retch.

## Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Retch.

## Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 7 of 8

## 8. Level linearity including the level range control

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lepeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.5	-0.9	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.3	-0.1	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Retch.

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Retch.



Continuation of Calibration Certificate

Cert. No. : ACL23181  
Job No. : VC66AC0062  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.5	89.6	0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petchur

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



Cert. No. : ACL23132  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00709656 / 189028 / 01207  
ID No.: UAE.EFM.021/2564

Condition As Found : GOOD

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

Location : -  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 18 APRIL 2023  
Calibration Date : 24-26 APRIL 2023  
Date of Issue : 27 APRIL 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL23132  
Job No. : VC66AC0048  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23132  
Job No. : VC66AC0048  
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petchur

Cert. No. : ACL23132  
Job No. : VC66AC0048  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.98)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
15.1

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.6
Flat	23.3

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.0	1.1	1.1	±5.0

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petch

Cert. No. : ACL23132  
Job No. : VC66AC0048  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petch

Cert. No. : ACL23132  
Job No. : VC66AC0048  
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## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

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T. Petch

Cert. No. : ACL23132  
Job No. : VC66AC0048  
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## 8. Level linearity including the level range control

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.1	-0.3	±3.0

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

T. Petch



Continuation of Calibration Certificate

Cert. No. : ACL23132  
Job No. : VC66AC0048  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.5	89.7	0.2	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

*g. Petchi*

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Name : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 23-TPM-052  
Request No : Req-2023-0051  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : 3M  
Model : QT-32  
Serial Number : TPS030007  
Resolution : 0.1 °C  
ID Number : UAE.EFM082/2561  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 10 January 2023  
Calibrated Date : 25 January 2023  
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. Pacht Mathavorn

Calibration Engineer Supervisor

Issue Date :

25 January 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Calibration Laboratory. (TS16949:2016 7.6.3.2)

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Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 23-TPM-052

Request No : Req-2023-0051

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Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.003	20.2	-0.2	0.14
	25.003	25.2	-0.2	0.14
	30.003	30.2	-0.2	0.14
	35.002	35.2	-0.2	0.14
	40.005	40.1	-0.1	0.14
	45.004	45.1	-0.1	0.14
	50.006	50.1	-0.1	0.14
DRY	60.006	60.1	-0.1	0.14
	20.005	20.1	-0.1	0.14
	25.006	25.1	-0.1	0.14
	30.005	30.1	-0.1	0.14
	35.005	35.1	-0.1	0.14
	40.006	40.0	0.0	0.14
	45.007	45.0	0.0	0.14
GLOBE	50.005	50.0	0.0	0.14
	60.006	60.0	0.0	0.14
	20.004	20.0	0.0	0.14
	25.005	25.0	0.0	0.14
	30.004	30.0	0.0	0.14
	35.003	35.0	0.0	0.14
	40.005	40.0	0.0	0.14
	45.006	45.0	0.0	0.14
	50.005	50.0	0.0	0.14
	60.003	60.0	0.0	0.14

End of Certificate

Calibrated By :

Mr. Sirichok Jirapokdeksanon

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Name : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 23-TPM-050  
Request No : Req-2023-0049  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : 3M  
Model : QT-32  
Serial Number : TPS030005  
Resolution : 0.1 °C  
ID Number : UAE.EFM080/2561  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 10 January 2023  
Calibrated Date : 25 January 2023  
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. Pacht Mathavorn

Calibration Engineer Supervisor

Issue Date :

25 January 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Calibration Laboratory. (TS16949:2016 7.6.3.2)

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เอกสารไม่ควบคุม



Calibration Note  
UUC Adjustment : Not Adjust  
Certificate No : 23-TPM-050  
Request No : Req-2023-0049  
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.005	20.1	-0.1	0.14
	25.003	25.1	-0.1	0.14
	30.004	30.1	-0.1	0.14
	35.005	35.1	-0.1	0.14
	40.004	40.2	-0.2	0.14
	45.003	45.2	-0.2	0.14
	50.006	50.2	-0.2	0.14
	60.005	60.2	-0.2	0.14
DRY	20.003	20.1	-0.1	0.14
	25.005	25.1	-0.1	0.14
	30.005	30.1	-0.1	0.14
	35.006	35.1	-0.1	0.14
	40.003	40.2	-0.2	0.14
	45.004	45.2	-0.2	0.14
	50.005	50.2	-0.2	0.14
	60.003	60.2	-0.2	0.14
GLOBE	20.004	20.1	-0.1	0.14
	25.006	25.1	-0.1	0.14
	30.004	30.1	-0.1	0.14
	35.003	35.1	-0.1	0.14
	40.006	40.1	-0.1	0.14
	45.006	45.1	-0.1	0.14
	50.006	50.1	-0.1	0.14
	60.003	60.1	-0.1	0.14

End of Certificate

Calibrated By :  
Mr. Sirichok Jirapudkadevan

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

Certificate of Calibration

Customer  
Name : UNITED ANALYST AND ENGINEERING  
CONSULTANT CO., LTD.  
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak,  
Prakanong, Bangkok 10260  
Certificate No : 23-TPM-193  
Request No : Req-2023-0709  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : TSI QUEST  
Model : QT-32  
Serial Number : TPW020005  
Resolution : 0.1 °C  
ID Number : UAE.EFM.122/2565  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 28 March 2023  
Calibrated Date : 3 April 2023  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/INGO, Model: GT11/RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: QR25-0494

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. Noppadol Luangart  
Technical Manager  
Issue Date : 3 April 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.  
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Calibration Note  
UUC Adjustment : Not Adjust  
Certificate No : 23-TPM-193  
Request No : Req-2023-0709  
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.020	20.2	-0.2	0.13
	25.034	25.2	-0.2	0.13
	30.034	30.2	-0.2	0.13
	35.028	35.2	-0.2	0.13
	40.041	40.2	-0.2	0.13
	45.043	45.2	-0.2	0.13
	50.046	50.2	-0.2	0.13
	60.050	60.2	-0.2	0.13
DRY	20.033	20.2	-0.2	0.13
	25.037	25.2	-0.2	0.13
	30.037	30.2	-0.2	0.13
	35.036	35.2	-0.2	0.13
	40.039	40.2	-0.2	0.13
	45.040	45.2	-0.2	0.13
	50.043	50.2	-0.2	0.13
	60.049	60.2	-0.2	0.13
GLOBE	20.032	20.2	-0.2	0.13
	25.033	25.2	-0.2	0.13
	30.036	30.2	-0.2	0.13
	35.039	35.2	-0.2	0.13
	40.042	40.2	-0.2	0.13
	45.042	45.2	-0.2	0.13
	50.043	50.2	-0.2	0.13
	60.046	60.2	-0.2	0.13

End of Certificate

Calibrated By :  
Mr. Sirichok Jirapudkadevan

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 : 23-TPM-371  
Request No : Req-2023-1526  
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : Quest Technologies  
Model : QT-34  
Serial Number : TEB060015  
Resolution : 0.1 °C  
ID Number : UAE.EMA2.057/2552  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 21 July 2023  
Calibrated Date : 7 August 2023  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/INGO, Model: GT11/RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: QR23-0494

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. Noppadol Luangart  
Technical Manager  
Issue Date : 7 August 2023

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

UUC Adjustment : Not Adjust

Certificate No : 23-TFM-371

Request No : Req-2023-1526

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.032	20.1	-0.1	0.13
	25.035	25.1	-0.1	0.13
	30.035	30.1	-0.1	0.13
	35.036	35.1	-0.1	0.13
	40.038	40.0	0.0	0.13
	45.040	45.0	0.0	0.13
	50.043	50.1	-0.1	0.13
	60.049	60.1	-0.1	0.13
DRY	20.031	20.0	0.0	0.13
	25.033	25.0	0.0	0.13
	30.034	29.9	+0.1	0.13
	35.039	34.9	+0.1	0.13
	40.038	39.9	+0.1	0.13
	45.041	44.9	+0.1	0.13
	50.043	50.0	0.0	0.13
	60.047	60.0	0.0	0.13
GLOBE	20.032	20.0	0.0	0.13
	25.032	25.0	0.0	0.13
	30.034	29.9	+0.1	0.13
	35.036	35.0	0.0	0.13
	40.039	39.9	+0.1	0.13
	45.040	44.9	+0.1	0.13
	50.043	50.0	0.0	0.13
	60.049	60.0	0.0	0.13

End of Certificate

Calibrated By :

Mr. Sitichok Jirapadheesakul

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

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

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Certificate No : 23-ACT-111

Request No : Req-2023-1408

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.84	-0.16	-	-	0.14	0.25
114 dB / 1000 Hz	113.79	-0.21	-	-	0.13	0.25

Frequency of Sound pressure level

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

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

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

Note :

- Acceptance limit was IEC60842:2017 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 items calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

