

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือที่ใช้ในการตรวจวิเคราะห์

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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>Stack</b>									
1	Pre-Test Console	Total Suspended Particulate	Apex Instruments, USA.	XC-572-V A2003277	Envi Equipment Service Co., Ltd.	E23-04045	28 Apr 23	27 Apr 24	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 61658783	Entech Industrial Sulation Co., Ltd.	G 650651	28 Sep 22	27 Sep 23	-

### List of Opacity Training Certification for Opacity Mesurement

No.	Name		Training Couse	Train	Date	Remark
1			Opacity	Pollution Control Department	30-31 March 2017	-
2			Opacity	Pollution Control Department	30-31 March 2017	-

## 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> )	Andersen Instruments, Inc.	G25A 11MX	Tisch Environmental, Inc.	28062022	28 Jun 21	27 Jun 23	-
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)	22P918	11 Jul 22	10 Jul 23	-
3	Air Flow Meter	Particular Matter (PM <sub>2.5</sub> )	Mesa Labs	DeltaCal DC1 158850	Innovative Instrument Co., Ltd.	22-AFM-116	16 Aug 22	15 Aug 23	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> ) Particular Matter (PM <sub>2.5</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1587	27 Jul 22	26 Jul 23	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 42C-0508011076	UAE Consultant Co., Ltd.	18032023	18 Mar 23	17 Mar 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Fisher Scientific	42C 0517512000	UAE Consultant Co., Ltd.	16032023	16 Mar 23	15 Mar 24	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 0517512001	UAE Consultant Co., Ltd.	20042023	20 Apr 23	19 Apr 24	-
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM08130002	UAE Consultant Co., Ltd.	11012023	11 Mar 23	10 Jan 24	-
10	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0607415779	UAE Consultant Co., Ltd.	03052023	3 May 23	2 May 24	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0611116459	UAE Consultant Co., Ltd.	07042023	7 Apr 23	6 Apr 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>Ambient</b>									
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43TLC-78567-389	UAE Consultant Co.,Ltd.	19042023	19 Apr 23	18 Apr 24	-
14	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-62236-334	UAE Consultant Co.,Ltd.	03052023	3 May 23	2 May 24	-
15	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
16	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040002	Thai Meteorological Department	275/22	2 Aug 22	1 Aug 23	-
17	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040005	Thai Meteorological Department	259/22	12 Jul 22	11 Jul 23	-
18	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20080022	Thai Meteorological Department	262/22	12 Jul 22	11 Jul 23	-
19	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040026	Thai Meteorological Department	261/22	12 Jul 22	11 Jul 23	-
20	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040039	Thai Meteorological Department	260/22	12 Jul 22	11 Jul 23	-

## 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 HA0F0026	Technology Promotion Association (Thailand-Japan)	23CH98	23 Jan 23	22 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0L0004	Technology Promotion Association (Thailand-Japan)	23TW4	5 Jan 23	4 Jan 24	-

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	Particulate ฝุ่นละอองรวม (TSP)	Mettler-Toledo	AB204-S / 1128312528	Technology Promotion Association (Thailand-Japan)	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองเล็กกว่า 10 ไมครอน (PM-10) ฝุ่นละอองเล็กกว่า 2.5 ไมครอน (PM-2.5)	Mettler-Toledo	AB204-S/FACT / B108115858	Technology Promotion Association (Thailand-Japan)	23MM332	7 Apr 23	5 Apr 24	-
3	Analytical Balance (Readability 0.001 mg)		Mettler-Toledo	XP6 / B322373893	Technology Promotion Association (Thailand-Japan)	23MM333	7 Apr 23	5 Apr 24	-
4	UV-VIS Spectrophotometer	NOx as NO2	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพน้ำ									
5	pH Meter	ความเป็นกรดต่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	23 Mar 24	-
6	pH Meter		Mettler-Toledo	SevenCompact S220/ C113432421	National Food Institute, Ministry of Industry, Thailand	2303560-001-01	26 Jun 23	25 Jun 24	-
7	Conductivity Meter	ความเค็ม (Salinity) การนำไฟฟ้า (Electrical Conductivity)	SI Analytics	Lab955 / 16300356	DKSH (Thailand) Ltd.	C24230059	16 Mar 23	15 Mar 24	-
8	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (SS) ของแข็งละลายทั้งหมด (TDS)	Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	25 Apr 24	-
9	Hot Air Oven	ของแข็งทั้งหมด (TS)	Memmert	UF55 / B216.1666	National Food Institute, Ministry of Industry, Thailand	2400141-001-01	11 Oct 23	10 Oct 24	-
10	Analytical Balance (Readability 0.1 mg)	น้ำมันและไขมัน (Oil&Grease)	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	9 May 24	-
11	BOD Incubator	บีโอดี (BOD)	Arco	UC4-1320 / (UAE.WAQ.015/2561)	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
12	DO Meter		YSI	5100 / 11B101863	Harikul Science	HSU012C	1 Mar 23	29 Feb 24	-
13	COD Reactor (Heating Block)	ซีโอดี (COD)	Hanna	HI839800-02 / H018500I	Hanna Instruments (Thailand) Ltd.	HIT-2312-0342	10 Mar 23	9 Mar 24	-

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพน้ำ									
14	UV-VIS Spectrophotometer	ไนเตรท-ไนโตรเจน (Nitrate-Nitrogen), สี (Color) ฟอสฟอรัสทั้งหมด (Phosphorus), Sulphate (SO <sub>4</sub> <sup>2-</sup> ) ไนโตรเจนทั้งหมด (Total Nitrogen), ซีโอดี (COD) ฟอสฟอรัสทั้งหมด (Total Phosphorus)	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	19 May 24	-
15	Digestor Unit	ไนโตรเจนในรูป ที เค เอ็น (TKN)	FOSS TECATOR	2520auto / 91794469	National Food Institute, Ministry of Industry, Thailand	2302413-001-01	30 Mar 23	29 Mar 24	-
16	Distillation Unit (Kjeldahl Method)		FOSS TECATOR	KT8100/ 91889052	FOSS South East Asia	8411	29 May 23	28 May 24	
17	Atomic Absorption Spectrophotometer (AAS)	โลหะหนัก: ตะกั่ว นิกเกิล สารหนู ทองแดง SAR แคดเมียม ปรอท เหล็ก แมงกานีส อลูมิเนียม	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	-
18	Inductively Coupled Plasma (ICP)		Agilent Technologies	System ID:G8015A G8015AA / MY18030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	13 Nov 23	12 Nov 24	-
19	Cold Vapor Atomic Absorption Spectrophotometer (CVAAS)	ปรอท-น้ำได้ดิน, น้ำผิวดิน	Nippon Instrument Corporation	RA-4500 / 17780278	Coax Group Corporation Ltd.	Preventive Maintenance Report	11 Jul 23	10 Jul 24	-
20	Incubator	โคลิฟอร์มทั้งหมด (Coliform Bacteria) ฟีคัลโคลิฟอร์ม (Fecal Bacteria)	Memmert	IPP 260 / V615.0187	Technology Promotion Association (Thailand-Japan)	23TM378	12 Apr 23	11 Apr 24	-
21	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	23TM193	15 Feb 23	14 Feb 24	-
22	Auto Clave		ALP	CL-40L / 807298	National Food Institute, Ministry of Industry, Thailand	2304203-001-01	10 Aug 23	9 Aug 24	-
23	Analytical Balance		OHAUS	PX623 / C236754745	DKSH (Thailand) Ltd.	C01234158	7 Dec 23	6 Dec 24	-

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

## CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.  
Address : 81 Soi Udonnuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Description of Equipment : Console meter  
Manufacturer : Apex Instrument  
Model Number : XC-572-V  
Serial Number : A2003277  
ID/Control No. :  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 28/04/2023  
Issue Date : 28/04/2023

## Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

## Result of Calibration

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

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



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

Meter Console Information		Calibration Conditions			Factors/Conversions	
Console Model Number	XC-572-V	Date	Time	28/04/2023 09:50 AM	Std Temp	293 K
Console Serial Number	A2003277	Calibration Reference No.	SER23-04017		Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99	mmHg	K <sub>i</sub>	0.386
DGM Serial Number	00005781	Calibration Meter Gamma	0.999		Console Leak Check	PASS

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
Elapsed (Q)	(Pa)	(V <sub>in</sub> )	(V <sub>out</sub> )	(t <sub>in</sub> )	(t <sub>out</sub> )	(V <sub>wi</sub> )	(V <sub>wf</sub> )	(t <sub>in</sub> )	(t <sub>out</sub> )
min	mm H <sub>2</sub> O	m <sup>3</sup>	m <sup>3</sup>	°C	°C	m <sup>3</sup>	m <sup>3</sup>	°C	°C
11.75	13.0	967.7180	967.8580	28	28	139.35512	139.49214	29	28
11.75	13.0	967.8580	967.9980	28	28	139.49214	139.62974	29	28
8.05	26.0	968.0060	968.1460	28	28	139.62974	139.76746	28	28
8.03	26.0	968.1460	968.2860	29	29	139.76746	139.90464	28	28
13.30	40.0	968.2950	968.5750	29	29	139.91146	140.18482	28	28
13.25	40.0	968.5750	968.8550	29	29	140.18482	140.45718	27	27
9.98	70.0	968.8660	969.1460	30	30	140.46739	140.73824	27	27
9.97	70.0	969.1460	969.4260	30	30	140.73824	141.00758	27	27
8.80	90.0	969.4380	969.7180	31	31	141.01872	141.28718	26	26
8.80	90.0	969.7180	969.9980	31	31	141.28718	141.55604	26	26



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

Meter Console Information		Calibration Conditions			Factors/Conversions	
Console Model Number	XC-572-V	Date	Time	28/04/2023 09:50 AM	Std Temp	293 K
Console Serial Number	A2003277	Calibration Reference No.	SER23-04017		Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99	mmHg	K <sub>i</sub>	0.386
DGM Serial Number	00005781	Calibration Meter Gamma	0.999		Console Leak Check	PASS

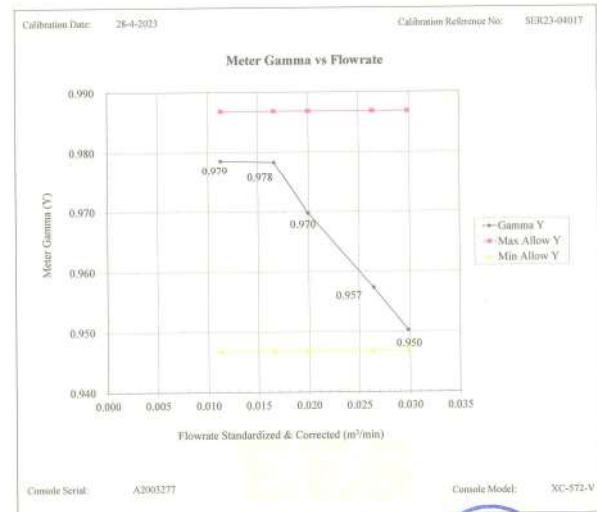
Calibration Data							
Results							
Dry Gas Meter							
Standardized Data		Calibration Factor		Flowrate		Variation	
Dry Gas Meter	Calibration Meter	Value	Variation	Std & Corr	.0212 m <sup>3</sup> /min	(ΔH <sub>g</sub> )	(ΔH <sub>g</sub> )
(V <sub>in</sub> )	(Q <sub>w</sub> )	(V <sub>w</sub> )	(Q <sub>w</sub> )	(Y)	(ΔY)	(Q <sub>w</sub> )	(ΔH <sub>g</sub> )
m <sup>3</sup>	m <sup>3</sup> /min	m <sup>3</sup>	m <sup>3</sup> /min			m <sup>3</sup> /min	mm H <sub>2</sub> O
0.136	0.012	0.133	0.011	0.977	0.010	0.011	44.617
0.136	0.012	0.133	0.011	0.981	0.014	0.011	44.242
0.136	0.017	0.134	0.017	0.980	0.013	0.017	41.495
0.136	0.017	0.133	0.017	0.976	0.010	0.017	41.649
0.273	0.021	0.265	0.020	0.972	0.005	0.020	44.350
0.274	0.021	0.265	0.020	0.968	0.001	0.020	44.193
0.274	0.021	0.265	0.020	0.968	0.001	0.020	44.193
0.275	0.028	0.264	0.026	0.960	-0.007	0.026	44.624
0.275	0.028	0.262	0.026	0.954	-0.012	0.026	45.005
0.275	0.028	0.262	0.026	0.954	-0.012	0.026	45.005
0.276	0.031	0.262	0.030	0.980	-0.017	0.030	45.429
0.276	0.031	0.263	0.030	0.951	-0.016	0.030	45.294
0.276	0.031	0.263	0.030	0.951	-0.016	0.030	45.294
				0.967	Y Average		44.090
							ΔH <sub>g</sub> Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.  
For ΔH<sub>g</sub>, orifice pressure differential that equates to 0.75 cfm (0.0212 m<sup>3</sup>/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.08 mm) H<sub>2</sub>O.



