ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือที่ใช้ในการตรวจวิเคราะห์

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate	Apex Instruments, USA.	XC-572-V 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 Sulution 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	Mr.Jakrapunt Pummarintr	Opacity	Pollution Control Department	30-31 March 2017	-
2	Mr.Theerawat Martphosri	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
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	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_{10})	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	22P918	11 Jul 22	10 Jul 23	-
3	Air Flow Meter	Particular Matter ($PM_{2.5}$)	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_{10}) Particular Matter ($PM_{2.5}$)	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_{10}) Particular Matter ($PM_{2.5}$)	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
Ambient									
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	ความเป็นกรดด่าง (pH) อุณหภูมิ (Tempareture)	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.WAO.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_4^{2-}) 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 นิเกิล 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-น้ำใต้ดิน, 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.

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

CERTIFICATE OF CALIBRATION

Customer	:	United Analyst and Engineering Consultant Co., Ltd.
Address	:	81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment	:	Console meter
Manufacturer	:	Apex Instrument
Model Number	:	XC-572-V
Serial Number	:	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 (IS).

Result of Calibration

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

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

Calibrated by [redacted]

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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	
Console Model Number	XC-572-V
Console Serial Number	A2003277
DGM Model Number	SK25EX
DGM Serial Number	00005781

Calibration Conditions			
Date	Time	28/04/2023	09:50 AM
Calibration Reference No.		SER23-04017	
Barometric Pressure		758.99	mmHg
Calibration Meter Gamma		0.999	

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

Calibration Data

Run Time	Metering Console					Calibration Meter			
Elapsed	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(Q)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})	(Vwi)	(Vwf)	(t_{wi})	(t_{wf})
min	mm H_2O	m^3	m^3	°C	°C	m^3	m^3	°C	°C
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	140.46730	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

เอกสารไม่ควบคุม

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

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	A2003277
DGM Model Number	SK25EX
DGM Serial Number	00005781

Calibration Conditions			
Date	Time	28/04/2023	09:50 AM
Calibration Reference No.		SER23-04017	
Barometric Pressure		758.99	mmHg
Calibration Meter Gamma		0.999	

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

Calibration Data

Results

Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate		
Dry Gas Meter		Calibration Meter		Value	Variation	Std & Corr	.0212 m^3_{std}/min	Variation
($V_{m(std)}$)	($Q_{m(std)}$)	($Vw_{(std)}$)	($Qw_{(std)}$)	(Y)	(△Y)	($Q_{std(corr)}$)	(△$H_@$)	(△$H_@$)
m^3	m^3/min	m^3	m^3/min			m^3/min	mm H_2O	
0.136	0.012	0.133	0.011	0.977	0.010	0.011	44.617	0.528
0.136	0.012	0.133	0.011	0.981	0.014	0.011	44.242	0.152
0.136	0.017	0.134	0.017	0.980	0.013	0.017	41.495	-2.595
0.136	0.017	0.133	0.017	0.976	0.010	0.017	41.649	-2.441
0.273	0.021	0.265	0.020	0.972	0.005	0.020	44.358	0.268
0.274	0.021	0.265	0.020	0.968	0.001	0.020	44.193	0.104
0.275	0.028	0.264	0.026	0.960	-0.007	0.026	44.624	0.534
0.275	0.028	0.262	0.026	0.954	-0.012	0.026	45.005	0.915
0.276	0.031	0.262	0.030	0.950	-0.017	0.030	45.429	1.339
0.276	0.031	0.263	0.030	0.951	-0.016	0.030	45.294	1.204
				0.967	Y Average		44.090	△H@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For △$H_@$, orifice pressure differential that equates to 0.75 cfm (0.0212 m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (50 mm) H_2O.