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

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โครงการผลิตปิโตรเลียมบนบก พื้นที่ผลิต WBNE และพื้นที่ผลิต STE แปลงสำรวจบนบกหมายเลข L44/43 อำเภอวิเชียรบุรี  
และอำเภอศรีเทพ จังหวัดเพชรบูรณ์ ระหว่างเดือนกรกฎาคม - ธันวาคม พ.ศ. 2566  
บริษัท อีโค โอเรียนท์ รีซอสเซส (ประเทศไทย) จำกัด

ใบรับรองสอบเทียบเครื่องมือประจำห้องปฏิบัติการ สำหรับตรวจวัดคุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพอากาศในบรรยากาศโดยทั่วไป									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)	(PM-10)	Mettler-Toledo	AB204-S/FACT / B108115858	Mettler-Toledo (Thailand) Ltd.	23MM332	7 Apr 23	5 Apr 24	-
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพน้ำ									
3	Gas Chromatography - Mass Spectrometer (GC-MS)	สารกลุ่ม BTEX เบนซีน (Benzene), โทลูอีน (Toluene), เอทิลเบนซีน (Ethylbenzene), ไซลีนทั้งหมด (Total Xylene)	Bruker Scion	451-GC / BR1201M099 Scion-SQ / GQS1203F021 CP8400 / BR1203M331	Thai Unique Co.,Ltd.	SV2305/21210	23 May 23	21 May 24	-
4	Inductively Coupled Plasma- Optical Emission Spectrometer (ICP-OES)	กลุ่มโลหะหนัก : ตะกั่ว (Pb), นิกเกิล (Ni), แบเรียม (Ba), ปรอททั้งหมด (Total Hg), ซีลีเนียม (Se),	Agilent Technologies	System ID:G8015A G8015AA / MY1803001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30 Nov 22	29 Nov 23	-
5	Atomic Absorption Spectrometer (AAS)	ทองแดง (Cu),แมงกานีส (Mn),สังกะสี (Zn), เหล็ก (Fe), สารหนู (As), แคดเมียม (Cd), โครเมียมเฮกซะวาเลนต์ (Cr6+)	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute of Scientific and Technological Research(TISTR)	MTC.ACL.No. 387/66	2 Feb 23	1 Feb 24	-
6	Conductivity Meter	การนำไฟฟ้า(EC) ความเค็ม (Salinity)	SI Analytics	Lab955 / 16300356	DKSH Technology Limited	C24230059	16 Mar 23	14 Mar 24	WW, Soil น้ำทั่วไป
7	pH Meter	ค่าความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2301846-001-01	24 Feb 23	23 Feb 24	WW, Soil น้ำทั่วไป
8	pH Meter		Mettler-Toledo	SevenCompact S220/ C113432421	National Food Institute, Ministry of Industry, Thailand	2303560-001-01	26 Jun 23	24 Jun 24	น้ำดื่ม น้ำดื่ม, น้ำใต้ดิน



ใบรับรองสอบเทียบเครื่องมือประจำห้องปฏิบัติการ สำหรับตรวจวัดคุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพน้ำผิวดิน และน้ำใต้ดิน									
9	Analytical Balance (Readability 0.1 mg)	ปิโตรเลียมไฮโดรคาร์บอนทั้งหมด (TPH), น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	AB-204S/FACT / 1129361010	National Food Institute, Ministry of Industry, Thailand	2303074-001-01	26 May 23	24 May 24	-
10	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (Total Suspended Solids : TSS)	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	23MM112	26 Apr 23	24 Apr 24	-
11	Hot Air Oven	ของแข็งละลายน้ำทั้งหมด (Total Dissolved Solids : TDS)	Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23	-
12	Incubator	แบคทีเรียกลุ่มฟีคอลโคลิฟอร์ม (Fecal Coliform Bacteria)	Memmert	IPP 260 / V615.0187	Technology Promotion Association (Thailand-Japan)	23TM378	12 Apr 23	10 Apr 24	-
13	Incubator		Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	23TM728	27 Apr 23	25 Apr 24	-
14	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	23TM193	15 Feb 23	14 Feb 24	-
15	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	23TM194	15 Feb 23	14 Feb 24	-
16	Analytical Balance		Mettler-Toledo	MS603S / B007010311	Technology Promotion Association (Thailand-Japan)	23MM150	7 Apr 23	5 Apr 24	-
17	Auto Clave		ALP	CL-40L / 808763	Technology Promotion Association (Thailand-Japan)	23TM763	27 Apr 23	25 Apr 24	-

Due Date of Calibration\* : กำหนดตามแผนการสอบเทียบประจำปี อย่างน้อยปีละ 1 ครั้ง



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



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.018/2550  
**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 :**   
( ) Ponthipha Tameyakul  
( ) Malee Butkruea  
**Issue Date :** 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

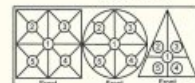
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Approval of the head of Corporate Services : Equipment Calibration and Testing Services

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

Cert.No.: 23MM331  
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	Position 2	Position 3	Position 4	Position 5
(g)	(g)	(g)	(g)	(g)
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006

### 3. Departure from nominal value

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(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	2.08
70	69.9999	+0.0001	0.18	2.04
100	99.9999	+0.0001	0.19	2.03
150	150.0003	-0.0003	0.29	2.00
200	200.0005	-0.0005	0.29	2.00

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

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เอกสารไม่ควบคุม



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

Cert.No.: 23MM331  
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 220 g **Resolution** 0.0001 g

#### Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(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	Standard Deviation of Reading (g)
(g)	
100	0.00007
200	0.00007

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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23MM332  
Page: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S /FACT  
**Serial No. :** B108115858  
**ID No. :** UAE.AIR.018/2555  
**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 :**   
( ) Ponthipha Tameyakul  
( ) Malee Butkruea  
**Issue Date :** 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0015OC-2  
Cert.No.: 23MM332  
Page: 2 of 3

**Procedure used :-**

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

**Condition of this result of calibration**

**1. Reference standard instruments:-**

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

- 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	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
( g )	( g )	( g )	( ± mg )	( 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	Standard Deviation of Reading ( g )
( g )	
100	0.00009
200	0.00007

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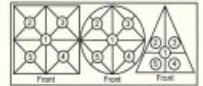


Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0015OC-2  
Cert.No.: 23MM332  
Page: 3 of 3

**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	-0.0003	+0.0003	+0.0006	+0.0002	0.0005

**3. Departure from nominal value**

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
( g )	( g )	( g )	( ± mg )	( k )
Unloaded	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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THAI UNIQUE OPEN LAB SERVICE

## OPERATIONAL QUALIFICATION REPORT (OQ)

## Equipment Operational Qualification Report

Report No. SV2305/21210

Equipment GC-MS

System Model SQ

System ID GQS1203F021

Equipment Details Bruker

Test Protocol Scion OQ Protocol

Protocol Rev. A

Date 23-May-23

Report Type Report

Org. Name United Analyst and Engineering Consultant Co.,Ltd

Org. Location 3 Soi Udomsuk 41 Sukhumvit Rd.  
Bangchak Phrakhanong Bangkok  
Thailand 10260

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SCION™

## Operational Qualification Protocol

For SCION Instrument

Name and Model:

Serial Number:

System ID Number:

Publication no. 394207000

Revision A

November 2011

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บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาอุทิศ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200  
80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

## CERTIFICATE OF CALIBRATION

## GAS CHROMATOGRAPH MASS SPECTROMETER

Certificate No.: SV2305/21210

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

Address: 3 Soi Udomsuk 41 Sukhumvit Rd. Bangchak  
Phrakhanong Bangkok Thailand 10260

Instruments Model: MS Scion-SQ S/N GQS1203F021  
GC 451-GC S/N BR1203M099  
AUTO SAMPLER CP8400 S/N BR1203M331

Standard Reference Number: 393065201

Procedure Document Number: 394207000

## System Test

PM perform and Diagnostic Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Air Water Check Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Tune Test EI	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Signal to Noise Test (EI) SCAN	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Injection EI Area Precision Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Injection EI RT Precision Test	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
User Demonstration	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL



Engineer Somchai P.  
Somchai Pohongkam

Date 23 May 2023

SCION Operational Qualification Protocol

## Contact

Scion Customer Service and Support uses a Customer Relationship Management (CRM) system. The interaction with this system offers the Customer immediate benefits including the contact center or help desk.

Scion worldwide service &amp; support offices can be found from Scion website:



www.scion.com/support.html

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Thai Unique Co., Ltd.

Service Division

Publication no. 394207000, Revision A, November 2011

Page 2 of 3

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

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## 1.0 Revision History

This qualification protocol is updated as necessary, which includes the event of any regulatory changes to Title 21 of the Code of Federal Regulations (21 CFR) Parts 210 and 211 (if applicable), any software or hardware changes, or updates that may impact on regulatory compliance.