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Meter Console Information		Calibration Conditions			Factors/Conversions	
Console Model Number	XC-572-V	Date	Time	28/04/2023 09:50 AM	Std Temp	293 K
Console Serial Number	A2003277	Calibration Reference No.	SER23-04017		Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99	mmHg	K <sub>i</sub>	0.386
DGM Serial Number	00005781	Calibration Meter Gamma	0.999		Console Leak Check	PASS



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Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	28/04/2023	Std Temp	293 K
Console Serial Number	A2003277	Time	09:50 AM	Std Press	760 mm Hg
DGM Model Number	SK25EX	Calibration Reference No.	SER23-04017	K <sub>i</sub>	0.386
DGM Serial Number	00005781	Barometric Pressure	758.99 mmHg	Console Leak Check	PASS
		Calibration Meter Gamma	0.999		



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### THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions	
Console Model Number	XC-572-V	Date	28/04/2023 12:00 PM
Console Serial Number	A2003277	Calibration Reference No.	SER23-04017
DGM Model Number	SK25EX	Reference Thermometer	DIGICON
DGM Serial Number	00005781	Serial Number	183169105
Meter Box Model Number	JENCO 765 KF		
Meter Box Serial Number	JC 19039		

Results										
Console Thermocouple Simulator										
Channel and test point	Meter Box Channel Temperature Reading (°C)									
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	1038.0
Stack	-18.0	23.0	36.0	91.0	149.0	259.0	369.0	480.0	592.0	1038.0
Aux	-18.0	23.0	36.0	91.0	149.0					
Probe	-18.0	23.0	36.0	91.0	149.0					
Filter	-18.0	23.0	36.0	91.0	149.0					
Oven	-18.0	23.0	36.0	91.0	149.0					
Exit	-18.0	23.0	36.0							

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



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Instrument description	Flue gas Analyzer
Instrument model	Testo 350 New
Instrument serial no.	61658783
ID no. or control no.	UAE/EPH.121/2502
Manufacturer	Testo SE & Co. KGaA
Probe description	-
Probe model	-
Probe serial	-
Customer name	UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Customer address	81 SOI UDOMSUKAI, SUKHUMVIT ROAD, BANGCHAK PRAKANONG, BANGKOK 10260
Total pages of certificate	3 Pages
Receiving no.	1-223745
Receiving date.	22-Sep-22
Parameter of calibration	Gas Calibration (Oxygen 2.498, 10.00, 21.00 % Vol, Carbon Monoxide 80.16, 309.9, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 202.2 ppm, Nitric Oxide 30.08, 150.9, 320.6 ppm, Sulphur Dioxide 50.04, 100.9, 601.1 ppm, )
Condition of UUC.	Used
Ambient condition	All of the Measurement were carried out the stabilized laboratory
	Temperature : ± 23 ± 5 °C
	Humidity : 55 ± 15 %RH
Calibration place	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210
Calibration procedure no.	WI-CL-28-C

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

Date of calibration : 28-Sep-22

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### Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O2 ) 2.498 % Vol	4219/21	Unde	30-Sep-25
Oxygen ( O2 ) 10.00 % Vol	2453/19	Unde	18-Jul-23
Oxygen ( O2 ) 21.00 % Vol	3426/19	Unde	16-Jul-23
Carbon monoxide ( CO ) 80.16 ppm	2582/22	Unde	09-Aug-24
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Unde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Unde	09-Aug-24
Nitrogen Dioxide ( NO2 ) 30.34 ppm	2703/22	Unde	22-Aug-24
Nitrogen Dioxide ( NO2 ) 80.96 ppm	3240/21	Unde	26-Jun-24
Nitrogen Dioxide ( NO2 ) 202.2 ppm	3239/21	Unde	20-Jul-23
Nitric Oxide ( NO ) 30.08 ppm	5551/0908	Nmt	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Unde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	2944/21	Unde	02-Jul-23
Sulphur Dioxide ( SO2 ) 50.04 ppm	3205/21	Unde	25-Jul-23
Sulphur Dioxide ( SO2 ) 100.9 ppm	4942/20	Unde	20-Nov-22
Sulphur Dioxide ( SO2 ) 601.1 ppm	3204/21	Unde	20-Jul-23

### Measured room conditions

Temperature : 22.5 °C Humidity : 55.6 %RH Pressure : 1012.6 mbar

### Calibration conditions

Gas Temperature : 23 °C Flow rate : 1200 ml/min Gas pressure : 1021.4 mbar

### Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
O2 (%Vol)	2.498	2.45	-0.048	0.20
O2 (%Vol)	10.00	9.82	-0.18	0.40
O2 (%Vol)	21.00	21.09	0.09	0.80
CO (ppm)	80.16	80	-0.16	3.0
CO (ppm)	309.9	310	0.1	6.0
CO (ppm)	1003	1002	-1	12
NO2 (ppm)	30.34	27.2	-3.14	8.0
NO2 (ppm)	80.96	70.3	-10.66	8.0
NO2 (ppm)	202.2	181.2	-21.0	12
NO (ppm)	30.08	26	-4.08	8.0
NO (ppm)	150.9	144	-6.9	8.0
NO (ppm)	320.6	308	-12.6	12
SO2 (ppm)	50.04	44	-6.04	6.0
SO2 (ppm)	100.9	89	-11.9	6.0
SO2 (ppm)	601.1	565	-36.1	13

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Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.098	2.45	-0.048	0.20
O2 (%Vol)	10.00	9.82	-0.18	0.40
O2 (%Vol)	21.00	21.09	0.09	0.80
CO (ppm)	80.16	80	-0.16	3.0
CO (ppm)	309.9	310	0.1	6.0
CO (ppm)	1003	1002	-1	12
NO2 (ppm)	30.34	31.5	1.16	8.0
NO2 (ppm)	80.96	80.5	-0.46	8.0
NO2 (ppm)	202.2	204.5	2.3	12
NO (ppm)	30.08	29	-1.08	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.8	322	1.4	12
SO2 (ppm)	50.04	51	0.96	6.0
SO2 (ppm)	100.9	101	0.1	6.0
SO2 (ppm)	601.1	605	3.9	13

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

End of Report



ขอขอบพระภาคินัยบัตรนี้เพื่อแสดงว่า

ได้ผ่านการกำหนดการมีกอบรมและทดสอบผู้ตรวจวัดความที่บแสงของเขม่าควันด้วยสายตา และการใช้แผนภูมิเขม่าควันของจริงเกิดมานัน ประจำปึงประมาณ ๒๕๖๐

ระหว่างวันที่ ๓๐ - ๓๑ มีนาคม ๒๕๖๐

จัดโดย สำนักจัดการคุณภาพอากาศและเสียง กรมควบคุมมลพิษ  
ให้ใช้ ณ วันที่ ๓๑ มีนาคม ๒๕๖๐



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ให้ใช้ ณ วันที่ ๓๑ มีนาคม ๒๕๖๐



RECALIBRATION

DUE DATE:

June 28, 2022

## Certificate of Calibration

### Calibration Certification Information

Cal. Date: June 28, 2021	Rootmeter S/N: 438320	Ta: 297 °K
Operator: Jim Tisch	Pa: 753.6 mm Hg	
Calibration Model #: G2SA	Calibrator S/N: 11MX	

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3910	3.3	2.00
2	3	4	1	0.9890	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8430	9.0	5.50
5	9	10	1	0.6970	12.5	8.00

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va (x-axis)	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9906	0.7121	1.4106	0.9956	0.7158	0.8878
0.9853	0.9975	1.9949	0.9915	1.0025	1.2555
0.9844	1.1123	2.2304	0.9894	1.1179	1.4037
0.9831	1.1661	2.3393	0.9881	1.1721	1.4723
0.9779	1.4030	2.8213	0.9829	1.4102	1.7756
QSTD		m= 2.04215	QA		m= 1.27876
		b= -0.04258			b= -0.02680
		r= 1.00000			r= 1.00000

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

Standard Conditions	
Tstd	298.15 °K
Pstd	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
AP:	rootsmeter 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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-5000-24 FAX: 0-2719-9484

## Certificate of Calibration

Certificate No.: 22P918  
Page: 1 of 2

Equipment: U Tube Manometer

Manufacturer: Dwyer

Model: 1221-35-W/M

Serial No.: -

ID No.: UAE-EFM.180/2561

Condition As-Received: Used Item

Received Date: 01 July 2022

Calibration Date: 11 July 2022

Reference: 2202-0093WSC

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

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1012 mbar

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

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	1169	MP-0113-22	14 Jul 2023

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

3. Scale and conversion factor is 1 kPa = 4.0146203 inH<sub>2</sub>O

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

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

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 at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Nopparat Phongam  
Issue Date: 11 July 2022

Approved Signatory



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B 0250402



Cert.No.: 22P918  
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	-1.02	2.02	0.02
4.00	2.00	-2.00	4.00	0.00
6.00	3.02	-2.98	6.00	0.00
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.02	-6.00	12.02	0.02
14.00	7.00	-6.98	13.98	-0.02
16.00	8.00	-7.98	15.98	-0.02
18.00	9.00	-8.02	18.02	0.02
20.00	10.00	-10.02	20.02	0.02
22.00	11.00	-11.02	22.02	0.02
24.00	11.98	-12.00	23.98	-0.02
26.00	12.98	-13.04	26.02	0.02
28.00	13.98	-14.04	28.02	0.02
30.00	14.98	-15.04	30.02	0.02
32.00	15.98	-16.06	32.04	0.04
34.00	17.00	-17.06	34.06	0.06
36.00	17.78	-17.94	35.72	0.22

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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a 1037939

INNOVATIVE INSTRUMENT CALIBRATION LAB  
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE  
7/19 MOO 13, SUKHUMVIT AKORN 11 TAMBON BANG KAEU,  
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10140 THAILAND  
TEL: 0668-216-7800-1 FAX: 0668-216-7140



INNOVATIVE  
Accredited by ISO 9001:2015



Page 1/2

## Certificate of Calibration

Customer: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Name: 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,  
Bangkok 10260

Certificate No.: 22-AFM-116  
Request No.: Req-2022-1333

### Unit Under Calibration Details

Measurement Item: Air Flow meter  
Sensor Model: -  
Manufacture: BGI  
Sensor Serial Number: -  
Model: Delta Cal DC1  
Serial Number: 158850  
ID: UAE-EFM.038/2561

Location of Calibration: LAB 4 AIR VELOCITY METER

### Calibration Environment and Details

Temperature: 23 °C ± 3 °C  
Humidity: 35 %RH ± 20 %RH  
Barometric Pressure: 1013 hPa ± 10 hPa  
Received Date: 22 July 2022  
Calibration Date: 16 August 2022

Calibration Procedure: In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilbrete J High Flow	18591012012	Sensidyne	15 June 2023

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

### Note:

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

Calibration By:



Approved By:



Issue Date:

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

FM-708-AFM-01 Rev.00 Issue date 01/07/19

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AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10140 THAILAND  
TEL: 0668-216-7800-1 FAX: 0668-216-7140



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Accredited by ISO 9001:2015



Page 2/2

Certificate No.: 22-AFM-116  
Request No.: Req-2022-1333

### Result of Calibration:

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
(LPM)	(LPM)	(LPM)	(LPM)	(LPM)
14.5	14.50	14.48	0.02	0.21
15.0	15.00	14.97	0.03	0.22
15.5	15.50	15.76	0.04	0.23
16.6	16.60	16.54	0.06	0.24
18.3	18.30	18.23	0.07	0.27

### Note:

STD: Standard

UUC: Unit Under Calibration

Calibration media: Air

\* Indicates non accredited

End of Certificate

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

FM-708-AFM-01 Rev.00 Issue date 01/07/19

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### Certificate of Calibration

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

Certificate No : 22-TPM-346  
Request No : Req-2022-1333  
Page : 1/2

#### Unit Under Calibration Details

Calibration Parameter : Temperature  
Instrument Name : Air Flow meter  
Manufacturer : BGI  
Model : Delta Cal DC1  
Serial Number : 158850  
Resolution : 0.1 °C  
ID Number : UAE.EFM.838/2561  
Range Calibration : 20 °C to 45 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 3  
Calibration Position (mm) : 45  
Instrument Status : Used

#### Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 22 July 2022  
Calibrated Date : 16 August 2022  
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:  
08060057, 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-ONSAC 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 :

Issue Date :

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

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

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#### Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 22-TPM-346

Request No : Req-2022-1333

Page : 2/2

#### Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
T <sub>a</sub>	20.003	20.0	0.0	0.14
	25.004	24.9	+0.1	0.14
	30.000	30.0	0.0	0.14
	35.004	35.1	-0.1	0.14
	40.000	40.1	-0.1	0.14
	45.003	45.2	-0.2	0.14
T <sub>f</sub>	20.003	20.0	0.0	0.14
	25.004	25.0	0.0	0.14
	30.000	30.0	0.0	0.14
	35.004	34.9	+0.1	0.14
	40.000	40.0	0.0	0.14
	45.003	45.0	0.0	0.14

End of Certificate

Calibrated By :

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

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

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53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL: 0-2717-3090-24 FAX: 0-2719-9484



### Certificate of Calibration

Certificate No. : 22P2722  
Page : 1 of 2

Equipment : Aneroid Barometer

Manufacturer: Barigo

Model : -

Serial No. : -

ID No. : UAE.ANV.013/2547

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0584WSC

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,

Prakhanong, 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

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

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

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aousanee

Issue Date : 25 July 2022

Approved Signat

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B 0293205



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

#### Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range : 720 mmHg to 780 mmHg

Scale Interval : 1 mmHg ( The Fifth Estimate )

#### Increasing Pressure

Applied Pressure (mmHg)	718.46	728.33	738.85	750.22	760.90	772.01	785.89
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.54	0.67	0.15	-0.22	-0.90	-2.01	-5.89

#### Decreasing Pressure

Applied Pressure (mmHg)	785.90	771.99	760.85	750.17	739.90	729.57	718.62
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-5.90	-1.99	-0.85	-0.17	0.10	0.43	1.38