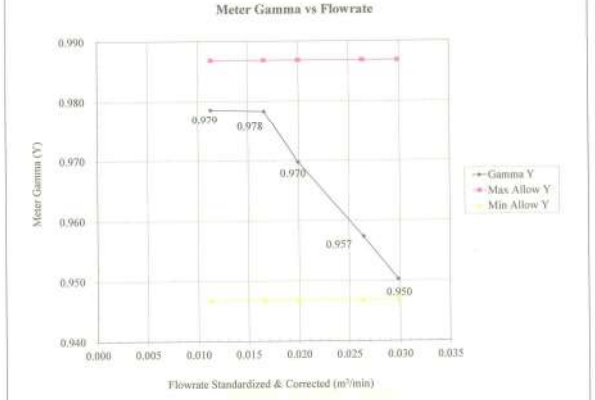
เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	A2003277
DGM Model Number	SK25EX
DGM Serial Number	00005781

Calibration Conditions			
Date	Time	28/04/2023	09:50 AM
Calibration Reference No.		SER23-04017	
Barometric Pressure		758.99	mmHg
Calibration Meter Gamma		0.999	

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

Calibration Date: 28-4-2023 Calibration Reference No: SER23-04017



Console Serial: A2003277 Console Model: XC-572-V

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EES

Certificate No. : E23-04045
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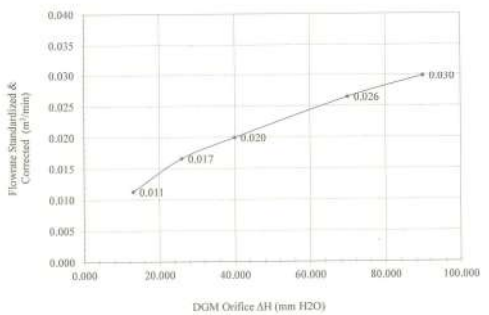
Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	A2003277
DGM Model Number	SK25EX
DGM Serial Number	00005781

Calibration Conditions			
Date	Time	28/04/2023	09:50 AM
Calibration Reference No.		SER23-04017	
Barometric Pressure		758.99	mmHg
Calibration Meter Gamma		0.999	

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

Calibration Date: 28-4-2023 Calibration Reference No: SER23-04017

Meter Pressure vs Flowrate



Console Serial: A2003277 Console Model: XC-572-V

EES

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EES

Certificate No. : E23-04045
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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	A2003277
DGM Model Number	SK25EX
DGM Serial Number	00005781
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 19039

Calibration Conditions			
Date	Time	28/04/2023	12:00 PM
Calibration Reference No.		SER23-04017	
Reference Thermometer		DIGICON	
Serial Number		183169105	

Results

Channel and test point	Console Thermocouple Simulator										
	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-18.0	23.0	36.0	91.0	149.0	259.0	369.0	480.0	592.0	815.0	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

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

EES

เอกสารไม่ควบคุม

ENTECH

Calibration Certificate

Certificate No: G 650651
Date of issue : 29-Sep-22

Instrument description	:	Flue gas Analyzer
Instrument model	:	Testo 350 New
Instrument serial no.	:	61658783
ID no. or control no.	:	UAE.EFM.121/2562
Manufacturer	:	Testo SE & Co. KGaA
Probe description	:	-
Probe model	:	-
Probe serial	:	-
Customer name	:	UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Customer address	:	81 SOI UDOMSUK41,SUKHUMVIT ROAD,BANGCHAK PRAKANONG BANGKOK 10260
Total pages of certificate	:	3 Pages
Receiving no.	:	L-223345
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 Measurment ware caried out the stabilized labotary Temperature : 23 ±5 °C Humidity : 55 ± 15 %RH
Calibration place	:	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, 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 traceblity to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 28-Sep-22

[redacted]

FM-CL-09-C Rev.8 Page 1 of 3 Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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ENTECH

Calibration Certificate

Certificate No.: G 650651

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O2) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide (CO) 80.16 ppm	2582/22	Linde	08-Aug-24
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide (NO2) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO2) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO2) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide (NO) 30.08 ppm	SGS10068	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.9 ppm	4942/20	Linde	20-Nov-22
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	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

FM-CL-09-C Rev.8 Page 2 of 3 Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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ENTECH

Where Solutions Begin

Calibration Certificate

Certificate No.: G 650651

Calibration Results After Adjustment (Table 3)

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	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)	320.6	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

FM-CL-09-C Rev.8 Page 3 of 3 Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.
17/121 Soi Ngamwongwan 47 Yaek 4B, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8898 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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กรมควบคุมมลพิษ
POLLUTION CONTROL DEPARTMENT

ขอมอบประกาศนียบัตรนี้เพื่อแสดงว่า

[redacted]

ได้ผ่านการกำหนดการฝึกอบรมและทดสอบผู้ตรวจวัดความทึบแสงของเขม่าควันด้วยสายตา
และการใช้แผนภูมิเขม่าควันของริงเกิลมานน์ ประจำปีงบประมาณ ๒๕๖๐