Issue Number	Date	Comments

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## 2.0 Qualification Representative and Reviewer Details


### 2.1 Qualification Representative Details

Each person responsible for executing any part of this Protocol must complete the table below, providing a sample of their signature and initials, and recording the date the Qualification was performed.

Qualification representatives are nominated to execute and verify the completeness of the test protocol and correctness of all entries.

All testing must be performed in accordance with procedures outlined in this manual. The representative must be trained and qualified to perform the procedures outlined in this document.

A copy of their appropriate qualifications is to be inserted into "Qualification Representative Details" on page 30.

Name (Print)	SOMCHAI POHTONGKAM
Title	ENGINEER
Signature	
Initials	SOMCHAI
Date	23 MAY 23



Name (Print)	
Title	
Signature	
Initials	
Date	

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

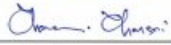
## 2.2 Reviewer Details


Each representative responsible for reviewing any part of this protocol must record their details in the following tables, providing a sample of their signature and initials, and recording the date the qualification was performed.

An employee or designee of the company operating the instrument must review these qualification procedures. All calculations and data will be checked by the reviewer. Data review must be performed in accordance with the qualification guidelines "Qualification Guidelines and GMP Documentation" on page 10 and in compliance with current Good Manufacturing Practice (cGMP) as specified by 21 CFR Parts 210 and 211.

Documentation supporting training in the area of data review and cGMP must be carefully maintained and reviewed by the instrument owner.

Reviewer representatives are responsible for reviewing the completeness of the qualification protocol and accuracy of all entries.

Name (Print)	CHANA CHANSAI
Title	ENGINEER
Signature	
Initials	
Date	23 MAY 2023




Name (Print)	
Title	
Signature	
Initials	
Date	

เอกสารไม่ควบคุม

## 3.0 Customer Responsibilities

The customer shall ensure that the Preventive Maintenance (PM) or Installation Qualification (IQ) up to point 9.11 is completed. A customer representative should be available at all times during the Operational Qualification Protocol.

**Note** The Operational Qualification Protocol test procedure should be performed after significant repairs, and at least once a year.

Qualification Rep. Initials		Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

## 2.3 Quality Assurance/Control Details

As Quality Assurance/Control (QA/QC), who is empowered to approve instrument compliance documents, I approve the procedures in the SCION Operational Qualification Protocol, which I may have amended, I accept the qualification of the Qualification Representative, and I will review and initial the results.

Name (Print)	
Title	
Signature	
Initials	
Date	

Name (Print)	
Title	
Signature	
Initials	
Date	

เอกสารไม่ควบคุม

## 4.0 Qualification Guidelines and GMP Documentation

### 4.1 Qualification Summary

At the end of qualification execution, all tables and data entry fields must be completed and all test results, where specified, must be printed and attached to the protocol.

The Qualification Representative and the Reviewer must sign (signature or initials) and date each page that has a signature field. This represents agreement and acceptance of all data and information on the signed page.

**Note** Scion does not provide instructions for full Qualification of the personal computer (PC) used to operate the SCION. If further qualification of the PC is required the end-user must contact the PC manufacturer.

**Note** Scion does not provide full qualification instructions for non-Scion manufactured accessories. Limited instructions may be supplied. If qualification of a non-Scion accessory is required, the end user must contact the accessory manufacturer.

### 4.2 Qualification Guidelines

The following are general guidelines for performing the qualification tests in accordance with cGMP for the Manufacturing, Processing, Packaging, or Holding of Drugs per 21CFR Parts 210 and 211. Additional local requirements may also apply.

- Read the guidelines before starting the qualification.
- Perform all tests exactly as written.
- Use a pen with permanent blue or black ink unless otherwise specified by company policy.
- Neatly strike out any incorrect words or numbers, made while writing comments or recording results, information or data within this Protocol, with a single line. The word(s) crossed out must remain legible. Write the correction as close as possible to the original entry. Write a brief description of the error. For example, write 'Transcription error' or 'Re-written for clarity'. Initial and date the change.
- Entering initials where a signature is requested, and vice versa is permitted. The exception to this is in 2.0 : Qualification Representative and Reviewer Details on page 6, where examples of each person's signature and initials are required.
- Use the date format dd Mon yyyy (e.g. 08 Mar 2011) unless otherwise specified by company policy.

เอกสารไม่ควบคุม



- Complete all tables and data fields to comply with this protocol. Blank fields are not permitted. For items that are not applicable, draw a line through the field, and write 'N/A' (Not Applicable). If entire tables or sections of tables are not applicable, strike a line either through the entire table or the specific area and enter 'N/A'. Complete the signature fields on the page.
- Write 'Pass', 'Fail' or 'N/A' as applicable to the test requirement or outcome.
- Ensure that results and/or specific documents are printed and attached to the specified appendix.
- The Qualification Representative and Reviewer must both sign (signature or initials) and date the signature fields on each page. This represents agreement and acceptance of all data and information on the page.

### 4.3 Page Numbering of Appendices

Each page that is inserted after the appendix is numbered with the letter of the appendix and a sequential number. The appendix page number must be initialed and dated by both the Qualification Representative and the Reviewer.

For example, pages inserted after Appendix C are numbered

C-1, C-2, C-3...etc. along with the initials and date.

If the reverse of each appendix page is left blank, it should be marked 'N/A' and signed and dated.

When the IQ is complete the total number of pages inserted after each appendix is written on the front page of the respective appendix sheet.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

### 4.5 Reference Documents

The following documents are relevant to this Qualification:

- Installation Qualification Protocol
- Completed service report from Preventative Maintenance (PM) schedule

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

### 4.4 Exception Reports

An exception to the protocol occurs when the observed result differs from the acceptance criteria or expected result.

All exceptions to the protocol must be documented in the Exception Report. The Exception Report includes a detailed description of the exception and resolution by the Qualification Representative.

Each Exception Report shall be issued with a unique identification number in the form ERID-XX-X. This number is generated by the page number on which the exception occurred followed by a sequential number indicating each exception found on the page.

For example, if an exception occurs on page 34, the Exception Report shall be identified as 'ERID-34-1'. If another exception occurs on page 34, the second report shall be identified as 'ERID-34-2'. This identification number should be recorded in the 'Pass / Fail / N/A' field after each test.

Each Exception Report must be signed by the Qualification Representative and the Reviewer as evidence of approval.

The Exception Report is inserted in the appropriately named appendix and numbered as per Section 4.3 of this protocol.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

### 4.6 Required Materials

The following stock solutions are required:

- 100 fg/μL OFN 394204200
- 1 pg/μL OFN 393065201
- 100 pg/μL OFN 393110101
- 10 pg/μL BZP 93065301
- 100 pg/μL BZP 394206200

The above solutions will be used to prepare the following working solutions which will be required to execute this OQ:

**Note** Refer to Appendix 1 for the preparation of the standard solutions.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

## 4.7 General Guidelines

The following are general cGMP guidelines.

- Perform each procedure exactly as written.
- Fill in each item on the form or mark it Not Applicable (N/A).
- If an item is marked N/A, initial it and date it.
- The Reviewer reviews and initials all entries recorded by the Qualification Representative.
- Keep all raw data. The Qualification Representative and the Reviewer will initial it, and date it.
- Do not destroy raw data.
- Attach raw data from an instrument, such as the SCION, as an Addendum using the instructions in the following Addendums section.
- If several instruments are qualified simultaneously, reference shared information, such as standard preparation and chemical information, to the document containing the original information by its model and instrument identification number.
- Label all reference standards as required by local regulations.
- Record the time each reference standard was opened.
- Use reference standards within 24 hours of preparation.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

## 4.8 Specific Instructions for Documentation

The Reviewer designates specific documentation instructions as follows.

Permanent Ink Color	Blue
Preferred Date Format	23 MAY 23

If more instructions are required: Use an addendum sheet, write the addendum number, and a brief description.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

เอกสารไม่ควบคุม

## 4.11 Addendums

The following are reasons to complete an addendum sheet:

- A deviation needs documentation.
- Additional information or data needs to be recorded.
- Insufficient space to include the correction on the sheet where the error was made.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

## 4.12 Addendum Example

The following is an example of using an addendum sheet to document a deviation.

If some of the items on the sales order were not present, you could do the following:

1. Use an addendum sheet.
2. Write Instrument Delivery on the Procedure line.
3. Write the addendum page number followed by a letter. For example: page 12A, where 12 is the page and A represents the first addendum on that page.
4. Write the plan to obtain the missing items, which may be the following:
  - Scion notified that Part Number XXXXX and XXXX are missing.
  - Scion replied that the parts are in stock and will be sent overnight. While waiting for the parts to arrive, I will continue to set up the instrument.
5. Review the plan with the Reviewer and make the necessary modifications.
6. Document the arrival of the parts and write that this addendum is resolved. Attach a copy of delivery documents and create addendum pages as required.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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## 4.9 Documentation Corrections

**Note** All original entries must remain legible after corrections are made.

1. Draw a line through the incorrect information.
2. Write the correction as close as possible to the original entry, or enter a footnote.
3. Write a brief description of the error. For example, write "transcription error," "rewritten for clarity," or "correcting wrong entry".
4. Initial and date the change.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

## 4.10 Marking Procedures Not Applicable

Some sections may not be relevant for the qualification. To indicate that a procedure or part of a form is unnecessary and that it was not forgotten or inadvertently overlooked:

1. Draw a line through the portion that is not applicable. Write the letters N/A (for not applicable), your initials, and the date near the diagonal line.
2. If a procedural step is unnecessary, select N/A if it is indicated, or write a comment in an Addendum. The Qualification Representative and the Reviewer enter their initials and the date near the line.