The uncertainty of measurement was ± 0.24 mmHg

\* UUC = Unit Under Calibration

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

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TEL. 0-2717-3800-34 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No.: Z2H1587  
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer  
Manufacturer: Bango  
Model: -  
Serial No.: -  
ID No.: UAE.ANV.127/2550

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

Condition As-Received: Used Item  
Received Date: 20 July 2022  
Calibration Date: 22 July 2022  
Reference: 2207-0580WSC  
Ambient Temperature: ( 25 ± 3 ) °C  
Relative Humidity: ( 50 ± 20 ) %

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

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

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

### Condition of this result of calibration

#### 1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

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

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

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

Calibrated by: Somchai Dumvor  
Issue Date: 03 August 2022

Approved Signatory:

[Signature]  
[Signature]  
[Signature]

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B 0293723



Cert. No.: Z2H1587  
Page: 2 of 2

### Result of Calibration:-

Function:

Before Adjustment

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	38	-2.1	1.6
25.0	60.0	57	-3.0	1.8
25.0	80.0	74	-6.0	2.0

### Result of Calibration:-

Function:

After Adjustment

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	40	-0.1	1.6
25.0	60.0	60	0.0	1.8
25.0	80.0	77	-3.0	2.0

### Result of Calibration:-

Function:

Without Adjustment

Temperature measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
20.00	20.0	0.00	0.72
25.04	25.0	-0.04	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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a 1119773



United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrahanong, 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 : Apr 19, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42C  
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

#### Standard Gas Concentration

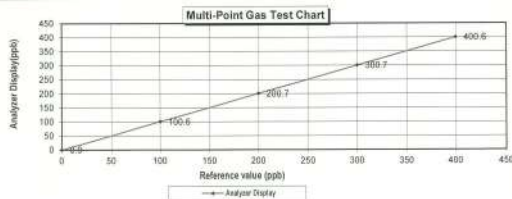
Sulphur Dioxide (SO <sub>2</sub> )	45.75	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.35	PPM	Model :	1461
Methane (CH <sub>4</sub> )	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	1007	PPM		
Cylinder No. :	CC159599			
Expiration Date :	Jul 30, 2022			

#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	1461
Serial Number :	1180540071

#### Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.90	0.90	0.90
Level 2	20.00%	100.0	0.60	0.60	0.60
Level 3	40.00%	200.0	0.70	0.35	0.35
Level 4	60.00%	300.0	0.70	0.23	0.23
Level 5	80.00%	400.0	0.60	0.15	0.15
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.45	
Acceptable Limit ± 5%					



เอกสารไม่ควบคุม



United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrahanong, 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 : Apr 7, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42C  
Manufacturer : Thermo Electron Corporation Serial Number : 0517512000

#### Standard Gas Concentration

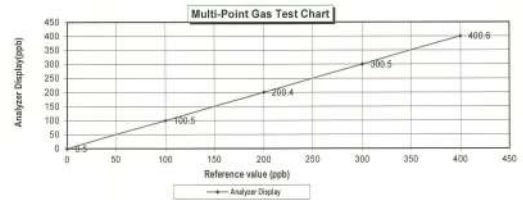
Sulphur Dioxide (SO <sub>2</sub> )	44.75	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.35	PPM	Model :	1461
Methane (CH <sub>4</sub> )	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	1007	PPM		
Cylinder No. :	CC159599			
Expiration Date :	Jul 30, 2022			

#### Dilutor Detail

Manufacturer :	Thermo Scientific
Model :	1461
Serial Number :	1180540071

#### Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.50	0.50	0.50
Level 2	20.00%	100.0	0.50	0.50	0.50
Level 3	40.00%	200.0	0.40	0.20	0.20
Level 4	60.00%	300.0	0.50	0.17	0.17
Level 5	80.00%	400.0	0.60	0.15	0.15
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.30	
Acceptable Limit ± 5%					



เอกสารไม่ควบคุม



**MULTI-POINT GAS TEST REPORT**

Test Date : Apr 7, 2022

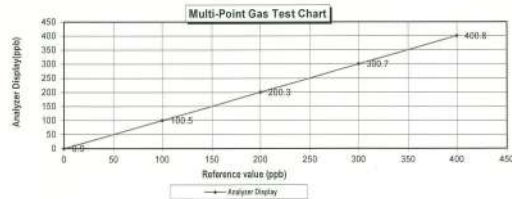
Equipment : Gas Analyzer (NO<sub>x</sub>) Model : 42C  
Manufacturer : Thermo Electron Corporation Serial Number : 0517512001

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 1461  
Serial Number : 1180540071

**Multi-point gas test data**

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.90	0.90	0.90
Level 2	20.00%	100.0	100.5	0.50	0.50
Level 3	40.00%	200.0	200.3	0.15	0.15
Level 4	60.00%	300.0	300.7	0.23	0.23
Level 5	80.00%	400.0	400.8	0.20	0.20
Remark :	Measuring Range	500.0 ppb	Average Difference (%)	0.40	
	Acceptable Limit ± 5%				



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**MULTI-POINT GAS TEST REPORT**

Test Date : Apr 7, 2022

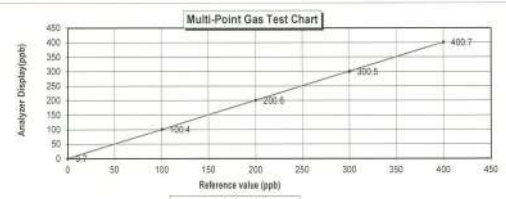
Equipment : Gas Analyzer (NO<sub>x</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM08130002

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 1461  
Serial Number : 1180540071

**Multi-point gas test data**

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.70	0.70	0.70
Level 2	20.00%	100.0	100.4	0.40	0.40
Level 3	40.00%	200.0	200.6	0.30	0.30
Level 4	60.00%	300.0	300.5	0.17	0.17
Level 5	80.00%	400.0	400.7	0.17	0.17
Remark :	Measuring Range	500.0 ppb	Average Difference (%)	0.35	
	Acceptable Limit ± 5%				



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Airgas Specialty Gases  
Airgas USA, LLC  
6900 United Drive  
Dunsmuir, CA 95923  
USA

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

Part Number: E04N189E16A01D5 Reference Number: 122-402135/87-1  
Cylinder No. : EE0143742 Cylinder Volume: 144.4 CF  
Laboratory: 724 - Durham (BAP), NC Cylinder Pressure: 2015 PSIG  
PGVP Number: B22221 Valve Color: 850  
Gas Code: CO, NO, NO<sub>x</sub>, SO<sub>2</sub>, BA, N Certification Date: Jun 21, 2021  
Expiration Date: Jun 21, 2024

Certification and test procedures are in accordance with EPA Regulatory Protocol for Air and Certified Calibration Standards (EPA 8200-1-02). Using the assay procedures and analytical technology does not guarantee analytical accuracy. The standard is also a certified secondary standard under EPA's certification program. There are no fees for impurities which affect the use of the calibration standard. All concentrations are in a unitless basis, as per EPA's protocol.

Do not use this cylinder for any other gas.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO <sub>x</sub>	45.35 PPM	45.35 PPM	G1	± 1.0% (NIST Traceable)	2014/02/21, 03/02/2021
Nitric Oxide	45.35 PPM	45.35 PPM	G1	± 1.0% (NIST Traceable)	2014/02/21, 03/02/2021
Sulfur Dioxide	45.00 PPM	45.00 PPM	G1	± 1.0% (NIST Traceable)	2014/02/21, 06/02/2021
Carbon Monoxide	1000 PPM	994.3 PPM	G1	± 0.7% (NIST Traceable)	09/14/2021
Nitrogen	Balance				

**CALIBRATION STANDARDS**

Type	Lot ID	Cylinder No.	Concentration	Uncertainty	Expiration Date
NITRA	20081-20	07070006	40.82 PPM Nitric Oxide/Nitrogen	± 1.0%	Dec 31, 2025
PRV	12384	0598525	2.51 PPM Nitrogen Dioxide/Nitrogen	± 2.0%	Feb 28, 2020
GMIS	40142938302	07083551	4.245 PPM Nitrogen Dioxide/Nitrogen	± 2.0%	Feb 28, 2020
N-TM	1601184	02470271	45.02 PPM Sulfur Dioxide/Nitrogen	± 0.8%	Jun 17, 2022
N-TM	1602118	02470271	994.3 PPM Carbon Monoxide/Nitrogen	± 0.8%	Nov 15, 2025

The SRM, PPM or MVD noted above is only in reference to the DMS listed on the assay and may vary in the analysis.

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
Nucleon 8700 AF-R300-333 CO	FTIR	Jun 03, 2021
Nucleon 8700 AF-R300-333 NO	FTIR	Jun 03, 2021
Nucleon 8700 AF-R300-333 NO <sub>2</sub>	FTIR	Jun 03, 2021
Nucleon 8700 AF-R300-333 SO <sub>2</sub>	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES: PO #522103287  
GROSS WT: 28.40kg  
NET WT: 4.75kg



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**MULTI-POINT GAS TEST REPORT**

Test Date : May 3, 2023

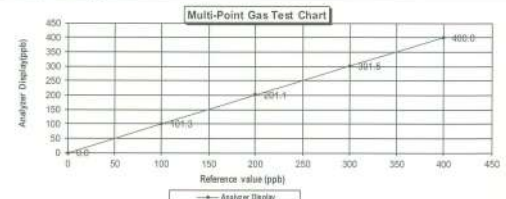
Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Electron Corporation Serial Number : 43C-0607415779

**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) 994.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

**Dilutor Detail**  
Manufacturer : Thermo SCIENTIFIC  
Model : 1461  
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	101.3	1.30	1.28
Level 3	40.00%	200.0	201.1	1.10	0.55
Level 4	60.00%	300.0	301.5	1.50	0.50
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark :	Measuring Range	500.0 ppb	Average Difference (%)	0.47	
	Acceptable Limit ± 5%				



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### MULTI-POINT GAS TEST REPORT

Test Date : Apr 7, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Electron Corporation Serial Number : 43C-061116459

#### Standard Gas Concentration

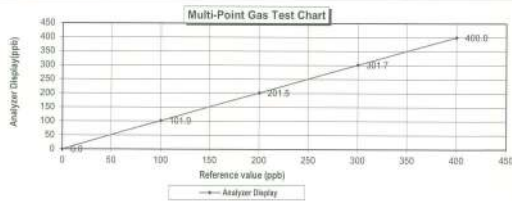
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### 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	101.9	1.90	1.86	1.86
Level 3	40.00%	200.0	201.5	1.50	0.74	0.74
Level 4	60.00%	300.0	301.7	1.70	0.56	0.56
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb		Average Difference (%)	0.63



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### MULTI-POINT GAS TEST REPORT

Test Date : Apr 19, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Environmental Instruments Serial Number : 43CTL-78567-389

#### Standard Gas Concentration

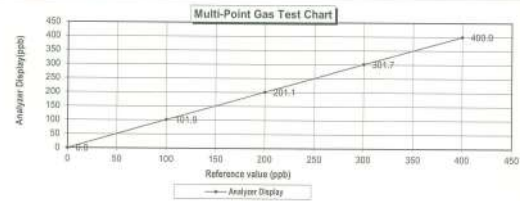
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### 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	101.9	1.90	1.86	1.86
Level 3	40.00%	200.0	201.1	1.10	0.55	0.55
Level 4	60.00%	300.0	301.7	1.70	0.56	0.56
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%) 0.60		



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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

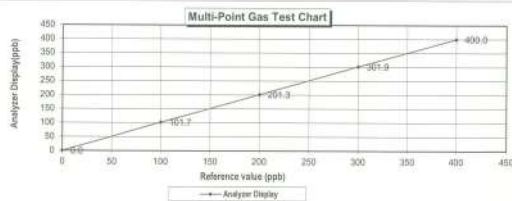
Sulphur Dioxide (SO<sub>2</sub>) : 44.68 PPM  
Nitric Oxide (NO) : 45.94 PPM  
Methane (CH<sub>4</sub>) : - PPM  
Carbon Monoxide (CO) : 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### 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	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.7	1.70	1.67	1.67
Level 3	40.00%	200.0	201.3	1.30	0.65	0.65
Level 4	60.00%	300.0	301.9	1.90	0.63	0.63
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.59



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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 : 2 August, 2022

Certification No. : 275/22

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 20040002 wind speed and wind direction 20040182

ID No. : No.2/20

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 1007.7 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 731/241480 : 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 9.14 m/sec



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 275/22

2 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.8	0.22
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.6	0.41
17.02	-	-	-	16.6	0.42
20.02	-	-	-	19.5	0.52

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

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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. 259/22

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 : 20040005 : wind speed and wind direction : 20040184

ID No. : No.4/20

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 : 1006.4 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 : S/N 91563

: HOOK GAGE NO 1425 : Pitot 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 at 20 - 30 m/sec

คุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 259/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.6	0.40
3.02	-	-	-	2.4	0.62
5.00	-	-	-	4.1	0.90
7.04	-	-	-	6.4	0.64
9.02	-	-	-	8.1	0.92
11.01	-	-	-	10.4	0.61
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.7	0.31
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.7	0.32

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

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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. 262/22

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 : 20080022 : wind speed and wind direction : 20050136

ID No. : No.20/20

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 : 1003.5 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 : S/N 91563

: HOOK GAGE NO 1425 : Pitot 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 at 20 - 30 m/sec





# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 262/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum m/sec	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.7	0.30
3.02	-	-	-	2.5	0.52
5.00	-	-	-	4.2	0.80
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.7	0.32
11.01	-	-	-	10.5	0.51
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.7	0.32
20.02	-	-	-	19.3	0.72