ระหว่างวันที่ ๓๐ – ๓๑ มีนาคม ๒๕๖๐

จัดโดย สำนักจัดการคุณภาพอากาศและเสียง กรมควบคุมมลพิษ
ให้ไว้ ณ วันที่ ๓๑ มีนาคม ๒๕๖๐

[redacted]

กรมควบคุมมลพิษ
POLLUTION CONTROL DEPARTMENT

ขอมอบประกาศนียบัตรนี้เพื่อแสดงว่า

[redacted]

ได้ผ่านการกำหนดการฝึกอบรมและทดสอบผู้ตรวจวัดความทึบแสงของเขม่าควันด้วยสายตา
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จัดโดย สำนักจัดการคุณภาพอากาศและเสียง กรมควบคุมมลพิษ
ให้ไว้ ณ วันที่ ๓๑ มีนาคม ๒๕๖๐

[redacted]

TISCH Environmental

RECALIBRATION DUE DATE:
June 28, 2022

Certificate of Calibration

Calibration Certification Information

Cal. Date: June 28, 2021	Rootsmeter S/N: 438320	Ta: 297	°K
Operator: Jim Tisch		Pa: 753.6	mm Hg
Calibration Model #: G25A	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	12.9	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H\left(Ta/Pa\right)}$ (y-axis)
0.9906	0.7121	1.4106	0.9956	0.7158	0.8878
0.9865	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:

$$Qstd = 1/m\left(\left(\sqrt{\Delta H\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)}\right)-b\right) \qquad Qa = 1/m\left(\left(\sqrt{\Delta H\left(Ta/Pa\right)}\right)-b\right)$$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg

Key

- ΔH: calibrator manometer reading (in H2O)
- ΔP: 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

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

www.tisch-env.com
TOLL FREE: (877)263-7610
FAX: (513)467-9009

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

Certificate of Calibration

Certificate No. : 22P918
Page : 1 of 2

Equipment : U Tube Manometer
Manufacturer: Dwyer
Model : 1221-36-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

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

Reference: 2202-0083WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1012 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-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 instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	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 = 4.0146293 inH₂O
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 Signat [redacted]

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Cert.No.: 22P918
Page: 2 of 2

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

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

Applied Pressure (inH_2O)	UUC Indication: High-port side (inH_2O)	UUC Indication: Low-port side (inH_2O)	UUC Indication: ΔP (inH_2O)	Error (inH_2O)
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	-9.02	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
35.50	17.78	-17.94	35.72	0.22

The uncertainty of measurement was ± 0.11 inH_2O
* UUC = Unit Under Calibration
* ΔP = High-port side - Low-port side
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 %.

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7 LIV MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0600-2110-5860-1 FAX: 0600-2110-7140

Page 1/2

Certificate of Calibration

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

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

Unit Under Calibration Details
Measurement Item : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 158850
ID : UAE.EFM.038/2561
Location of Calibration : LAB 4 AIR VELOCITY METER
Sensor Model : -
Sensor Serial Number : -

Calibration Environment and Details
Temperature : 23 °C ± 3 °C
Humidity : 55 %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	Traceble	Due Calibration
Air Flow Meter	Gilibrator 3 High Flow	18501012012	Sensidyne	15 June 2023

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

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

[redacted]

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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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7 LIV MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0600-2110-5860-1 FAX: 0600-2110-7140

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
15.8	15.80	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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AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (6610-2116-5860-1 FAX: (6610-2116-7140

NSC-TISI-TISI7029 CALIBRATION0298

Certificate of Calibration

Customer:

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

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

Certificate No : 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.038/2561

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/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 10 March 2022, Calibration Certificate No. : QR22-0578

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

Note

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

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

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

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (6610-2116-5860-1 FAX: (6610-2116-7140

NSC-TISI-TISI7029 CALIBRATION0298

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)
Ta	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
Tf	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 Certificat[redacted]

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2719-3000-24 FAX. 0-2719-9484

NSC-TISI-TISI7025 CALIBRATION 0008

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

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

Reference: 2207-0584WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1010 mbar

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

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

Condition of this result of calibration

1.Reference standards instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505046	MP-0076-22	02 May 2023