**Note** The Qualification Representative and Reviewer must sign and date all forms, even when part or all of the form is marked N/A.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

## 5.0 Operational Qualification

This chapter contains the tests to be completed to perform an Operational Qualification for the SCION.

### 5.1 OQ Preparation

The following must be done before starting the OQ:

1. Preventative Maintenance must have been completed and signed off by the Qualification Representative, Reviewer, and QA/QC person, and attach a copy of the service report and add an addendum number.

Addendum P.M. Protocol

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

2. OQ must have been completed and signed off by the Qualification Representative, Reviewer, and QA/QC person.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

3. The QA/QC person must review, approve, append (if necessary), and sign the Pre-execution Approval.

Qualification Rep. Initials	<i>Sasha P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

4. The Qualification Representative and the Reviewer must sign and date the Pre-execution Approval.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

### 5.3 Data Sheet Specifications

Run these tests after the instrument has pumped down and is leak free. Use the factory methods. Follow the Installation Procedure; complete this section and the appropriate line of the OQ Summary. Print out the methods and results and attach as addendums. Use the factory test column Br-5ms 15m X 250 $\mu$ m X 0.25 $\mu$ m.

Table 5-1 TQ Specification

Mode	Concentration	Scan Range	Result $\uparrow$	N/A	Pass	Fail	Addendum
EI Full Scan	1 pg OFN	50-300	S/N $\geq$ 500:1				
EI MRM	100 fg OFN	272-222	S/N $\geq$ 5000:1				
PCI Full Scan $\ddagger$	10 pg BZP	80-230	S/N $\geq$ 50:1				
NCI Full Scan $\ddagger$	1 pg OFN	200-300	S/N $\geq$ 4000:1				

$\uparrow$  The Signal-to-Noise ratio S/N values are based on RMS noise figure.

$\ddagger$  CI tests use methane gas as reagent gas.

For any tests that did not pass, complete an Addendum for each, write the Addendum number and a brief description.

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	

Table 5-2 SQ Specification

Mode	Concentration	Scan Range	Result $\uparrow$	N/A	Pass	Fail	Addendum
EI Full Scan	1 pg OFN	50-300	S/N $\geq$ 600:1		<input checked="" type="checkbox"/>		
PCI Full Scan $\ddagger$	100 pg BZP	80-230	S/N $\geq$ 600:1	<input checked="" type="checkbox"/>			
NCI Full Scan $\ddagger$	200 fg OFN	200-300	S/N $\geq$ 1000:1	<input checked="" type="checkbox"/>			

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



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## 5.2 System Description

### 5.2.1 SCION Description

Installation Date:	2015	Principal Operator:		Phone Number:	
<b>Company Information</b>					
Company: United Analytical and Engineering			Installation Site: LAB		
Name:			Building:		
Address: 360/100 Sukvit 41			Address/Location: Sukhumvit Rd.		
City/State: Bangkok, Prachinburi			City/State: Bangkok		
Zip/Country: Thailand			Zip/Country: 10260		
<b>System Description</b>					
SCION	SA	Serial Number:	GQS1203F021		
Sales Order Number:		Sales Order Addendum Number:			
<b>GC</b>					
Module Type:	Scion 451	Serial Number:	BR1203M099		
<b>AutoSampler</b>					
Module Type:	AP 8400	Serial Number:	BR1203M099		
<b>MS Workstation</b>					
Version:	MSWS 8.2.1	Serial Number:	04106-6711-BBQ-4502		
<b>Computer Operating System</b>					
Operating System:	Windows 7	Version:	Pro	Serial No.:	00386-150436-158 Pack
<b>Computer</b>					
Make:	Dell	Model:	Optiplex	Serial No.:	DNV4451
Hard Drive:	1TB	Size / RAM:	4GB		
Addendum Number(s):	2. System description				

Qualification Rep. Initials	<i>Sahin P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 May 23	Date		Date	



เอกสารไม่ควบคุม

### 5.4 EI Precision Test TQ

The following precision tests are for systems with autosamplers only. The test solution is 1  $\mu$ g/ $\mu$ L OFN test mix part number 393065201.

The following is the required precision for 10 consecutive injections:

Injection	Retention Time	Peak Area
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
% RSD		

As an alternative, a % RSD summary report from MSWS can be added as an addendum.

Addendum N/A

	N/A	Pass	Fail	Addendum
Observed Mass is between 271.6 m/z to 272.4 m/z, which is $\pm$ 0.4 of the expected m/z.	<input checked="" type="checkbox"/>			
Retention Time $\leq$ 1% Relative Standard Deviation (RSD).	<input checked="" type="checkbox"/>			
Peak Area $\leq$ 10% Relative Standard Deviation (RSD).	<input checked="" type="checkbox"/>			

To complete this section use the factory MRM method on the system CD. Print a copy of the method and add as an addendum.

Addendum N/A

เอกสารไม่ควบคุม



If the hardware is not the same as the factory method, then note this in the addendum and how the hardware available has been configured to compensate. The most common variation here is the sampler, where the Combi Pal has been used instead of the 8400. This will have no impact on results and can be tracked and recorded in the addendum.

## 5.5 EI Precision Test SQ

The following precision tests are for systems with autosamplers only. The test solution is 1 pg/μL OFN test mix part number 393065201.

The following is the required precision for 10 consecutive injections:

Injection	Retention Time	Peak Area
1	3.680	75060
2	3.681	77980
3	3.680	72859
4	3.680	75512
5	3.680	65015
6	3.682	73959
7	3.680	82551
8	3.682	65509
9	3.679	72852
10	3.679	76104
% RSD	0.028	4.39

As an alternative, a % RSD summary report from MSWS can be added as an addendum.

Addendum \_\_\_\_\_

	N/A	Pass	Fail	Addendum
Observed Mass is between 271.6 m/z to 272.4 m/z, which is $\pm 0.4$ of the expected m/z.		✓		
Retention Time $\leq 1\%$ Relative Standard Deviation (RSD).		✓		
Peak Area $\leq 10\%$ Relative Standard Deviation (RSD).		✓		

เอกสารไม่ควบคุม

## 5.6 Final Evaluation

	N/A	Pass	Fail	Addendum
Is the equipment in normal operation condition?		✓		
Have all of the OQ requirements been completed?		✓		

Qualification Rep. Initials	<i>Sahn P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

To complete this section use the factory Scan method on the system CD. Print a copy of the method and add as an addendum.

Addendum N/A

If the hardware is not the same as the factory method, then note this in the addendum and how the hardware available has been configured to compensate. The most common variation here is the sampler, where the Combi Pal has been used instead of the 8400. This will have no impact on results and can be tracked and recorded in the addendum.

Addendum N/A

## 6.0 Protocol Approval

### 6.1 Protocol Acceptance / Approval by Customer

I agree that the procedures and information referenced in this document are applicable.

Instrument(s): Scion 451 SA with CP8400

Serial Number(s): GQS1203F021

Sales Order Number: \_\_\_\_\_

Company Name: United Analyst and Engineering Consultant Co., Ltd.

I agree that the Operational Qualification Protocol has been satisfactorily completed.	<input checked="" type="checkbox"/>
I confirm that the Operational Qualification Protocol has not been completed, because of these failed (non-passed) items	<input type="checkbox"/>

### Authorized Customer Representative

Name (Print)	
Title	
Signature	
Initials	
Date	

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

## 6.2 Operational Qualification Protocol Assignment

This Operational Qualification Protocol document is used for:

Operational Qualification Protocol as final test at Scion	<input type="checkbox"/>
Operational Qualification Protocol after Installation Qualification	<input type="checkbox"/>
Operational Qualification Protocol after Preventive Maintenance and OQ completion.	<input checked="" type="checkbox"/>

## 6.3 Protocol Acceptance / Protocol Approval by Scion

I agree that the procedures and information referenced in this document are applicable.

Instrument(s): Scion 451 SA with DP 8400

Serial Number(s): GXS 1203F021

Sales Order Number: \_\_\_\_\_

Company Name: United Analyst and Engineering Consultant Co., Ltd.