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

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



# 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. : 261/22

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 : 20040026 wind speed and wind direction : 20040177

ID No. : No.7/20

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 : 1004.3 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91583

: HOOK GAGE NO 1425 Pitot 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 at 20 - 30 m/sec



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 261/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum m/sec	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.8	0.20
3.02	-	-	-	2.6	0.42
5.00	-	-	-	4.3	0.70
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.7	0.32
11.01	-	-	-	10.5	0.51
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.9	0.11
17.02	-	-	-	16.7	0.32
20.02	-	-	-	19.8	0.22

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

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



# 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 : 1004.5 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91583

: HOOK GAGE NO 1425 Pitot 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 at 20 - 30 m/sec



# 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	m/sec	m/sec	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 :

*Handwritten signature*

Mr. Watcharapol Subwat

Mechanical Engineer



เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 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.019/2550  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** Balance Room 2  
**Received order :** 07 April 2023  
**Calibration Date :** 07 April 2023  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %  
**Calibrated by :**   
**Approved by :**   
( ) Ponthippa Tameyakul  
( ) Malee Butkruea  
**Issue Date :** 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

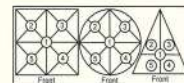
Cert.No.: 23MM331

Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

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



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	-0.0002	+0.0004	-0.0001	-0.0006	0.0005

#### 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	2.06
70	69.9999	+0.0001	0.18	2.04
100	99.9999	+0.0001	0.19	2.03
150	150.0003	-0.0003	0.29	2.00
200	200.0005	-0.0005	0.29	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23MM332  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S /FACT  
**Serial No. :** B108115858  
**ID No. :** UAE.AIR.016/2555  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udornsuk 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 :**   
**Approved by :**   
( ) Pornthippa Tameyakul  
( ) Malee Butkruesa  
**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  
**Procedure used :-**

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

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

### Condition of this result of calibration

#### 1. Reference standard instruments:-

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

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

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

#### Before Adjustment :

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

#### After Adjustment :

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

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

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

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

### Result of calibration

#### 2. Effect of off center loading

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

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

#### 3. Departure from nominal value

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

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

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23MM333  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** XP6  
**Serial No. :** B322373893  
**ID No. :** UAE.AIR.019/2556  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udornsuk 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 :**   
**Approved by :**   
( ) Pornthippa Tameyakul  
( ) Malee Butkruesa  
**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-3  
Procedure used :-

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

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

#### Condition of this result of calibration

##### 1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 6.1 g Resolution 0.000001 g

##### Before Adjustment :

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( ± mg )	Coverage Factor ( k )
3	2.999967	+0.000013	0.026	2.00
6	6.000003	-0.000003	0.036	2.00

##### After Adjustment :

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

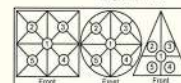
Applied Weight ( g )	Standard Deviation of Reading ( g )
3	0.0000027
6	0.0000030

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

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



#### 2. Effect of off center loading

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

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

#### 3. Departure from nominal value

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
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TEL. 0-2717-3000-29 FAX: 0-2719-9484



Cert.No.: 23MM332  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Electronic Balance  
Manufacturer : Mettler Toledo  
Model : AB204-S /FACT  
Serial No. : B108115858  
ID No. : UAE.AIR.016/2555  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Balance Room 2  
Received order : 07 April 2023  
Calibration Date : 07 April 2023  
Ambient Temperature : 15 °C to 40 °C  
Relative Humidity : 30 % to 90 %  
Calibrated by :   
Approved by :   
( ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services

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

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

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

#### Condition of this result of calibration

##### 1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 220 g Resolution 0.0001 g

##### Before Adjustment :

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

##### After Adjustment :

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

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

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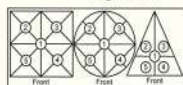
Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-00150C-2

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



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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002

##### 3. Departure from nominal value

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG 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.019/2550  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260

Location : Balance Room 2

Received order : 07 April 2023  
Calibration Date : 07 April 2023  
Ambient Temperature : 15 °C to 40 °C  
Relative Humidity : 30 % to 90 %

Calibrated by :

Approved by :

( ) Ponthipha Tameyakul  
(/ ) Malee Bulkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-00150C-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 (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	99.9999	+0.0001	0.19	2.03
200	200.0001	-0.0001	0.29	2.00

After Adjustment :

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

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

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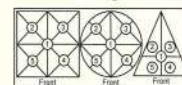
Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-00150C-1

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

#### Result of calibration

##### 2. Effect of off center loading

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



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

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

##### 3. Departure from nominal value


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

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

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เอกสารไม่

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



CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021

Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated


The calibration of this equipment may have been conducted under conditions that are not identical to those under which the product is intended to be used.

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

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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



REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 2 of 5

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

Relative humidity  $55 \pm 20$  %RH

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

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.


Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

DQE Services Co.,Ltd.  
**DQE Services**  
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REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 3 of 5

Calibration Results : Without adjustment


Photometric Accuracy :

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

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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**DQE Services**  
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REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 4 of 5

Photometric Accuracy :

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

FM-708-02 R01 1/11/2021

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

**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 5 of 5

**Wavelength Accuracy :**

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	0.31	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.3	0.63	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.3	0.64	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.4	0.19	0.18	2.00
637.98	638.3	-0.32	0.18	2.00
431.38	431.0	0.38	0.18	2.00
472.50	472.5	0.00	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	529.0	-0.12	0.18	2.00
573.17	573.0	0.17	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k.

which for a normal distribution corresponds to a coverage probability of approximately 95%

- \* Indicates non TISI accredited

- End of Certificate -

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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

**CERTIFICATE OF CALIBRATION**

Certificate No. : SP23-021 Page 1 of 5

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

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

**Location of calibration :** Laboratory 315

**Equipment :** UV-Vis Spectrophotometer

**Manufacturer :** Agilent Technologies

**Model :** Cary 60

**Serial No. :** MY15410009

**ID No. :** N/A

**Received Date :** 20 May 2023

**Calibration Date :** 20 May 2023

**Issue Date :** 23 May 2023

**Condition Instrument :** Good

Calibrated by [REDACTED]

The calibration results are traceable to the International System of Units (SI) maintained at National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

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

FM-708-02 R01 1/11/2021

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

**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 2 of 5

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

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

**Certified Reference Materials :**

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

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

**Spectral Band Width of UUC :** 1.5 nm.

**Scan Speed of UUC :** 60 nm/min

**Scan Interval of UUC :** 0.15 nm.

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

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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

**REPORT OF CALIBRATION**

Certificate No. : SP23-021 Page 3 of 5

**Calibration Results :** Without adjustment

**Photometric Accuracy :**

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.5742	0.0045	0.0031	2.00
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	2.1229	2.1171	0.0058	0.0088	2.00
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	1.9987	1.9917	0.0070	0.0087	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
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	1.0809	1.0808	0.0001	0.0030	2.00
	2.0391	2.0336	0.0055	0.0081	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5601	0.5585	0.0016	0.0031	2.00
	1.0512	1.0485	0.0027	0.0030	2.00
	1.9294	1.9317	-0.0023	0.0083	2.00

FM-708-02 R01 1/11/2021

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## REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 4 of 5

### Photometric Accuracy :

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

PM-708-02 R01 1/11/2021

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## REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 5 of 5

### Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
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287.81	287.5	0.31	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.3	0.63	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.3	0.64	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.4	0.19	0.18	2.00
637.98	638.3	-0.32	0.18	2.00
431.38	431.0	0.38	0.18	2.00
472.50	472.5	0.00	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	529.0	-0.12	0.18	2.00
573.17	573.0	0.17	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k.

which for a normal distribution corresponds to a coverage probability of approximately 95%.

- \* Indicates non TISI accredited

- End of Certificate -

PM-708-02 R01 1/11/2021

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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.: 23CH98  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Horiba  
Model : LAQUA-PH210  
Serial No. : HA0F0026  
ID No. : UAE.EFM.068/2564(EFM pH 01/64)  
Condition As-Received: Used Item  
Received Date : 20 January 2023  
Calibration Date : 23 January 2023  
Reference : 2301-0687WSC-1  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CH5 by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by :

Approved by :

( / ) Malee Butkruea  
( ) Saitnip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date : 25 January 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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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.: 23CH98  
Page.: 2 of 3

## Condition of this calibration result

1. Reference Standard Instrument : -  
Instrument Serial No. ID No. Cert. No. Due Date  
1) Document Process Calibrator 54030049 130RC116 22E2769 24 Aug 2023  
2) Ref. Standard Thermometer 4962054 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-1635

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 10.008	CPA chem	826590	09 July 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
			mV	pH		
pH Meter S/N.: HA0F0026	4.00	177.48	177.5	4.01	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00
	10.00	-177.48	-177.4	10.01	0.058	2.00

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a 1144769



Cert.No.: 23CH98  
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.: 991L0035	4.008	4.02	161	0.0086	2.05
	6.987	7.00	-11	0.011	2.00
	6.987	7.00	-11	0.011	2.00
	10.008	10.01	-187	0.0096	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652  
- Serial No. : 991L0035

Dimension of probe;

- Length : 112 mm.  
- Diameter : 16 mm.  
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.002	25.0	-0.002	0.13	2.00
30.0	30.003	30.0	-0.003	0.13	2.00
35.0	35.002	35.0	-0.002	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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a 1144768



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

Cert.No.: 23TW4  
Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : Horiba  
Model : LAQUA-DO210  
Serial No. : HE0L0004  
ID No. : UAE.EFM.087/2564(EFM DO.06/64)  
Received Date : 04 January 2023  
Test Date : 05 January 2023  
Reference : 2301-0081WSC-7  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260  
Laboratory Condition : Temperature (25 ± 5) °C  
Humidity (50 ± 20) %  
Test Procedure : In-house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by :

Approved by :

( / ) Malee Butkruea  
( ) Saitnip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date : 6 January 2023

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Cert.No.: 231W4  
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.: 9K0E0257

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.14	8.14	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.

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CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 23LM4  
Page.: 1 of 2

## Certificate of Calibration

**Equipment :** DO Meter With Sensor

**Manufacturer :** Horiba

**Model :** LAQUA-DO210

**Serial No. :** HE0L0004

**ID No. :** UAE.EFM.087/2564(EFM DO.06/64)

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

**Location :** TPA On Site Calibration Laboratory

**Received Order :** 4 January 2023

**Calibrated Date :** 6 January 2023

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**AC Line Voltage :** ( 220 ± 22 ) V

**Calibrated by :**

**Approved by :**

( ) Pornthippa Tameyakul

(✓) Suwit Imjai

**Issue Date :** 10 January 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 :** DO Meter With Sensor  
**Condition As-Received :** Used Item  
**Reference :** 2301-0061WSC-8

Cert. No.: 23LM4  
Page.: 2 of 2

#### Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

##### 1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2211265	21 Oct 2023

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

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K0E0257

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
25.0	80	24.999	25.0	0.001	0.16	2.00
30.0	80	30.002	30.0	-0.002	0.16	2.00
35.0	80	34.996	35.0	0.004	0.16	2.00

UUC\* : Unit Under Calibration

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

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เอกสาร



National Food Institute, Ministry of Industry, Thailand

1000/501 501/501 Anusorn Road, Bang 11 Khun Sukkheha, Bang 11 Khun Sukkheha, Bangkok 10700, Thailand  
Tel : +66 (0) 2-552 6566 Fax : +66 (0) 2-552 6568 Website : www.nfi.go.th E-mail : cal@nfi.go.th



## Calibration Certificate

**Certificate No.:** 2202093-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Phrakhanong, Bangkok 10260

Page 1 of 5

**Equipment:** pH Meter

**Manufacturer:** METTLER TOLEDO

**Model:** SevenEasy pH

**Serial No.:** 1230525212

**ID No.:** UAE.WAS.003/2553

**Order No.:** 2202093

**Operation No.:** 2202093-001

**Date of Receipt:** 11 March 2022

**Date of Calibration:** 16 March 2022

**Calibrated by** Mr. Manee Somsak  
Specialist

**Date of issue:** 21 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 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-C5-008 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม



## Calibration Report

Certificate No.: 2202093-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: METTLER TOLEDO  
Model: SevenEasy pH  
Serial No.: 123052512  
Type: Bench top  
ID No.: UAE.WAS.0032553

Date of Calibration: 16 March 2022 Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute.  
Environment Condition: Ambient Temperature : ( 23.0 ± 1.0 ) °C Relative Humidity : ( 48.5 ± 5.0 ) %  
Condition of Equipment: Good Condition  
Condition of this Results of Calibration:

1. Calibration Method : In house method : W-CG-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	2709001	Fluke	SCL-01F-0887	24 June 2022
2.2 Digital Thermometer	2709007	Fluke	CC-440599-01	30 October 2022
2.3 Thermo-Hygro Meter	850-AU-BTH 05058	POHPE	QR21-2787	15 November 2022

Certified Reference Material	Lot No.	Manufacturer	Ref#	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	780012	CPAchem	PH216.L5	21 November 2023
2.5 pH buffer 6.865 (Primary pH buffer Solution)	780013	CPAchem	PH217.L5	21 November 2023
2.6 pH buffer 10.01 (Primary pH buffer Solution)	780015	CPAchem	PH220.L5	21 November 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)	776840	CPAchem	PH107.L5	8 November 2022

3. This calibration is traceable to The International System of Units (SI Units)  
3.1 Instruments No.2.1 through NSC-TIS-17025 Laboratory Accreditation of Calibration No.0075  
3.2 Instruments No.2.2 through NSC-TIS-17025 Laboratory Accreditation of Calibration No.0061  
3.3 Instruments No.2.3 through NSC-TIS-17025 Laboratory Accreditation of Calibration No.0092  
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 BSM Refs no 7 Lot# 30.04.2020; BSM Refs H-9 Lot# 28.05.2020; BSM Refs H-8 Lot# 30.04.2020; BSM Refs H-10 Lot# 28.05.2020. 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.