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

Calibrated by : Suwit Auasaree
Issue Date : 25 July 2022

Approved Signatory : [redacted]
[ ] Sura Suwannasri
[✓] Attapol Panurach

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

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

Increasing Pressure

Applied Pressure (mmHg)	718.46	729.33	739.85	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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เอกสาร[redacted]

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484

Certificate of Calibration

Certificate No. : 22H1587
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.ANV.127/2550
Condition As-Received: Used Item
Received Date: 20 July 2022
Calibration Date: 22 July 2022 to 27 July 2022
Reference: 2207-0586WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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

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

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

Condition of this result of calibration

1.Reference standards instuments :

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 Dumwor
Issue Date : 03 August 2022
Approved Signatory : [redacted]
[ ] Pornthippa Tameyakul
[ ] Viporn Tantiyawutti

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B 0293723

Cert. No.: 22H1587
Page.: 2 of 2

Result of Calibration:- Before Adjustment
Function: Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	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:- After Adjustment
Function: Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	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:- Without Adjustment
Function: Temperature measurement.

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
20.00	20.0	0.00	0.72
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 base on standard uncertainty multiplied by coverage factor k = 2.00, providing confidence level approximately 95%.

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

MULTI-POINT GAS TEST REPORT

Test Date : Apr 19,2022

Equipment : Gas Analyzer (NO_2)
Manufacturer : Thermo Electron Corporation
Model : 42C
Serial Number : 42C-0508011076

Standard Gas Concentration

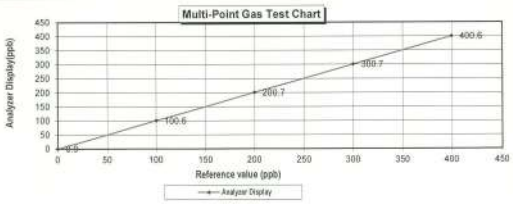
Sulphur Dioxide (SO_2)	45.75	PPM
Nitric Oxide (NO)	45.35	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	1007	
Cylinder No. :	CC159599	
Expiration Date :	Jul 30,2022	

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	0.9	0.90	0.90	0.90
Level 2	20.00%	100.0	100.6	0.60	0.60	0.60
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	300.7	0.70	0.23	0.23
Level 5	80.00%	400.0	400.6	0.60	0.15	0.15
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.45
:Acceptable Limit ± 5%						



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

MULTI-POINT GAS TEST REPORT

Test Date : Apr 7,2022

Equipment : Gas Analyzer (NO_2)
Manufacturer : Thermo Electron Corporation
Model : 42C
Serial Number : 0517512000

Standard Gas Concentration

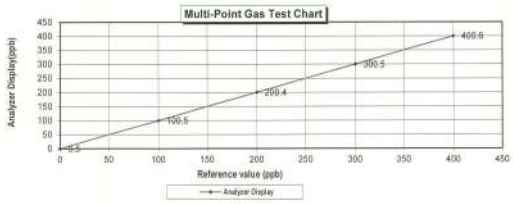
Sulphur Dioxide (SO_2)	44.75	PPM
Nitric Oxide (NO)	45.35	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	1007	
Cylinder No. :	CC159599	
Expiration Date :	Jul 30,2022	

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	0.5	0.50	0.50	0.50
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	200.4	0.40	0.20	0.20
Level 4	60.00%	300.0	300.5	0.50	0.17	0.17
Level 5	80.00%	400.0	400.6	0.60	0.15	0.15
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.30
:Acceptable Limit ± 5%						



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United Analyst and Engineering Consultant Co., Ltd.
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MULTI-POINT GAS TEST REPORT

Test Date : Apr 7,2022

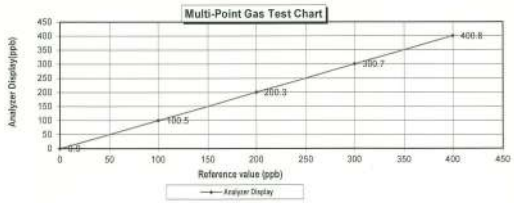
Equipment :	Gas Analyzer (NO_2)	**Model :**	42C
Manufacturer :	Thermo Electron Corporation	**Serial Number :**	0517512001

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.75	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.35	PPM	Model :	146i
Methane (CH_4)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	1007			
Cylinder No. :	CC159599			
Expiration Date :	Jul 30,2022			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.9	0.90	0.90	0.90
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	200.3	0.30	0.15	0.15
Level 4	60.00%	300.0	300.7	0.70	0.23	0.23
Level 5	80.00%	400.0	400.8	0.80	0.20	0.20
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.40