เอกสารไม่ควบคุม

### Scion Certified Engineer

Name (Print)	SOMCHAI POHTONGKAM
Title	ENGINEER
Signature	<i>Somchai P.</i>
Initials	SOMCHAI
Date	



## 6.4 Remarks

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เอกสารไม่ควบคุม

## Appendices

Each page that is inserted after the appendix is numbered with the letter of the appendix and a sequential number. The appendix page number must be initialed and dated by both the Qualification Representative and the Reviewer.

For example, pages inserted after Appendix C are numbered C-1, C-2, C-3...etc along with the initials and date.

If the reverse of each appendix page is left blank it should be marked NA and signed and dated.

When the OQ is complete the total number of pages inserted after each appendix is written on the front page of the respective appendix sheet.

เอกสารไม่ควบคุม

## A.1 Qualification Representative Details

The Qualification Representative is to insert a copy of their appropriate qualification(s) after this page.

No. of Pages Inserted	
-----------------------	--

This area is intentionally left blank.

เอกสารไม่ควบคุม

**B.1 Exceptions**

Each Exception Report shall be issued with a unique identification number in the form of ERID-XX-X. This number is generated by the page number on which the exception occurred followed by a sequential number indicating each exception found on the page.

For example, if an exception occurs on page 34, it shall be identified as Exception Report 'ERID-34-1'. If another exception occurs on page 34, the second exception shall be identified as 'ERID-34-2'. This identification number should be recorded in the pass/fail field after each test.

Insert Exception Reports (if any) after this page.

No. of Pages Inserted	N/A
-----------------------	-----

*This area is intentionally left blank.*

เอกสารไม่ควบคุม

Addendum Procedure: 2. System description Page Number: 5

Qualification Rep. Initials	<i>Saku' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

Addendum Procedure: P.M. Protocol Page Number: 1

Addendum Procedure: 2. Test Result Page Number: 30

Qualification Rep. Initials	<i>Saku' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม

Qualification Rep. Initials	<i>Saku' P.</i>	Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



เอกสารไม่ควบคุม



## Calibration Certificate

Certificate No.: 2303560-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udomsak 41, Sukhumvit Road,  
Bangchack, Prakhong, 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.: 2303560  
Operation No.: 2303560-001  
Date of Receipt: 23 June 2023  
Date of Calibration: 26 June 2023

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

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

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

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

Qualification Rep. Initials		Reviewer Initials		QA/QC Initials	
Date	23 MAY 23	Date		Date	



Publication no. 39420700, Revision A, November 2011

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เอกสารไม่ควบคุม

## Operational Qualification Protocol Certification

for

SCION

with the serial number

GQS1203F021

has successfully completed all criteria for hardware Operational Qualification Protocol  
as detailed in this document.

Scion Certified Engineer

SOMCHAI POHTONGKAM  
Name (please print)



Signature

Date

23 MAY 23

Authorized Customer Representative

Name / Function (please print)

Signature

Date

Customer Address

United Analyst and Engineering Consultant Co., Ltd.

Publication no. 39420700, Revision A, November 2011

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เอกสารไม่ควบคุม

## Calibration Report

Certificate No.: 2303560-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: Mettler Toledo  
Model: Seven Compact S220  
Serial No.: C113432421  
Type: Bench top  
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023 Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature: ( 24.3 ± 1.5 ) °C Relative Humidity: ( 40 ± 3 ) %

Condition of Equipment: Good Condition

Condition of this Results of Calibration

1. Calibration Method: In house method: W-C5-002 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	2709037	Fuke	23E2003	14 June 2024	
2.2 Digital Thermometer	2709037	Fuke	CC-655657-01	30 October 2023	
2.3 Thermo-Hygro Meter	NFLBTH003/17	PCNPE	TE 650555-01	21 September 2023	
Certified Reference Material		Lot. No.	Manufacturer	Ref. No.	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH216-L5	18 February 2023	
2.5 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107-L5	18 February 2024	
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220-L5	18 February 2024	
2.7 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217-L5	18 February 2025	

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

- 3.1 Instruments No.2.1 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0068  
3.2 Instruments No.2.2 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061  
3.3 Instruments No.2.3 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061  
3.4 Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method: Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025  
3.5 Certified Reference Material No.2.7 traceable to BM RefH H-15 LotN 25.05.2022; BM RefH H-16 LotN 02.06.2022; BM RefH H-15 LotN 25.05.2022; BM RefH H-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.

  
27 June 2023

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

## Calibration Report

Certificate No.: 2303560-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: Mettler Toledo  
Model: Seven Compact S220  
Serial No.: C113432421  
Type: Bench top  
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023 Page 3 of 5

### Calibration Results:

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

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

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

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

Certified Value (25 °C (pH))	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	177	-	0.0071	2.00
6.855	6.90	9	96.26	0.0074	2.00
10.01	10.01	-168	96.20	0.0085	2.00
6.886	7.02	3	-	0.0093	2.00

*P. Janyasakul*  
27 June 2023

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



เอกสารไม่ควบคุม

## Calibration Report

Certificate No.: 2303560-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: Seven Compact S220  
Serial No.: C113432421 ID No.: UAE.WAT.009/2564  
Manufacturer: Mettler Toledo

Date of Calibration: 26 June 2023 Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

### Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.
- Description of probe, model: H11310 S/N: 078743

Dimension of probe: Diameter 12 mm, Length 175 mm.

Sheath material: Plastic

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

Note: \* UUC\*: Unit Under Calibration

*P. Janyasakul*  
27 June 2023

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

----- End -----

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



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## Calibration Report

Certificate No.: 2303560-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C Model: Seven Compact S220  
Serial No.: C113432421 ID No.: UAE.WAT.009/2564  
Manufacturer: Mettler Toledo

Date of Calibration: 26 June 2023 Page 4 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature ( 24.4 ± 1.0 ) °C  
Relative Humidity ( 54 ± 2 ) %

### Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2533097	PSL-T 1282/85	03-Nov-23	TISTR
Platinum Resistance Thermometer (PRT)	5627A	923972			

Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341992/2

- 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.

6. Condition of Calibrated Item : Good  
7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

*P. Janyasakul*  
27 June 2023

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



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## Calibration Certificate

Certificate No.: 2203120-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhonong, Bangkok 10260

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: AB204-S/FACT

Serial No.: 1129361010

ID No.: UAE.WAS.002/2552

Order No.: 2203120

Operation No.: 2203120-001

Date of Receipt: 1 June 2022

Date of Calibration: 1 June 2022

Calibrated by Mr.Taveesak Seilee Scientist

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

Date of Issue: 7 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.

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



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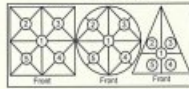






Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0459OC-1

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



Maximum difference between off-center and central loading

### 2. Effect of off center loading

A mass of 100 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)
-0.0001	-0.0001	0.0000	-0.0001	-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	2.13
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	0.00000	0.16	2.00
150	150.00000	0.00000	0.29	2.00
200	200.00000	0.00000	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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Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0575OC-1

Cert. No.: 22TM1490  
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) 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

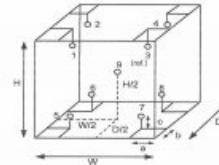
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



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 m³

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

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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: 0-2717-3900-27 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.0272559  
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 Bulkrusa  
(✓) 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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Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0575OC-1

Cert. No.: 22TM1490  
Page : 3 of 3

Result of Calibration :- (°) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* 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

Measured Temperature (°C)									
Calibration Point (°C)	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	178.643	179.753	181.011	180.093	179.496	179.743	181.278

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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1133251



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



Cert. No.: 23TM378  
Page : 1 of 3

## Certificate of Calibration

**Equipment :** Incubator  
**Manufacturer :** Memmert  
**Model :** IPP 260  
**Serial No. :** VB15.0187  
**ID No. :** UAE.MIC.003/2559  
**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 :** 12 April 2023  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**Calibrated by :** Preecha Hishib  
**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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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

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**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2304-0155OC-1  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Not Available

Cert. No.: 23TM378  
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	0.052	0.53	0.60	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty  ( ± °C )
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	35.092	35.148	34.817	35.149	34.894	35.323	34.773	35.058	34.602	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



**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2304-0155OC-1  
**Procedure Used :-**

Cert. No.: 23TM378  
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	MY49001451	23LM27	25 Feb 2024

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

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

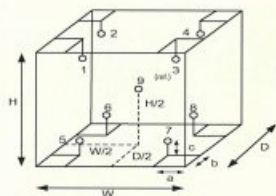
**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	26
REL.Humid. ( % )	57	61
AC Supply ( Volt )	220	220

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



### Probe Installation Details :

### Dimension of Chamber :

a = 5.0 cm	D = 0.50 m
b = 5.0 cm	W = 0.84 m
c = 5.0 cm	H = 0.80 m
	Capacity = 0.26 m³

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM728  
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 :**   
( ) Pornthippa 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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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

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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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 534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
 TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM193  
 Page : 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
 Manufacturer : Memmert  
 Model : WNE 14  
 Serial No. : L416.0608  
 ID No. : UAE.MIC.002/2560  
 Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
 3 Soi Udomsuk 41, Sukhumvit Road,  
 Bangkok, Phrakhanong,  
 Bangkok 10260  
 Location : Microbiology Laboratory  
 Received Order : 15 February 2023  
 Calibration Date : 15 February 2023  
 Ambient Temperature : ( 26 ± 10 ) °C  
 Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Suwit Imjai

Approved by :   
 Approved Signatory

( ) Pornthipha Tameyakul  
 ( / ) Malee Butkruea

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 3 : Equipment, Calibration and Testing Services

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

Cert. No.: 23TM728  
 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.