เอกสารไม่ควบคุม



## Calibration Report

Certificate No.: 2202093-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH ; 1 mV  
Manufacturer: METTLER TOLEDO  
Model: SevenEasy pH  
Serial No.: 123052512  
Type: Bench top  
ID No.: UAE.WAS.0032553

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
2	295.811	296	2.00	0.58	2.00
4	177.462	178	4.00	0.58	2.00
6	58.159	59	6.00	0.58	2.00
7	-0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.463	-177	10.00	0.58	2.00
12	-295.812	-296	12.00	0.58	2.00
14	-414.119	-414	14.00	0.58	2.00

2. Calibration of pH Meter with Electrode ( Manual Temperature Compensation at 25 °C )  
Equipment: pH Electrode  
Type: Combined Electrode  
Manufacturer: METTLER TOLEDO  
Model: HLab Solids  
Serial No.: 9453943  
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 Deviation (%)	Uncertainty (± pH)	Coverage Factor (K)
	pH	mV			
4.008	4.01	172	98.1	0.0071	2.00
6.866	6.87	8	-	0.0074	2.00
10.015	10.01	-175	97.4	0.0090	2.00
6.963	6.96	-5	-	0.0082	2.00

เอกสารไม่ควบคุม



## Calibration Report

Certificate No.: 2202093-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C  
Model: SevenEasy pH  
Serial No.: 123052512  
ID No.: UAE.WAS.0032553  
Manufacturer: METTLER TOLEDO

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-035 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	1023	2118104	PSL-T 985164	24-Jun-22	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

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

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

เอกสารไม่ควบคุม



## Calibration Report

Certificate No.: 2202093-001-01  
Equipment: Digital Thermometer with RTD (pH Meter)  
Resolution: 0.1 °C  
Model: SevenEasy pH  
Serial No.: 123052512  
ID No.: UAE.WAS.0032553  
Manufacturer: METTLER TOLEDO

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 to a minimum depth of 120 mm.  
- Description of probe, model: N/A S/N: N/A  
Dimension of probe: Diameter 3.5 mm, Length 135 mm.

Sheath material: Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.2	15.001	-0.2	0.099
25.2	25.002	-0.2	0.099
35.2	35.002	-0.2	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 -----

เอกสารไม่ควบคุม



## Calibration Certificate

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

Page 1 of 5

Equipment: pH Meter  
Manufacturer: METTLER TOLEDO  
Model: Seven Compact S220

Serial No.: C113432421

ID No.: UAE.WAT.009/2564

Order No.: 2203527

Operation No.: 2203527-001

Date of Receipt: 30 June 2022

Date of Calibration: 5 July 2022

Calibrated by Mr. Warapob Boontong  
Scientist

Date of Issue: 5 July 2022

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

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

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

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2008 35 35, Avun Anom Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2422 88888 Fax: +66(0) 2422 85455

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## Calibration Report

Certificate No.: 2203527-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH : 1 mV  
Manufacturer: METTLER TOLEDO  
Model: Seven Compact S220  
Serial No.: C113432421  
Type: Bench top  
ID No.: UAE.WAT.009/2564

Date of Calibration: 5 July 2022 Page 2 of 5

Location: Calibration Laboratory, National Food Institute  
Environment Condition: Ambient Temperature: ( 23.5 ± 1.5 ) °C Relative Humidity: ( 55 ± 5 ) %  
Condition of Equipment: Good Condition  
Condition of this Results of Calibration

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

2. Reference Standards : Certified Reference Materials

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-445599-01	30 October 2022
2.3 Thermo-Hygro Meter	NFI.BTH605/18	PCNPE	GR22-0301	18 February 2023
Certified Reference Material	Lot No.	Manufacturer	Ref. N	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	805203	CPAchem	PHQ16.LS	21 April 2024
2.5 pH buffer 6.865 (Primary pH buffer Solution)	805204	CPAchem	PHQ17.LS	21 April 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	805205	CPAchem	PHQ20.LS	21 April 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	805206	CPAchem	PHQ107.LS	21 April 2023

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

- Instruments No.2.1 through NIS-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0078
- Instruments No.2.2 through NIS-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0081
- Instruments No.2.3 through NIS-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0282
- Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Harned cell using calibrated thermometer, barometer, and manometer. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
- Certified Reference Material No.2.7 traceable to BM Ref N-H-27 Lot# 04.08.2021; BM Ref N-H-28 Lot# 28.08.2021; BM Ref N-H-27 Lot# 04.08.2021; BM Ref N-H-28 Lot# 28.08.2021, 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

2008 มาตรฐานอุตสาหกรรม 35 มาตรฐานอุตสาหกรรม 35 มาตรฐานอุตสาหกรรม 35 มาตรฐานอุตสาหกรรม 35  
2008 35 35, Avun Anom Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2422 88888 Fax: +66(0) 2422 85455

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## Calibration Report

Certificate No.: 2203527-001-01  
Equipment: pH Meter  
Resolution: 0.01 pH : 1 mV  
Manufacturer: METTLER TOLEDO  
Model: Seven Compact S220  
Serial No.: C113432421  
Type: Bench top  
ID No.: UAE.WAT.009/2564

Date of Calibration: 5 July 2022 Page 3 of 5

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
2	295.911	296	2.00	0.58	2.00
4	177.462	177	4.00	0.58	2.00
6	59.159	59	6.00	0.58	2.00
7	-0.001	0	7.00	0.58	2.00
8	-58.158	-59	8.00	0.58	2.00
10	-177.463	-177	10.00	0.58	2.00
12	-295.912	-296	12.00	0.58	2.00
14	-414.119	-414	14.00	0.58	2.00

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

Equipment: pH Electrode  
Type: Combined Electrode  
Manufacturer: METTLER TOLEDO  
Model: HIAB Expert Pro-BM  
Serial No.: 2210418  
ID No.: N/A  
Performance of Electrode system (Three-Point Calibration at pH4, pH7 and pH10)

Certified Value (25 °C (pH))	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.010	182	-	0.0071	2.00
6.865	6.860	14	100.0	0.0075	2.00
10.008	10.010	-169	97.9	0.0093	2.00
6.005	6.990	6	-	0.0087	2.00

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

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2008 35 35, Avun Anom Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2422 88888 Fax: +66(0) 2422 85455

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## Calibration Report

Certificate No.: 2203527-001-01  
Equipment: Digital Thermometer with RTD  
Resolution: 0.1 °C  
Model: Seven Compact S220  
Serial No.: C113432421  
ID No.: UAE.WAT.009/2564  
Manufacturer: METTLER TOLEDO

Date of Calibration: 5 July 2022 Page 4 of 5

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

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1521	A85997	TE 650057-01	10-Dec-22	NATIONAL FOOD INSTITUTE
Platinum Resistance Thermometer (PRT)	385	509201			

Support Equipment : - Low Temperature Bath (ISOCAL-5), 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.
- Condition of Calibrated item : Good
- Result of Calibration : ☒ Without adjustment ☐ After adjustment

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

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2008 35 35, Avun Anom Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand  
Tel: +66(0) 2422 88888 Fax: +66(0) 2422 85455

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## Calibration Report

Certificate No.: 2203527-001-01  
Equipment: Digital Thermometer with RTD  
Resolution: 0.1 °C Model: Seven Compact S220  
Serial No.: C113432421 ID No.: UAE.WAT.009/2564  
Manufacturer: METTLER TOLEDO

Date of Calibration: 5 July 2022

Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

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

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.038	- 0.1	0.12
25.1	25.038	- 0.1	0.12
35.2	35.024	- 0.2	0.12

### Note

- UUC\* : Unit Under Calibration

The report uncertainty of measurement was based on standard uncertainty multiplied by coverage factor (k=2) to provide a level of confidence of approximately 95 %.

----- End -----

F-CS-012 Revision: 01 Date: 20-04-63

2533 Sukhumvit Road, Bangkok 10260 Thailand  
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info@calibration@dksh.com Website: www.dksh.com/certification-thailand

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เอกสารไม่ควบคุม

CAL-FM-C24-09: 12 Sep 2022

## Certificate of Calibration

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

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

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

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

Calibration By: Mr. Atchai 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

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

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Phone: +66 2639 7000 Email: info@calibration@dksh.com Website: www.dksh.com/certification-thailand

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CAL-FM-C24-09: 12 Sep 2022

Certificate No.: C24230059 Page: 2 of 2

### Calibration Results:

#### Before Adjustment

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

#### After Adjustment : at 1413 µS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	24.6 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

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวลดลอม

ชื่อเครื่องวัด: CONDUCTIVITY METER รุ่น: Lab 955 หมายเลขเครื่อง: 16300356

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

ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 ±0.1°C

Mr. Atchai Ngamchanat  
Service Engineer

2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info@calibration@dksh.com Website: www.dksh.com/certification-thailand

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CAL-FM-R31-03: 20 Jul 2022

2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info@calibration@dksh.com Website: www.dksh.com/certification-thailand

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CAL-FM-C24-09: 12 Sep 2022





## Calibration Report

**Certificate No.:** 2400141-001-01  
**Equipment:** CHAMBER (Hot Air Oven)  
**Model:** UF 55 **Serial No.:** B216.1666  
**Resolution:** 0.1 °C **ID No.:** UAE.WAO.027/2559  
**Manufacturer:** MEMMERT  
**Date of Calibration:** 11 October 2023 **Page 2 of 3**

**Location:** Laboratory, Floor 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Environment Condition:**  
Ambient Temperature ( 28 ± 1 ) °C  
Relative Humidity ( 63 ± 2 ) %  
Line Voltage ( 228 ± 1 ) Volt

### Condition of this results of Calibration:

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

### 2. Reference Standard Instrument :

Instrument	Model	Serial No./ID No.	Certificate No.	Due Date	Through
Digital Thermometer with sensor	34972A	MY49016894	TE 660380-01	22 April 2024	NATIONAL FOOD INSTITUTE
	RTD	CHW201-209/ RTD#201-209			

- This certificate is traceable to International System of Units (SI Units).

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

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

- Condition of Calibrated item : Good

### UUC Description :

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

- Result of Calibration : X Without adjustment ☐ After adjustment

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

2008 บ้านสุขุมวิท 36 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
2008 Soi 36, Asoi Asoin Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand  
Tel : +66(0) 2462 8588 Fax : +66(0) 2462 8545

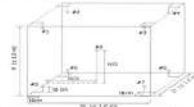
## Calibration Report

**Certificate No.:** 2400141-001-01  
**Equipment:** CHAMBER (Hot Air Oven)  
**Model:** UF 55 **Serial No.:** B216.1666  
**Resolution:** 0.1 °C **ID No.:** UAE.WAO.027/2559  
**Manufacturer:** MEMMERT  
**Date of Calibration:** 11 October 2023 **Page 3 of 3**

**Calibration point:** 104.0, 140.0 and 180.0 °C

### Calibration result:

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



### Table 1 : Reporting of Temperature

Calibration point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9	
104.0	104.05	103.98	104.02	104.08	104.00	104.05	103.99	104.17	104.00	0.53
140.0	140.09	139.99	139.91	140.05	139.99	139.91	139.97	140.26	139.97	0.73
180.0	180.46	180.33	180.25	180.28	180.33	179.96	180.31	180.64	180.16	0.90

### Table 2 : Reporting of Characterization Result

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

**Note:** The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

UUC\* = Unit Under Calibration

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

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

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

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

\*\*\*\*\* End \*\*\*\*\*

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

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2008 Soi 36, Asoi Asoin Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand  
Tel : +66(0) 2462 8588 Fax : +66(0) 2462 8545

## Calibration Certificate

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

Page 1 of 4

**Equipment:** Electronic Balance

**Manufacturer:** METTLER TOLEDO

**Model:** XSR204

**Serial No.:** C117635043

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

**Order No.:** 2302827

**Operation No.:** 2302827-001

**Date of Receipt:** 10 May 2023

**Date of Calibration:** 10 May 2023

**Calibrated by** Mr. Manas Somsak  
Specialist

**Date of Issue:** 18 May 2023

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

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

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

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2008 Soi 36, Asoi Asoin Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand  
Tel : +66(0) 2462 8588 Fax : +66(0) 2462 8545

## Calibration Report

**Certificate No.:** 2302827-001-01  
**Equipment:** Electronic Balance **Manufacturer:** METTLER TOLEDO  
**Model:** XSR204 **Resolution:** 0.0001 g  
**Serial No.:** C117635043 **ID No.:** UAE.WAS.012/2564  
**Capacity:** 220 g

**Date of Calibration:** 10 May 2023

Page 2 of 4

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

**Place of Calibration:** Balance room (Water Analysis Unit), UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

**Condition of Equipment:** Good Condition

### Condition of This Results of Calibration:

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

### Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 100g	8505567572	TC5	M23840535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-HL	NFLBTH 016/23	Quality Return	Q823-0489	21 February 2024

- This certification is traceable to SI UNIT

- 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.