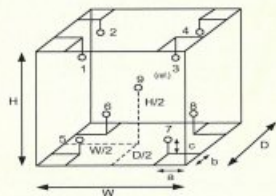
Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

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

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



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.50 m
b = 10 cm	W = 0.64 m
c = 10 cm	H = 0.80 m
	Capacity = 0.26 m <sup>3</sup>

เอกสารไม่ควบคุม



Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2302-0295OC-2  
 Procedure Used :-

Cert. No.: 23TM193  
 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

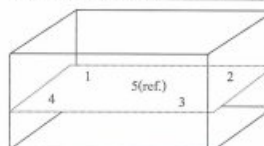
2. This certificate is valid only to the item calibrated on date and place of calibration.

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	23	61	231



Front

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

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Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295OC-2  
Result of Calibration : ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM193  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.453	44.437	44.428	44.477	44.459

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.079	0.036	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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Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295OC-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

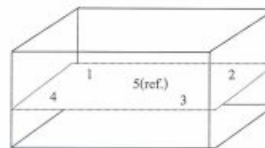
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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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.: 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 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Suwit Imjai

Approved by :   
( ) Pornthipha Tameyakul  
( ) Malee Butkrusae

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 3: Equipment Calibration and Testing Services

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Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295OC-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 )				
			Position				
			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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Cert.No.: 23MM150  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Electronic Balance  
Manufacturer : Mettler Toledo  
Model : MS603S J01  
Serial No. : B007010311  
ID No. : UAE.TOX.008/2553  
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%

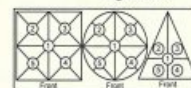
This certificate may not be reproduced other than in full, except with the prior written  
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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0016OC-1

Cert.No.: 23MM150  
Page: 3 of 3



### Result of calibration

#### 2. Effect of off center loading

A mass of 200 g was placed to various position on the pan.  
The weighing machine reading error obtained is given in the table

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
-0.001	+0.001	+0.001	-0.002	-0.002	0.002

#### 3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.000	0.000	1.3	2.09
0.5	0.499	+0.001	1.3	2.09
1	0.999	+0.001	1.3	2.09
50	50.000	0.000	1.3	2.09
100	99.999	+0.001	1.3	2.09
150	149.999	+0.001	1.3	2.09
200	199.999	+0.001	1.3	2.09
300	299.999	+0.001	1.4	2.07
400	399.999	+0.001	1.6	2.11
500	500.000	0.000	1.7	2.11
600	599.999	+0.001	1.7	2.09

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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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-0016OC-1

Cert.No.: 23MM150  
Page: 2 of 3

### Procedure used :-

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

### Condition of this result of calibration

#### 1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024
2) Standard Weight (E2)	158471	-	70RC197	MM-0059-22	25 Apr 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 620 g Resolution 0.001 g

#### Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
300	299.999	+0.001	1.4	2.07
600	599.997	+0.003	1.7	2.09

#### After Adjustment :

#### 1. Determination of the standard deviation of weighing machine

Applied Weight (g)	Standard Deviation of Reading (g)
300	0.0006
600	0.0008

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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 Hishib  
Approved by :   
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Autoclave  
 Condition As-Received : Used Item  
 Reference : 2304-04610C-2

Cert. No.: 23TM763  
 Page : 2 of 3

#### Procedure Used :-

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	34972A	MY59003411	22LM165	26 Nov 2023

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

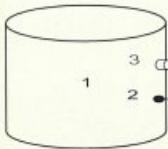
3. This certification is traceable to the International System of Unit.

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	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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#### 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/en-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.

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Equipment : Autoclave  
 Condition As-Received : Used Item  
 Reference : 2304-04610C-2

Cert. No.: 23TM763  
 Page : 3 of 3

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

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

#### System Information

Instrument system name and ID	ICP-OES 5110 v01
Instrument system site and location	UAE Consultant
List system component product numbers	List the serial numbers of each component
1. 830154	1. MY 150 3000 1
2.	2.
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

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**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 HP 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.

**Agilent Water Recirculator**

- ☐ **Section NOT Applicable**
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean, and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Polyclear Plus cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

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

- ☒ 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	4062.3	7556.1	4196.3	2910.7
Mn 257.610 nm SRBR	11415.1	36894.7	11493.6	34660.9
Al 396.152 nm SBR	7.3	15.7	8.7	13.5
K 766.491 nm SBR	5.3	31.9	5.7	44.4

\* 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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**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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**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**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	225.713	VAC	224.510	VAC
Mains Current	0.219	A	0.273	A
Instrument Temperature	23.4	°C	23.5	°C
RF Air Flow (sensor speed)	14.0	Hz	19.0	Hz
Plasma Exhaust Temperature	No measurement		55.0	°C
Water Flow Oscillator	No measurement		1.03	L/min
Water Flow Detector	0.80	L/min	1.33	L/min
Water Inlet Temperature	19.1	°C	12.8	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	26.9	°C	-38.7	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	614.15	kPa	629.92	kPa
Purge Gas Supply Pressure*1	441.34	kPa	654.13	kPa
Option Gas Supply Pressure*1	-	kPa	-	kPa
Nebulizer Flow	No measurement		0.10	L/min
Nebulizer Back Pressure	No measurement		163.85	kPa
Plasma Gas Flow	No measurement		15.00	L/min
Auxiliary Gas Flow	No measurement		1.10	L/min
RF Power	No measurement		1207.1	W
RF Supply Current	No measurement		5.233	A
RF Supply Voltage	No measurement		194.518	V

\*1 If option installed

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# Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

## ICP-OES Parts List Table

Part description	Part Number	Product /Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A, G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Plus Cooling Fluid	G3292-80012	Agilent Water Recirculator	-
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	-
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	-
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	-
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	-
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	-
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	-
<b>Additional Parts may be required from engineers stock:</b>			
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 IIF 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.

Issued: 4 March 2021, Revision: A.01

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Agilent Technologies

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	Nukoon L.
Test Completed On	12/9/2021 9:14:59 AM

## Result Summary

Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

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เอกสารไม่ควบคุม



# Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

- ☒ 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: 8004532117 Date service completed: 09/12/21

Agilent signature: Nukoon L. Customer signature: Aphorn Onkong

Document part number: G8014-90075

Issued: 4 March 2021, Revision: A.01

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Agilent Technologies

เอกสารไม่ควบคุม

## Resolution Test

Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.27
As (188.980 nm)	≤ 8.20	6.23
C (193.027 nm)	≤ 11.50	8.26
Mo (202.032 nm)	≤ 8.20	6.42
Cr (206.158 nm)	≤ 13.40	9.27
Zn (213.857 nm)	≤ 8.70	6.77
Pb (220.353 nm)	≤ 9.50	7.12
Co (228.615 nm)	≤ 17.20	11.88
Ba (230.424 nm)	≤ 9.40	7.36
Mn (257.610 nm)	≤ 13.30	9.52
Mn (260.568 nm)	≤ 20.30	14.30
Cr (267.716 nm)	≤ 11.00	7.99
Cu (324.754 nm)	≤ 25.00	19.08
Cu (327.395 nm)	≤ 14.20	11.32
Sr (338.071 nm)	≤ 33.50	24.39
Ba (455.403 nm)	≤ 44.00	33.86
Sr (460.733 nm)	≤ 36.00	17.38
Ba (493.408 nm)	≤ 36.00	25.53
Ba (614.171 nm)	≤ 42.00	24.99
Ar (675.283 nm)	≤ 74.00	59.49
K (766.491 nm)	≤ 80.00	65.27