### Calibration Results:

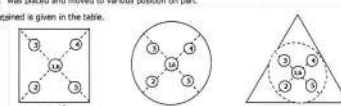
#### 1. Repeatability of Reading:

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

#### 2. Off-Center Error:

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

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
( g )	( g )	( g )	( g )	( g )	( g )	( g )
100.0002	100.0002	100.0002	100.0002	100.0003	100.0002	0.0001

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

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2008 Soi 36, Asoi Asoin Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand  
Tel : +66(0) 2462 8588 Fax : +66(0) 2462 8545









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

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

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (±°C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor k		
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2		
Measured Temperature (°C)									
Calibration Point (°C)	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

Average\* : The average of 30 values in each position.  
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.  
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.  
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.  
UUC\* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

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a 1149512



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9444



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

## Certificate of Calibration

Equipment : BOD Incubator  
Manufacturer : Arco  
Model : UC4-1320  
Serial No. : 13URC45013201  
ID No. : UAE.WAO.015/2561  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udornasuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Lab Floor 2  
Received Order : 15 February 2023  
Calibration Date : 15 February 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Preecha Khlahit  
Approved by :  
( ) Pornthippa Tameyakul  
( / ) Malee Buksruea  
( ) Suwit Imjai

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0051476



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

Cert. No.: 23TM249  
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

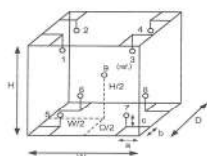
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Not Available



### Probe Installation Details :

Dimension of Chamber :  
a = 10 cm D = 0.62 m  
b = 10 cm W = 1.2 m  
c = 10 cm H = 1.2 m  
Capacity = 0.69 m<sup>3</sup>

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

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

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

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

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k		
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2		
Measured Temperature (°C)									
Calibration Point (°C)	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

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

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

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

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

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

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Certificate No. : HIT-2312-0342

Page : 1 of 2

## CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater  
Meter Model : HI839800-02 Serial No. : H0185001  
Tube Heater : 25 Vial Capacity Accuracy :  $\pm 2^{\circ}\text{C}$   
Temperature Range :  $-10^{\circ}\text{C}$  to  $160^{\circ}\text{C}$  Temperature of Reaction :  $150^{\circ}\text{C}$   
Ambient Temperature :  $(25 \pm 2)^{\circ}\text{C}$  Relative Humidity :  $(50 \pm 15)\% \text{ RH}$   
Manufacturer : Hanna Instruments Made in : Romania  
Condition As-Received : Used Product Reference : RE230392  
Customer name : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,  
Phrakhanong, Bangkok 10260  
Received date : 8 March 2023  
Calibrate date : 10 March 2023  
Issue date : 20 March 2023  
Calibrated Location : Hanna Instruments (Thailand) Ltd.  
Calibration Procedure : This calibrator was conducted by using in-house; calibration procedure  
CP-04 by using certified reference material.

Calibrated by : ☒ Mr. Pichit Pettibong  
☐ Mr. Jakkapob Pentisan  
☐ Mr. Channarong Soirak

Approved by :

This certificate was certified only for the instrument we calibrated.

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

\*\* This certificate may not be reproduced other than in full, except with the prior written \*\*  
approval of the head of Hanna Instrument (Thailand).

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Certificate No. : HIT-2312-0342

Page : 2 of 2

## Condition of this calibration result

## Reference Standard Instruments:

Instruments	Model	Serial No.	Certificate No.	Traceable
Data Acquisition Switch Unit	34970A	MY44065265	WK2207-065-1	WK Electric Co., Ltd.

## Calibration Result:

## Measurement Temperature Source Accuracy for COD Reactor

Capacity (Vial)	Nominal Value ( $^{\circ}\text{C}$ )	Average Value ( $^{\circ}\text{C}$ )	$\pm$ Uncertainty ( $^{\circ}\text{C}$ )	$\pm$ Tolerance of UUC ( $^{\circ}\text{C}$ )	Acceptance Criteria
25 Vial	150.0	150.3	0.59	2	Pass

Figure: Shows the location of the temperature source.

(1A)	(2A)	(3A)	(4A)	(5A)
149.78 $^{\circ}\text{C}$	150.31 $^{\circ}\text{C}$	150.63 $^{\circ}\text{C}$	149.93 $^{\circ}\text{C}$	150.31 $^{\circ}\text{C}$
(1B)	(2B)	(3B)	(4B)	(5B)
150.35 $^{\circ}\text{C}$	150.18 $^{\circ}\text{C}$	149.93 $^{\circ}\text{C}$	150.18 $^{\circ}\text{C}$	150.21 $^{\circ}\text{C}$
(1C)	(2C)	(3C)	(4C)	(5C)
150.24 $^{\circ}\text{C}$	151.10 $^{\circ}\text{C}$	150.80 $^{\circ}\text{C}$	150.36 $^{\circ}\text{C}$	150.86 $^{\circ}\text{C}$
(1D)	(2D)	(3D)	(4D)	(5D)
150.16 $^{\circ}\text{C}$	149.77 $^{\circ}\text{C}$	150.22 $^{\circ}\text{C}$	150.67 $^{\circ}\text{C}$	150.43 $^{\circ}\text{C}$
(1E)	(2E)	(3E)	(4E)	(5E)
149.94 $^{\circ}\text{C}$	150.44 $^{\circ}\text{C}$	150.06 $^{\circ}\text{C}$	150.63 $^{\circ}\text{C}$	149.29 $^{\circ}\text{C}$

Remark: The Acceptance criteria is the error value plus or minus the Measurement Uncertainty, and then Not  
More than the Tolerance value of UUC, therefore concluded that pass.

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

\*\* End of certificate \*\*

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## CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021 Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated by

The calibration result

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding  
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FM-708-02 B01 1/11/2021

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## REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 2 of 5

Environment Condition : Ambient Temperature  $25 \pm 5^{\circ}\text{C}$ Relative humidity  $55 \pm 20\% \text{ RH}$ 

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

## Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-708-02 B01 1/11/2021

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DQE Services Co.,Ltd.

DQE Services

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

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

ISO 15189:2013  
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

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


FM-708-02 R01 1/11/2021

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DQE

Services

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



ISO 15189:2013  
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 4 of 5

Photometric Accuracy :

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

FM-708-02 R01 1/11/2021


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



ISO 15189:2013  
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	0.31	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.3	0.63	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.3	0.64	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.4	0.19	0.18	2.00
637.98	638.3	-0.32	0.18	2.00
431.38	431.0	0.38	0.18	2.00
472.50	472.5	0.00	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	529.0	-0.12	0.18	2.00
573.17	573.0	0.17	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

Remark : -UUC = Unit Under Calibration

-N/A = Not Available

-The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k.

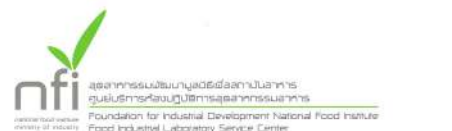
which for a normal distribution corresponds to a coverage probability of approximately 95%

-\* Indicates non TISI accredited

- End of Certificate -

FM-708-02 R01 1/11/2021

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## Verification Certificate

**Certificate No.:** 2302413-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

**Equipment:** HEATING BLOCK DIGESTION  
**Manufacturer:** FOSS  
**Model:** 2520  
**Serial No.:** 91794469  
**ID No.:** UAE.WAS.011/2560  
**Order No.:** 2302413  
**Operation No.:** 2302413-001  
**Date of Receipt:** 28 March 2023  
**Date of Calibration:** 30-31 March 2023

**Calibrated by** Mr.Nuttapat Niyomchat **Approved** [Signature]

**Date of Issue:** 10 April 2023

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

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

FCS-809 Revision: 01 Date: 20-04-65

2000 ถนนสุขุมวิท แขวง 26 ถนนสุขุมวิท เขตวัฒนา กรุงเทพมหานคร 10110  
 2000 Soi 36, Khun Anom Road, Bang 26, Khun Anom Road, Bang 26, Bangkok 10110, Thailand  
 Tel : +66(0) 2-420 8688 Fax : +66(0) 2-420 8645

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Request No. 25-66 / 0323

MTC. ACL.No. 387 / 66

## CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"  
Model AA240FS, Serial No. MY13160001  
2. Working standard solution "Inorganic Ventures"  
Multi Analyte Custom Grade Solution, Lot No. S2-MEB708640  
SUBMITTED BY: United Analyst and Engineering Consultant Co., Ltd.  
3. Sol 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

Approved

Acting Director

Ref. 2015266012600366001

Issued Date : 15 February 2023

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Head Office  
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpag@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sol 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 8592  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



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
	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
Absorbance	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

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpag@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sol 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 8592  
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E-mail : sumalee@tistr.or.th

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E-mail : sumalee@tistr.or.th



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MTC. ACL. No. 387 / 66

## 2. Precision

Element	Conc. (mg/L)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0085	0.0084	0.0090	0.0089	0.0089	0.0090	0.0086	0.0092	0.0090	0.0089	0.009	0.0003	2.88
	0.30	0.0993	0.1001	0.1007	0.1004	0.1004	0.0995	0.0997	0.0998	0.0999	0.0996	0.100	0.0005	0.45
	0.70	0.2238	0.2229	0.2244	0.2249	0.2243	0.2233	0.2235	0.2231	0.2251	0.2240	0.224	0.0007	0.33
	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
Cr	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
	0.05	0.0083	0.0084	0.0084	0.0075	0.0086	0.0086	0.0081	0.0080	0.0087	0.0092	0.008	0.0005	5.45
	0.30	0.0430	0.0444	0.0426	0.0429	0.0435	0.0432	0.0428	0.0441	0.0427	0.0436	0.043	0.0006	1.41
Cu	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
	0.10	0.0109	0.0104	0.0087	0.0100	0.0087	0.0094	0.0102	0.0092	0.0094	0.0100	0.010	0.0007	7.53
	0.50	0.0456	0.0442	0.0450	0.0444	0.0450	0.0455	0.0455	0.0441	0.0446	0.0444	0.045	0.0006	1.27
	1.00	0.0904	0.0901	0.0891	0.0876	0.0873	0.0901	0.0876	0.0886	0.0879	0.0901	0.089	0.0012	1.38
Pb	0.20	0.0093	0.0099	0.0104	0.0102	0.0104	0.0109	0.0102	0.0103	0.0115	0.0117	0.010	0.0007	6.85
	0.70	0.0344	0.0336	0.0336	0.0328	0.0338	0.0346	0.0336	0.0331	0.0343	0.0350	0.034	0.0007	2.02
	1.50	0.0709	0.0718	0.0706	0.0713	0.0698	0.0718	0.0712	0.0713	0.0715	0.0719	0.071	0.0006	0.90
	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
Mn	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
	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
Ni	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
	0.05	0.0315	0.0309	0.0322	0.0304	0.0329	0.0312	0.0313	0.0319	0.0308	0.0311	0.031	0.0007	2.35
	0.30	0.1705	0.1728	0.1688	0.1693	0.1711	0.1704	0.1704	0.1707	0.1708	0.1688	0.170	0.0012	0.70
	0.70	0.3559	0.3572	0.3548	0.3560	0.3559	0.3550	0.3579	0.3552	0.3574	0.3573	0.356	0.0011	0.31

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Head Office  
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
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Fax. (66) 0 2577 9009  
E-mail : rumpag@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sol 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 8592  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

## 3. Trueness

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

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

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

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

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

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

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Fax. (66) 0 2577 9009  
E-mail : rumpag@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
Sol 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 8592  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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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

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35 Mu 3 Tambon Khong Ha, Amphoe Khong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2377 9000  
Fax. (66) 0 2377 9009  
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

**Office/Laboratory**  
Sri 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 : mtc@tistr.or.th

**Office**  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 8592  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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MTC. ACL. No. 387 / 66

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

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

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

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

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

Calibrated

Approved

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End of Certificate

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35 Mu 3 Tambon Khong Ha, Amphoe Khong Luang,  
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Tel. (66) 0 2377 9000  
Fax. (66) 0 2377 9009  
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

**Office/Laboratory**  
Sri 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 : mtc@tistr.or.th

**Office**  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 8592  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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## Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES  
Preventive Maintenance

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

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

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



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## Agilent 5100, 5110 Preventive Maintenance Checklist



## Introduction

## Customer Information

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



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### Important Customer Web Links

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

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### Service Engineer's Responsibilities

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

เอกสารไม่ควบคุม

### Instrument Maintenance

#### System Information

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

Instrument System Name and ID	3110 VDV ICP-OES
Instrument System Site and Location	URE

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8013 A	NY 19030001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

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

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### Preparation

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

เอกสารไม่ควบคุม

## Preventive Maintenance Procedures

### Record Pre-PM instrument performance

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

### Clean and inspect ICP-OES system

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

### Agilent Water Recirculator

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

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### SPS 3 Auto Sampler

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

### SPS 4 Auto sampler

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

### AVS 4, 6, 7 Advanced Valve System

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

เอกสารไม่ควบคุม

### ICP-OES adjustment

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

### Record Post-PM instrument performance

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

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## Restore Instrument

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

## Service Review

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

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## Test Results

## Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	4190.3	6649.9	4700.6	7564.2
Mn 257.610 nm SRBR	13681.0	27295.3	14569.1	29992.5
Al 396.152 nm SBR	12.1	14.6	11.9	15.6
K 766.491 nm SBR	8.0	31.2	7.4	39.7

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

## Instrument Test Results Table

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

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

เอกสารไม่ควบคุม

## 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	225.153	VAC	220.613	VAC
Mains Current	0.090	A	0.219	A
Instrument Temperature	24.0	°C	25.1	°C
RF Air Flow (sensor speed)	15.0	Hz	19.0	Hz
Plasma Exhaust Temperature	No measurement		39.2	°C
Water Flow Oscillator	No measurement		1.37	L/min
Water Flow Detector	0.94	L/min	0.81	L/min
Water Inlet Temperature	17.3	°C	19.8	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-39.8	°C	-39.8	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	659.52	kPa	608.63	kPa
Purge Gas Supply Pressure*1	656.41	kPa	627.71	kPa
Option Gas Supply Pressure*1	-	kPa	-	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		166.30	kPa
Plasma Gas Flow	No measurement		11.96	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1199.5	W
RF Supply Current	No measurement		5.223	A
RF Supply Voltage	No measurement		194.461	V

\*1 If option installed

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## Consumed PM Parts

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

## Consumed Parts Reference

(Purchased by customer, not included as part of PM)

☐ Section Not Applicable

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

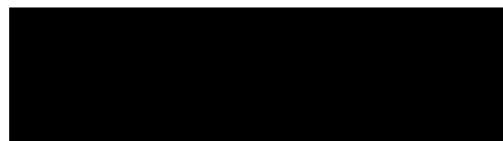
เอกสารไม่ควบคุม

## Signature Page

## Service Engineer Comments (optional)

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

## Service Verification



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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	Kanyakorn S.
Test Completed On	11/13/2023 9:18:24 AM
Result Summary	
Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Fail
Precision Test	Pass

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เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.92	
As (188.980 nm)	≤ 8.20	6.12	
C (193.027 nm)	≤ 11.50	8.31	
Mo (202.032 nm)	≤ 8.20	6.35	
Cr (206.158 nm)	≤ 13.40	8.99	
Zn (213.857 nm)	≤ 8.70	6.64	
Pb (220.353 nm)	≤ 9.50	7.06	
Co (228.615 nm)	≤ 17.20	11.68	
Ba (230.424 nm)	≤ 9.40	7.27	
Mn (257.610 nm)	≤ 13.30	9.46	
Mn (260.568 nm)	≤ 20.30	14.18	
Cr (267.716 nm)	≤ 11.00	8.01	
Cu (324.754 nm)	≤ 25.00	18.89	
Cu (327.395 nm)	≤ 14.20	11.29	
Sr (338.071 nm)	≤ 33.50	24.46	
Ba (455.403 nm)	≤ 44.00	33.62	
Sr (460.733 nm)	≤ 36.00	17.37	
Ba (493.408 nm)	≤ 36.00	25.47	
Ba (514.171 nm)	≤ 42.00	25.43	
Ar (675.283 nm)	≤ 74.00	60.50	
K (766.491 nm)	≤ 80.00	65.33	

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เอกสารไม่ควบคุม

Sensitivity Test			Fail		
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	142.0	958.5	41.7
Se (196.026 nm)	≥ 41.0	SRBR	105.9	937.4	67.5
Zn (213.857 nm)	≥ 1421.0	SRBR	4190.3	44372.5	111.6
Pb (220.353 nm)	≥ 46.0	SRBR	213.9	2521.3	125.4
Mn (257.610 nm)	≥ 3518.0	SRBR	13681.0	279651.7	416.6
Al (396.152 nm)	≥ 3.4	SBR	12.1	52269.7	3994.3
Ba (493.408 nm)	≥ 34.0	SBR	185.8	2284372.8	12280.0
K (766.491 nm)	≥ 1.8	SBR	8.0	107401.4	11876.7
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	189.4	2285.0	129.5
Se (196.026 nm)	≥ 159.0	SRBR	168.7	2813.7	233.8
Zn (206.200 nm)	≥ 234.0	SRBR	905.0	10158.4	123.0
Zn (213.857 nm)	≥ 1743.0	SRBR	6849.9	136760.6	390.5
Cd (214.439 nm)	≥ 4227.0	SRBR	5597.6	92921.3	273.9
Pb (220.353 nm)	≥ 320.0	SRBR	454.8	10111.2	451.1
Mn (257.610 nm)	≥ 10625.0	SRBR	27295.3	1126118.1	1697.0
Cr (267.716 nm)	≥ 1048.0	SRBR	3948.2	144875.3	1322.0
Cu (324.754 nm)	≥ 19.0	SBR	49.2	341489.7	6798.2
Al (396.152 nm)	≥ 6.0	SBR	14.6	235321.6	15043.9
Ba (493.408 nm)	≥ 60.0	SBR	183.3	8393101.3	45538.3
K (766.491 nm)	≥ 24.0	SBR	31.2	1447045.2	44917.1

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Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	1.22	
Se (196.026 nm)	≤ 2.60	0.76	
Zn (213.857 nm)	≤ 1.50	0.33	
Pb (220.353 nm)	≤ 2.60	0.86	
Mn (257.610 nm)	≤ 1.50	0.45	
Al (396.152 nm)	≤ 1.50	0.37	
Ba (493.408 nm)	≤ 1.50	0.68	
K (766.491 nm)	≤ 1.50	0.33	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.63	
Se (196.026 nm)	≤ 1.50	0.87	
Zn (206.200 nm)	≤ 1.50	0.59	
Zn (213.857 nm)	≤ 1.50	0.46	
Cd (214.439 nm)	≤ 1.50	0.70	
Pb (220.353 nm)	≤ 1.50	0.36	
Mn (257.610 nm)	≤ 1.50	0.95	
Cr (267.716 nm)	≤ 1.50	0.56	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.63	
Ba (493.408 nm)	≤ 1.50	0.86	
K (766.491 nm)	≤ 1.50	1.13	

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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	Kanyakorn S.
Test Completed On	11/13/2023 11:10:02 AM
Result Summary	
Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass
Subsystem Communications Test	Pass
Optics Test	
Intensity	Radial 3522064 Axial 4003312
Wavelength	Radial 737.212 Axial 737.212

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Resolution Test		Pass
Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.92
As (188.980 nm)	≤ 8.20	6.08
C (193.027 nm)	≤ 11.50	8.33
Mo (202.032 nm)	≤ 8.20	6.31
Cr (206.158 nm)	≤ 13.40	8.98
Zn (213.857 nm)	≤ 8.70	6.73
Pb (220.353 nm)	≤ 9.50	7.02
Co (228.615 nm)	≤ 17.20	11.65
Ba (230.424 nm)	≤ 9.40	7.38
Mn (257.610 nm)	≤ 13.30	9.46
Mn (260.568 nm)	≤ 20.30	14.05
Cr (267.716 nm)	≤ 11.00	7.92
Cu (324.754 nm)	≤ 25.00	18.84
Cu (327.395 nm)	≤ 14.20	11.31
Sr (338.071 nm)	≤ 33.50	24.18
Ba (455.403 nm)	≤ 44.00	33.28
Sr (460.733 nm)	≤ 36.00	17.41
Ba (493.408 nm)	≤ 36.00	25.43
Ba (614.171 nm)	≤ 42.00	25.27
Ar (675.283 nm)	≤ 74.00	56.87
K (766.491 nm)	≤ 80.00	65.88

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Sensitivity Test		Pass			
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	168.6	1284.6	53.3
Se (196.026 nm)	≥ 41.0	SRBR	122.4	1256.0	90.7
Zn (213.857 nm)	≥ 1421.0	SRBR	4700.8	53870.1	130.7
Pb (220.353 nm)	≥ 46.0	SRBR	236.0	3100.6	155.7
Mn (257.610 nm)	≥ 3518.0	SRBR	14569.1	318398.1	476.2
Al (396.152 nm)	≥ 3.4	SBR	11.5	59510.5	4761.6
Ba (493.408 nm)	≥ 34.0	SBR	170.6	2490835.6	14514.2
K (766.491 nm)	≥ 1.8	SBR	7.4	117698.7	14024.1
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	214.5	2706.2	142.8
Se (196.026 nm)	≥ 159.0	SRBR	188.0	3262.8	255.9
Zn (206.200 nm)	≥ 234.0	SRBR	1088.2	12794.8	135.3
Zn (213.857 nm)	≥ 1743.0	SRBR	7564.2	156883.9	427.8
Cd (214.439 nm)	≥ 4227.0	SRBR	6647.3	116281.7	304.4
Pb (220.353 nm)	≥ 320.0	SRBR	519.3	12490.2	530.3
Mn (257.610 nm)	≥ 10625.0	SRBR	29992.5	1305852.5	1890.2
Cr (267.716 nm)	≥ 1048.0	SRBR	4366.6	173343.4	1547.9
Cu (324.754 nm)	≥ 19.0	SBR	46.8	361093.0	7560.5
Al (396.152 nm)	≥ 6.0	SBR	15.6	274029.5	16498.6
Ba (493.408 nm)	≥ 60.0	SBR	203.6	9028914.5	44122.1
K (766.491 nm)	≥ 24.0	SBR	39.7	1701521.4	41771.8

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Precision Test		Pass
Radial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.85
Se (196.026 nm)	≤ 2.60	1.26
Zn (213.857 nm)	≤ 1.50	0.42
Pb (220.353 nm)	≤ 2.60	0.54
Mn (257.610 nm)	≤ 1.50	0.60
Al (396.152 nm)	≤ 1.50	0.47
Ba (493.408 nm)	≤ 1.50	0.68
K (766.491 nm)	≤ 1.50	0.50
Axial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.42
Se (196.026 nm)	≤ 1.50	0.66
Zn (206.200 nm)	≤ 1.50	0.42
Zn (213.857 nm)	≤ 1.50	0.54
Cd (214.439 nm)	≤ 1.50	0.42
Pb (220.353 nm)	≤ 1.50	0.22
Mn (257.610 nm)	≤ 1.50	0.54
Cr (267.716 nm)	≤ 1.50	0.49
Cu (324.754 nm)	≤ 1.50	0.85
Al (396.152 nm)	≤ 1.50	0.61
Ba (493.408 nm)	≤ 1.50	0.78
K (766.491 nm)	≤ 1.50	1.00

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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	Kanyakorn S.
Test Completed On	11/13/2023 11:15:43 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	20.00
Water Flow Test	Pass
RF Water Flow(L/min)	Camera Water Flow (L/min)
1.27	0.81
	Water Inlet Temperature (°C)
	20.37

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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	271.62	2.00	2.00	111.13
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	116.00	18.00	17.94	23.11
RF Generator Test					
Pass					
RF Power Supply Test	Passed				
RF Power Supply (V)	147.380				
RF Oscillator Test	Passed				
RF Oscillator Frequency (MHz)	25.843				
Work Coil Current (A)	44.410				
RF Power Supply Current (A)	1.999				
Camera Test					
Pass					
	Integration Time (ms)	Standard Deviation	Status		
Electronic Offset Test	1000	5.361	Passed		
Dark Current Test	6000	0.779	Passed		
Array Test	5	0.025	Passed		
Linearity Test		0.118	Passed		

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# UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY Ltd.

Automatic Mercury Analyzer

Model RA-4500

Preventive Maintenance Report

Serial No. : 17780278

Soft version : Ver 2.0.7

ROM version : Ver 2.0.1

Date : 11 July 2023

PM by

Approved by : ( Pathom S. )



Coax Group Corporation Ltd.

1131/62,64,325-331 Nakornchaisri road,  
Kwang ThanonNakornchaisri, Dusit, Bangkok 10300 Thailand  
Tel. 02-2435263, 02-6682436 Fax. 02-2437386

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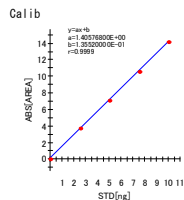
## Inspection result

ITEM	STANDARD	RESULT	JUDGE
1. Self Check			
1.1 Heating		PASS	OK
1.2 Cooling		PASS	OK
1.3 Leak		PASS	OK
1.4 Optical system		PASS	OK
1.5 Drift		PASS	OK
2. Analytical curve inspection(AREA)			
2.1 No Pretreatment (Low Conc.)	Correlation coefficient	1.0000	OK
	( r ) ≥ 0.9990		
3. Repeatability(AREA)			
3.1 No Pretreatment 100ppb, n=5			
		1. 99.12	ppb
		2. 101.48	ppb
		3. 101.24	ppb
		4. 102.34	ppb
		5. 101.92	ppb
	C.V. ≤ 5%	1.23%	OK
4. Blank	Below 1.0 (AREA)	0.2062	OK

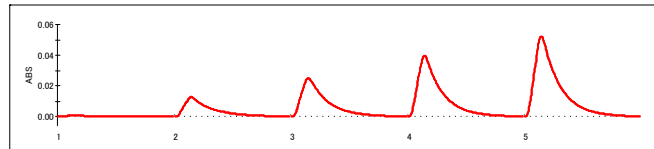
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Title : Preventive Maintenance RA-4500 sn:17780278  
 Date : 7/11/2023  
 Name : Coax Group  
 Memo : Calibration Curve 0-10ng



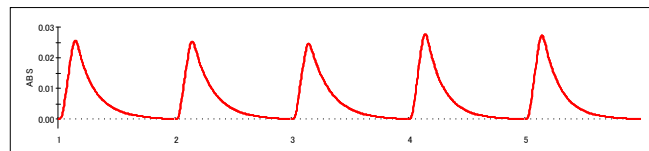
No.	STD [ppb]	SVOL [mL]	CVOL [mL]	DVOL [mL]	STD [ng]	AREA [ON]	MEAS [ng]	Dev [%]	Note
1	100.000	0.000	5.000	5.000	0.000	0.0859	-0.0353	-	
2	100.000	0.025	5.000	5.000	2.500	3.7687	2.5845	3.4	
3	100.000	0.050	5.000	5.000	5.000	7.1028	4.9562	0.9	
4	100.000	0.075	5.000	5.000	7.500	10.6441	7.4753	0.3	
5	100.000	0.100	5.000	5.000	10.000	14.2203	10.0193	0.2	