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เอกสารไม่ควบคุม

Sensitivity Test		Pass			
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	167.2	1131.3	42.4
Se (196.026 nm)	≥ 41.0	SRBR	119.1	1177.1	84.2
Zn (213.857 nm)	≥ 1421.0	SRBR	4082.3	49908.2	148.6
Pb (220.353 nm)	≥ 46.0	SRBR	191.1	2682.8	172.6
Mn (257.610 nm)	≥ 3518.0	SRBR	11415.2	265002.2	536.8
Al (396.152 nm)	≥ 3.4	SBR	7.8	49838.0	5676.5
Ba (493.408 nm)	≥ 34.0	SBR	116.1	1999041.4	17066.5
K (766.491 nm)	≥ 1.8	SBR	5.3	101078.4	16104.6
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	252.9	3214.2	147.0
Se (196.026 nm)	≥ 159.0	SRBR	216.2	3639.7	272.2
Zn (206.200 nm)	≥ 234.0	SRBR	1203.3	14046.1	133.7
Zn (213.857 nm)	≥ 1743.0	SRBR	7856.1	171323.1	472.9
Cd (214.439 nm)	≥ 4227.0	SRBR	7054.9	129539.3	335.4
Pb (220.353 nm)	≥ 320.0	SRBR	531.7	13218.2	566.2
Mn (257.610 nm)	≥ 10625.0	SRBR	30884.7	1314844.0	1807.4
Cr (267.716 nm)	≥ 1048.0	SRBR	4442.1	174420.3	1515.1
Cu (324.754 nm)	≥ 19.0	SBR	50.7	374603.6	7249.0
Al (396.152 nm)	≥ 6.0	SBR	15.7	279915.3	16790.4
Ba (493.408 nm)	≥ 60.0	SBR	209.7	10899956.6	51728.3
K (766.491 nm)	≥ 24.0	SBR	38.9	1983197.5	49746.6

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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	Nukoon L.	
Test Completed On	12/9/2021 12:55:49 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	5296135	5755042
Wavelength	737.212	737.212

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เอกสารไม่ควบคุม

Precision Test		Pass
Radial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.81
Se (196.026 nm)	≤ 2.60	1.21
Zn (213.857 nm)	≤ 1.50	0.39
Pb (220.353 nm)	≤ 2.60	0.41
Mn (257.610 nm)	≤ 1.50	0.45
Al (396.152 nm)	≤ 1.50	0.41
Ba (493.408 nm)	≤ 1.50	0.51
K (766.491 nm)	≤ 1.50	0.36
Axial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.51
Se (196.026 nm)	≤ 1.50	0.73
Zn (206.200 nm)	≤ 1.50	0.30
Zn (213.857 nm)	≤ 1.50	0.37
Cd (214.439 nm)	≤ 1.50	0.36
Pb (220.353 nm)	≤ 1.50	0.28
Mn (257.610 nm)	≤ 1.50	0.63
Cr (267.716 nm)	≤ 1.50	0.30
Cu (324.754 nm)	≤ 1.50	0.54
Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.64
K (766.491 nm)	≤ 1.50	0.56

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เอกสารไม่ควบคุม

Resolution Test		Pass	
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	7.22	
As (188.980 nm)	≤ 8.20	6.15	
C (193.027 nm)	≤ 11.50	8.22	
Mo (202.032 nm)	≤ 8.20	6.33	
Cr (206.158 nm)	≤ 13.40	9.21	
Zn (213.857 nm)	≤ 8.70	6.87	
Pb (220.353 nm)	≤ 9.50	7.02	
Co (228.615 nm)	≤ 17.20	11.81	
Ba (230.424 nm)	≤ 9.40	7.46	
Mn (257.610 nm)	≤ 13.30	9.49	
Mn (260.568 nm)	≤ 20.30	14.19	
Cr (267.716 nm)	≤ 11.00	7.90	
Cu (324.754 nm)	≤ 25.00	18.92	
Cu (327.395 nm)	≤ 14.20	11.32	
Sr (338.071 nm)	≤ 33.50	24.29	
Ba (455.403 nm)	≤ 44.00	33.68	
Sr (460.733 nm)	≤ 36.00	17.64	
Ba (493.408 nm)	≤ 36.00	25.56	
Ba (614.171 nm)	≤ 42.00	24.75	
Ar (675.283 nm)	≤ 74.00	59.18	
K (766.491 nm)	≤ 80.00	65.19	

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เอกสารไม่ควบคุม



Sensitivity Test			Pass			
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 46.0	SRBR	154.8	1242.3	58.5	
Se (196.026 nm)	≥ 41.0	SRBR	117.4	1259.6	97.9	
Zn (213.857 nm)	≥ 1421.0	SRBR	4192.8	52402.6	155.3	
Pb (220.353 nm)	≥ 46.0	SRBR	196.4	2814.2	179.9	
Mn (257.610 nm)	≥ 3518.0	SRBR	11993.6	281210.1	547.6	
Al (396.152 nm)	≥ 3.4	SBR	8.7	55103.6	5662.9	
Ba (493.408 nm)	≥ 34.0	SBR	125.4	2152916.9	17032.2	
K (766.491 nm)	≥ 1.8	SBR	5.7	107906.7	16079.8	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	297.5	4054.8	170.4	
Se (196.026 nm)	≥ 159.0	SRBR	260.2	4794.9	298.5	
Zn (206.200 nm)	≥ 234.0	SRBR	1305.9	16162.3	150.3	
Zn (213.857 nm)	≥ 1743.0	SRBR	8920.7	200915.6	504.7	
Cd (214.439 nm)	≥ 4227.0	SRBR	7958.3	149327.5	350.4	
Pb (220.353 nm)	≥ 320.0	SRBR	606.7	15244.5	584.0	
Mn (257.610 nm)	≥ 10625.0	SRBR	34460.9	1493092.8	1872.5	
Cr (267.716 nm)	≥ 1048.0	SRBR	5018.6	198000.6	1532.6	
Cu (324.754 nm)	≥ 19.0	SBR	57.5	423683.7	7248.6	
Al (396.152 nm)	≥ 6.0	SBR	18.5	320004.9	16441.4	
Ba (493.408 nm)	≥ 60.0	SBR	233.3	11882915.4	50714.5	
K (766.491 nm)	≥ 24.0	SBR	44.6	2218974.4	48657.9	

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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	Nukoon L.
Test Completed On	12/9/2021 1:34:10 PM
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
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

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	1.38	
Se (196.026 nm)	≤ 2.60	0.91	
Zn (213.857 nm)	≤ 1.50	0.38	
Pb (220.353 nm)	≤ 2.60	0.44	
Mn (257.610 nm)	≤ 1.50	0.43	
Al (396.152 nm)	≤ 1.50	0.38	
Ba (493.408 nm)	≤ 1.50	0.66	
K (766.491 nm)	≤ 1.50	0.36	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.61	
Se (196.026 nm)	≤ 1.50	0.52	
Zn (206.200 nm)	≤ 1.50	0.36	
Zn (213.857 nm)	≤ 1.50	0.33	
Cd (214.439 nm)	≤ 1.50	0.41	
Pb (220.353 nm)	≤ 1.50	0.36	
Mn (257.610 nm)	≤ 1.50	0.74	
Cr (267.716 nm)	≤ 1.50	0.25	
Cu (324.754 nm)	≤ 1.50	0.71	
Al (396.152 nm)	≤ 1.50	0.44	
Ba (493.408 nm)	≤ 1.50	0.73	
K (766.491 nm)	≤ 1.50	0.97	

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เอกสารไม่ควบคุม

Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	203.60	2.00	1.99	108.66
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	113.89	18.00	17.93	24.24
RF Generator Test			Pass		
RF Power Supply Test		Passed			
RF Power Supply (V)		141.475			
RF Oscillator Test		Passed			
RF Oscillator Frequency (MHz)		25.874			
Work Coil Current (A)		45.931			
RF Power Supply Current (A)		2.000			
Camera Test			Pass		
	Integration Time (ms)	Standard Deviation	Status		
Electronic Offset Test	1000	5.261	Passed		
Dark Current Test	6000	0.734	Passed		
Array Test	5	0.024	Passed		
Linearity Test		0.118	Passed		

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เอกสารไม่ควบคุม



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-MEB708640

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

3 Soi Udomsuk41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

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

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

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

CALIBRATION DATE : 2 February 2023

REFERENCE MATERIAL : Traceable to NIST "Carlo Erba", "PanReac AppliChem"

Cadmium Lot No. 1152457, Chromium Lot No. 1793249, Copper Batch No. T117098A, Iron Batch No. T126087A, Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated by 1. Dani Sathongkum  
( Mr. Danal Srithongkum )

Approved by Sunee Saeed  
( Miss Sunee Saeed )