No.	NAME	SVOL [mL]	CVOL [mL]	DVOL [mL]	AREA [ON]	MEAS [ng]	CONC [ug/L]	Note
1	hg 100 ppb	0.050	5.000	5.000	7.1027	4.9561	99.122	
2	hg 100 ppb	0.050	5.000	5.000	7.2687	5.0742	101.484	
3	hg 100 ppb	0.050	5.000	5.000	7.2514	5.0619	101.238	
4	hg 100 ppb	0.050	5.000	5.000	7.3285	5.1168	102.336	
5	hg 100 ppb	0.050	5.000	5.000	7.2996	5.0962	101.924	

No.	NAME	TRY	AV [ug/L]	SD [ug/L]	Cv [%]
1	hg 100 ppb	5	101.2208	1.246264	1.23

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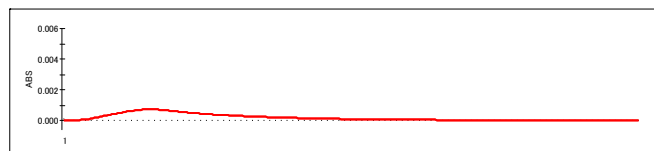


Self Check  
 Heat check: PASS!! ( 24.9degC[05:00] -> 28.9degC[02:31]  
 Sensor check: PASS!! ( 78- 18= 60)  
 Leak check: PASS!! ( 0.17L/min)  
 Sig/Ref check: PASS!! (Sig: 3.73V, Ref: 3.94V)  
 Drift check: PASS!! (-0.0027882 - -0.0032876 = 0.0004993)

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Title : Preventive Maintenance RA-4500 sn:17780278  
 Date : 7/11/2023  
 Name : Coax Group  
 Memo : Blank

No.	NAME	SVOL [mL]	CVOL [mL]	DVOL [mL]	AREA [ON]	MEAS [ng]	CONC [ug/L]	Note
1	Blank				0.2062	0.0503		



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 NIK NIPPON INSTRUMENTS CORPORATION



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
 CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
 5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
 TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM378  
 Page : 1 of 3

## Certificate of Calibration

Equipment : Incubator  
 Manufacturer : Memmert  
 Model : IPP 260  
 Serial No. : V615.0187  
 ID No. : UAE.MIC.003/2559  
 Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
 3 Soi Udomauk 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 :   
 Approved by :   
 ( ) Ponthippa Tameyakul  
 ( ) Malee Butkrues  
 ( ) Suwit Imjai  
 Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2304-0155OC-1

Cert. No.: 23TM378  
Page : 2 of 3

#### Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ).  
The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY49001451	23LM27	25 Feb 2024

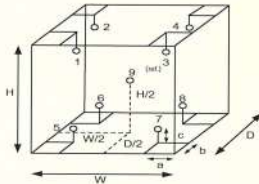
2. This certificate is valid only to the item calibrated on date and place of calibration.

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  
b = 5.0 cm  
c = 5.0 cm  
D = 0.50 m  
W = 0.64 m  
H = 0.80 m  
Capacity = 0.26 m<sup>3</sup>

เอกสารไม่



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



Cert. No.: 23TM193  
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 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 :**

( ) Pornthippa 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 : Water Bath  
Condition As-Received : Used Item  
Reference : 2302-0295OC-2

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	28 Nov 2023

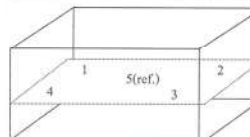
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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



## Calibration Certificate

**Certificate No.:** 2304203-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
 Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

**Equipment:** Autoclave  
**Manufacturer:** ALP  
**Model:** CL-40L  
**Serial No.:** 807298  
**ID No.:** UAE.MIC.019/2560  
**Order No.:** 2304203  
**Operation No.:** 2304203-001  
**Date of Receipt:** 10 August 2023  
**Date of Calibration:** 10 August 2023

**Calibrated by** Mr.Worapob Sooktong **Approv**  
 Scientist

**Date of Issue:** 15 August 2023

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

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

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

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



## Calibration Report

**Certificate No.:** 2304203-001-01  
**Equipment:** Autoclave  
 Model: CL-40L Serial No.: 807298  
 Resolution: 1 °C ID No.: UAE.MIC.019/2560  
 Manufacturer: ALP  
**Date of Calibration:** 10 August 2023

Page 2 of 3

**Location:** 301, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Environment Condition:** Ambient Temperature ( 28 ± 1 ) °C  
 Relative Humidity ( 65 ± 2 ) %  
 Line Voltage ( 225 ± 1 ) Volt

### Condition of this results of Calibration:

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

### 2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with RTD (Data Logger)	HiTemp140-2	S25601	NC-22-11-22-176	9-Nov-23	MADETECH INC.
	HiTemp140-2	S25602	NC-22-11-22-175	9-Nov-23	MADETECH INC.
	HiTemp140-2	R54918	TE 660383-01	8-Apr-24	NATIONAL INSTITUTE

- 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.
- This standard does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical.
- Condition of Calibrated Item : Good  
 UUC Description : Setting program function sterilization : STERILIZE/NORMAL  
 Time of sterilization 15 Minute At 121 °C
- Result of Calibration : ☒ Without adjustment  
☐ After adjustment

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

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



## Calibration Report

**Certificate No.:** 2304203-001-01  
**Equipment:** Autoclave  
 Model: CL-40L Serial No.: 807298  
 Resolution: 1 °C ID No.: UAE.MIC.019/2560  
 Manufacturer: ALP  
**Date of Calibration:** 10 August 2023

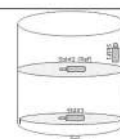
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### Calibration point:

121 °C

### Calibration result:

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
Min	27.0	63.5	223.3
Max	28.3	67.3	225.9



Standard, A, Point  
 100% = 100% to the wet temperature probe.  
 100% = 100% to the upper half of the chamber.  
 100% = 100% to the chamber door, within 100 mm.

### Table 1 : Reporting of Temperature

Calibration Point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.2 is REF)			Uncertainty ± (°C)
	Std.# 1	Std.# 2 (Ref)	Std.# 3	
121	121.68	121.70	121.66	0.66

### Table 2 : Reporting of Characterization Result

UUC* Setting	UUC* Reading				Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	Min (°C)	Max (°C)	Average (°C)	MPa			
121	121	121	121	0.10	0.11	0.12	0.23

### Note

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

\*\*\*\*\* End \*\*\*\*\*

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

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## Certificate of Calibration



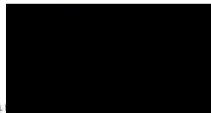
Equipment: Balance  
Model: PX823  
Serial No. (or ID.): C236754745 (UAE.MIC.055/2565)  
Manufacturer: Ohaus  
Condition: In condition  
Certificate No.: C01234158  
Issued Date: 08 December 2023  
Job No.: WO-00011251  
Page: 1 of 3

Customer: United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,  
Phrakhanong District, Bangkok, THAILAND 10260

Environment Condition: Temperature 25 °C ± 0.5 °C  
Humidity 54 %RH ± 1.7 %RH

Calibration Place: United Analyst and Engineering Consultant Co., Ltd. (301 Microbiology Room)  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,  
Phrakhanong District, Bangkok, THAILAND 10260

Calibration By: Mr. Adisai Maknoi  
Calibration Date: 07 December 2023  
The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14  
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02222534



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

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DKSH Technology Limited  
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260  
Phone: +66 2638 7000 Email: info.asia@dsh.com Website: www.dsh.com/certification-thailand

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CAL-FM-C01-14: 12 Sep 2022



Certificate No.: C01234158

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### Calibration Results:

#### Before Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
200 (g)		-	0.000	-0.003	0.000	0.001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0006
500	0.0008

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0013	2.10
5	5.0001	5.000	0.000	0.0013	2.10
10	10.0001	10.001	0.001	0.0013	2.10
20	20.0000	20.000	0.000	0.0013	2.09
50	50.0001	50.000	0.000	0.0013	2.09
100	100.0001	100.001	0.001	0.0013	2.09
200	200.0004	200.002	0.002	0.0014	2.07
300	300.0005	300.002	0.002	0.0015	2.05
400	400.0006	400.004	0.003	0.0016	2.03
500	500.0006	500.008	0.007	0.0019	2.02
600	600.0007	600.009	0.008	0.0021	2.01

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2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260  
Phone: +66 2638 7000 Email: info.asia@dsh.com Website: www.dsh.com/certification-thailand

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CAL-FM-C01-14: 12 Sep 2022



Certificate No.: C01234158

Page: 3 of 3

### After Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		Reference Points (g)				
		A	B	C	D	E
200 (g)		-	0.001	-0.002	-0.002	0.001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0006
500	0.0008

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0013	2.10
5	5.0001	5.000	0.000	0.0013	2.10
10	10.0001	10.000	0.000	0.0013	2.10
20	20.0000	20.000	0.000	0.0013	2.10
50	50.0001	50.000	0.000	0.0013	2.10
100	100.0001	100.000	0.000	0.0014	2.09
200	200.0004	200.000	0.000	0.0014	2.07
300	300.0005	300.001	0.001	0.0015	2.05
400	400.0006	400.002	0.001	0.0017	2.04
500	500.0006	500.001	0.000	0.0019	2.02
600	600.0007	600.002	0.001	0.0021	2.01

The End of Certificate

บริษัท ดีเคเอส อีเซีย จำกัด  
DKSH Technology Limited  
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260  
Phone: +66 2638 7000 Email: info.asia@dsh.com Website: www.dsh.com/certification-thailand

Delivering Growth - in Asia and Beyond.

เอกสารไม่ควบคุม

CAL-FM-C01-14: 12 Sep 2022



Refer to Certificate No.: C01234158

Page: 1 of 3

### Statements of conformity:

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab14. Therefore, those parameters have not been assessed separately.

#### Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

Decision rule : ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w=0$ ), Specific Risk < 50% PFA.  
☒ Choice B Non-binary statement with guard band ( $w=1$  U), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.  
☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w=r$  U).  
; PFA - Probability of False Accept



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**Statements of conformity:**

**Before Adjustment**

Readability: 0.001 g

Nominal Value g	Error of Indication g	Guard band (w) g	Tolerance (z) g	Conformity
1	0.000	0.0013	0.002	Pass
5	0.000	0.0013	0.010	Pass
10	0.001	0.0013	0.020	Pass
20	0.000	0.0013	0.040	Pass
50	0.000	0.0013	0.100	Pass
100	0.001	0.0013	0.200	Pass
200	0.002	0.0014	0.400	Pass
300	0.002	0.0015	0.600	Pass
400	0.003	0.0016	0.800	Pass
500	0.007	0.0019	1.000	Pass
600	0.008	0.0021	1.200	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

**Statements of conformity:**

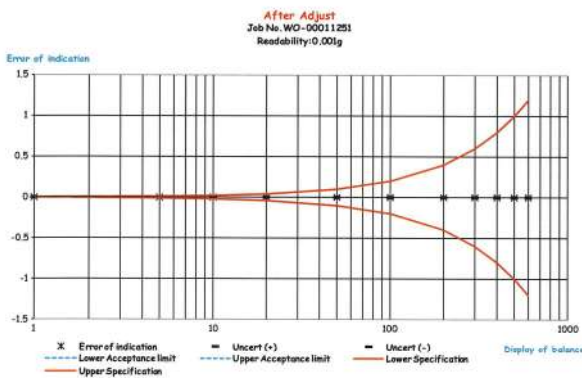
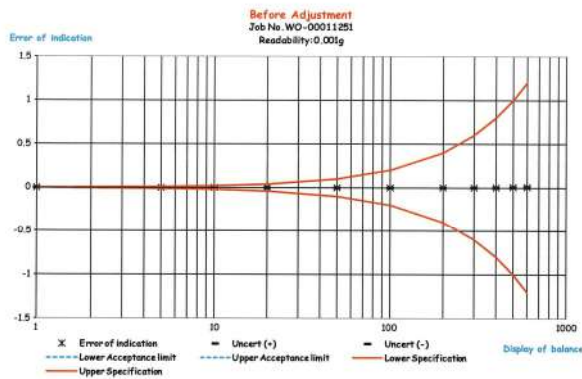
**After Adjustment**

Readability: 0.001 g

Nominal Value g	Error of Indication g	Guard band (w) g	Tolerance (z) g	Conformity
1	0.000	0.0013	0.002	Pass
5	0.000	0.0013	0.010	Pass
10	0.000	0.0013	0.020	Pass
20	0.000	0.0013	0.040	Pass
50	0.000	0.0013	0.100	Pass
100	0.000	0.0014	0.200	Pass
200	0.000	0.0014	0.400	Pass
300	0.001	0.0015	0.600	Pass
400	0.001	0.0017	0.800	Pass
500	0.000	0.0019	1.000	Pass
600	0.001	0.0021	1.200	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

**The End of Statements of conformity**



**ใบตรวจสอบสภาพเครื่องชั่ง**

เลขที่ใบงาน: WO-00011251

ชนิดเครื่องมือ: Balance

รุ่น: PX623

หมายเลขเครื่อง: C236754745

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
07 Dec 2023			07 Dec 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ/Adapter, power supply 220/110V	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสมบูรณ์ชุดกระดกกันลม (Cover)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. ความสมบูรณ์ชุดชั่งระดับน้ำ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การปรับระดับของขาตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การสอบเทียบของไม่เกิด	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. ความสมบูรณ์ชุดของ Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. การแสดงผลของ Display หลังวางน้ำหนัก	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ชุดรองจานชั่ง (Stopper) / pan support	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. การทำงานของ Function Internal / External	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. ความสะอาดของตัวเครื่องภายนอกและภายใน load cell	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Adisai Maknoi  
Service Engineer