2. Atipat  
( Mr. Atipat Ratana )

Senior Technical Officer  
Acting Director of Analytical Chemistry Laboratory

Ref. 2015266012600366001

Issued Date : 15 February 2023

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

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Request No. 25-66 / 0323

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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	0.2235	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	0.0436	0.043	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	0.0441	0.0446	0.0444	0.044	0.045	0.0006	1.27
	1.00	0.0904	0.0901	0.0891	0.0876	0.0873	0.0901	0.0876	0.0886	0.0879	0.0901	0.089	0.0012	1.38
Pb	0.20	0.0093	0.0099	0.0104	0.0102	0.0104	0.0109	0.0102	0.0103	0.0115	0.0117	0.010	0.0007	6.85
	0.70	0.0344	0.0336	0.0336	0.0328	0.0338	0.0346	0.0336	0.0331	0.0343	0.0350	0.034	0.0007	2.02
	1.50	0.0709	0.0718	0.0706	0.0713	0.0698	0.0718	0.0712	0.0713	0.0715	0.0719	0.071	0.0006	0.90
Mn	0.05	0.0115	0.0130	0.0131	0.0127	0.0135	0.0136	0.0124	0.0133	0.0124	0.0130	0.013	0.0006	4.88
	0.30	0.0709	0.0700	0.0714	0.0704	0.0700	0.0705	0.0714	0.0698	0.0694	0.0700	0.070	0.0007	0.96
	0.70	0.1619	0.1633	0.1646	0.1638	0.1646	0.1614	0.1632	0.1614	0.1636	0.1652	0.163	0.0014	0.83
Ni	0.10	0.0113	0.0105	0.0113	0.0114	0.0110	0.0113	0.0117	0.0112	0.0107	0.0117	0.011	0.0004	3.45
	0.50	0.0509	0.0517	0.0508	0.0502	0.0517	0.0516	0.0516	0.0523	0.0518	0.0503	0.051	0.0007	1.36
	1.00	0.0997	0.1006	0.1006	0.1006	0.0996	0.0998	0.1007	0.1000	0.1013	0.0999	0.100	0.0006	0.55
Zn	0.05	0.0315	0.0309	0.0322	0.0304	0.0329	0.0312	0.0313	0.0319	0.0308	0.0311	0.031	0.0007	2.35
	0.30	0.1705	0.1728	0.1688	0.1693	0.1711	0.1704	0.1704	0.1707	0.1708	0.1688	0.170	0.0012	0.70
	0.70	0.3559	0.3572	0.3548	0.3560	0.3559	0.3550	0.3579	0.3552	0.3574	0.3573	0.356	0.0011	0.31

Continue 3 / 5

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Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2325 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2571 6392  
Fax. (66) 0 2571 6392  
E-mail : sunee@tistr.or.th

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Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

## CALIBRATION DATA

## 1. Noise Level

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

Continue 2 / 5

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FM.BLMTC.002 Rev.4

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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

Continue 4 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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E-mail : numpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Soi 1C, Bangpoo Industrial Estate, Sukhum



Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

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

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

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

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

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

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

Continue 5 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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เอกสารไม่ควบคุม 5225, 5217

Request No. 25-66 / 0323

5 / 5

MTC. ACL. No. 387 / 66

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

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

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

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

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

Calibrated by 1. Dani Srithongkum  
(Mr. Danai Srithongkum)  
2. Atipat  
(Mr. Atipat Ratana)

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

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

End of Certificate

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

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E-mail : sumalee@tistr.or.th

เอกสารไม่ควบคุม 5225, 5217

## Certificate of Calibration

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 Udumuk 41 Sukhumvit Road,  
Bangkok, Prakanong, Bangkok 10260 Thailand

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

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

Calibration By: 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, 838313, 838316

(Mr. Atachai Ngamchanat)

Person in charge

(Mr. Nitnun Srihawan)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).  
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.  
ชื้อเอกสารควบคุม 5225, 5217  
DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260  
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CAL-FM-C24-09: 12 Sep 2022

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Certificate No.: C24230059

Page: 2 of 2

## Calibration Results:

## Before Adjustment

Standard	Unit Under Calibration	Correction	Coverage Factor	Uncertainty ( ± )
Conductivity Solution	Reading		( k )	
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	Unit Under Calibration	Correction	Coverage Factor	Uncertainty ( ± )
Conductivity Solution	Reading		( k )	
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

เอกสารไม่ควบคุม

CAL-FM-C24-09: 12 Sep 2022



# ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม



เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab 955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ชื่อ)		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 ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ – เปิด 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. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวคูณเลือกความยาวคลื่น (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. ช่องวัดหลายตัวอย่าง (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. ฝาปิดกันปลาย 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. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
Automatic titrator					
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ 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. ระบบท่อสายยาและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ: Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 ±0.1°C

Mr. Atachai Ngamchanat

Service Engineer

เอกสารไม่ควบคุม

CAL-FM-R31-03: 20 Jul 2022

บริษัท ดีเคเอส อีเซีย จำกัด  
DKSH Technology Limited  
2533 สุขุมวิท 39, แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certification-thailand  
Delivering Growth - in Asia and Beyond.

## Calibration Report

Certificate No.:	2301846-001-01			
Equipment:	pH Meter	Resolution:	0.01 pH     1 mV	
	Manufacturer:	Mettler Toledo	Model:	SevenEasy TM S20 pH
	Serial No.:	1231155210	Type:	Bench top
	ID No.:	UAE.WAT.010/2553		
Date of Calibration:	24 February 2023			
		Page 2 of 5		
Location:	Chemical Calibration Laboratory, National Food Institute			
Environment Condition:	Ambient Temperature: ( 25.1 ± 1.5 ) °C	Relative Humidity: ( 50 ± 5 ) %		
Condition of Equipment:	Good Condition			
Condition of this Results of Calibration	In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)			
1. Calibration Method	In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)			
2. Reference Standards / Certified Reference Material				
<u>Instruments</u>	<u>Serial / ID No.</u>	<u>Manufacturer</u>	<u>Certificate No.</u>	<u>Due Date</u>
2.1 DC Voltage Calibrator	2709007	Fuke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fuke	CC 60677-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH 007/15	PONPE 430	QR22-0886	26 April 2023
<u>Certified Reference Material</u>	<u>Lot No.</u>	<u>Manufacturer</u>	<u>Ref. N</u>	<u>Expiry Date</u>
2.4 pH buffer 4.008 (Primary pH buffer Solution)	832608	CPAchem	PH216.L5	8 August 2024
2.5 pH buffer 6.865 (Primary pH buffer Solution)	832607	CPAchem	PH217.L5	8 August 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	832609	CPAchem	PH220.L5	8 August 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)	832610	CPAchem	PH107.L5	8 August 2023
3. This certification is traceable to The International System of Unit (SI Unit)				
3.1 Instruments No 2.1	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0068		
3.2 Instruments No 2.2	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061		
3.3 Instruments No 2.3	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0292		
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Homed cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025		
3.5 Certified Reference Material No.2.7	traceable to	BIM RefH H-27 Lot# 04.05.2021; BIM RefH H-28 Lot# 28.05.2021; BIM RefH H-27 Lot# 04.05.2021; BIM RefH H-28 Lot# 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

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## Calibration Certificate

Certificate No.: 2301846-001-01  
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter  
Manufacturer: Mettler Toledo  
Model: SevenEasy TM S20 pH  
Serial No.: 1231155210  
ID No.: UAE.WAT.010/2553  
Order No.: 2301846  
Operation No.: 2301846-001  
Date of Receipt: 17 February 2023  
Date of Calibration: 24 February 2023

Calibrated by Mr. Worapob Sooklong  
Scientist  
Approved by N. Niyomchart  
(Mr. Nuttapol Niyomchart)  
Specialist, Division of Calibration Laboratory  
Responsible for the Technical Management Team  
Date of Issue: 24 February 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement 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.:2301846-001-01

Resolution:0.01 pH : 1 mV

Equipment:pH Meter

Manufacturer:Mettler Toledo

Model:SevenEasy TM S20 pH

Serial No.:1231155210

Type:Bench top

ID No.:UAE.WAT.010/2553

Date of Calibration:24 February 2023

Page 3 of 5

Calibration Results:

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.120	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.158	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

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

Equipment:pH Electrode

Type:Combined Electrode

Manufacturer:Mettler Toledo

Model:InLab Solids

Serial No.:9018311

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	186	-	0.0071	2.00
6.865	6.90	19	97.86	0.0075	2.00
10.008	10.01	-160	97.29	0.0095	2.00
6.865	6.99	15	-	0.0092	2.00

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เอกสารไม่ควบคุม

## Calibration Report

**Certificate No.:** Z301846-001-01  
**Equipment:** Digital Thermometer with RTD  
 Resolution: 0.1 °C Model: SevenEasy TM S20 pH  
 Serial No.: 1231155210 ID No.: UAE.WAT.010/2553  
 Manufacturer: Mettler Toledo

**Date of Calibration:** 24 February 2023

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**Location:** Chemical 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	1523	2118154	PSL-T 0673/65	07-Jun-23	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (Micro Bath), Model: 7103, S/N: A39538,AN65 AB5181.

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

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## Calibration Report

**Certificate No.:** Z301846-001-01  
**Equipment:** Digital Thermometer with RTD  
 Resolution: 0.1 °C Model: SevenEasy TM S20 pH  
 Serial No.: 1231155210 ID No.: UAE.WAT.010/2553  
 Manufacturer: Mettler Toledo

**Date of Calibration:** 24 February 2023

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**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	15.015	- 0.1	0.11
25.0	25.014	0.0	0.11
35.1	35.016	- 0.1	0.11

### 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 -----

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