:Acceptable Limit ± 5%



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

MULTI-POINT GAS TEST REPORT

Test Date : Apr 7,2022

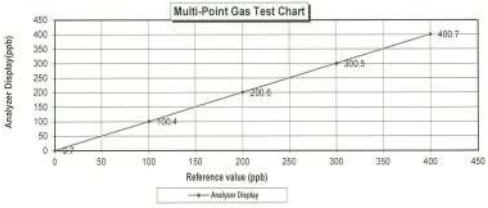
Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM08130002

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.75	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.35	PPM	Model :	146i
Methane (CH_4)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	1007			
Cylinder No. :	CC159599			
Expiration Date :	Jul 30,2022			

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.7	0.70	0.70	0.70
Level 2	20.00%	100.0	100.4	0.40	0.40	0.40
Level 3	40.00%	200.0	200.6	0.60	0.30	0.30
Level 4	60.00%	300.0	300.5	0.50	0.17	0.17
Level 5	80.00%	400.0	400.7	0.70	0.17	0.17
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.35

:Acceptable Limit ± 5%



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Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6950 United Drive
Durham, NC 27713
airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E15A01D5	Reference Number:	122-402135187-1
Cylinder Number:	EB0143262	Cylinder Volume:	144.4 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number:	B22021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document, EPA 600/R-12/531, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. The calibration gas mixture contains no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder Below 100 psig to Ensure Accuracy

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.50 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.34 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC706666	40.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 07, 2025
PRM	12386	2598024	8.51 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401429838102	CC595581	4.248 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2 %	Feb 18, 2025
NTRM	16011140	CC470277	45.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14062119	CC434277	998.5 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or NIST noted above is only in reference to the GMIS used in the above analyzer in the analysis.

ANALYTICAL EQUIPMENT

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

Triad Data Available Upon Request

NOTES:PO #5221032807
GROSS WT 28.40kg
NET WT. 4.75kg

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United Analyst and Engineering Consultant Co., Ltd.
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MULTI-POINT GAS TEST REPORT

Test Date : May 3,2023

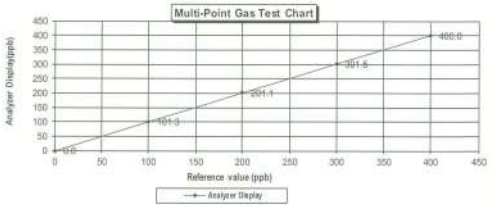
Equipment :	Gas Analyzer (SO_2)	**Model :**	43C
Manufacturer :	Thermo Electron Corporation	**Serial Number :**	43C-0607415779

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.3	1.30	1.28	1.28
Level 3	40.00%	200.0	201.1	1.10	0.55	0.55
Level 4	60.00%	300.0	301.5	1.50	0.50	0.50
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		Average Difference (%)		0.47

:Acceptable Limit ± 5%



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

MULTI-POINT GAS TEST REPORT

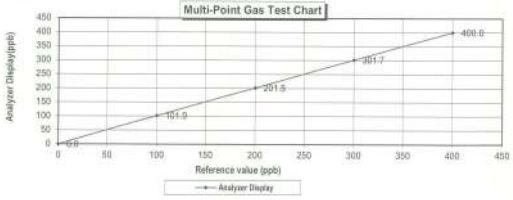
Test Date : Apr 7,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43C
Manufacturer :	Thermo Electron Corporation	**Serial Number :**	43C-0611116459

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.9	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
:Acceptable Limit ± 5%						



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

MULTI-POINT GAS TEST REPORT

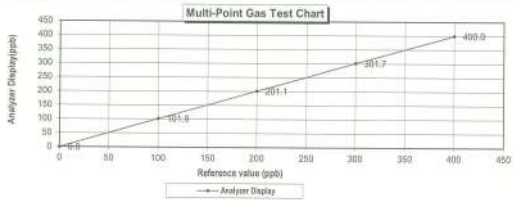
Test Date : Apr 19,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43C
Manufacturer :	Thermo Environmental Instruments	**Serial Number :**	43CTL-78567-389

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.9	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
:Acceptable Limit ± 5%						



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MULTI-POINT GAS TEST REPORT

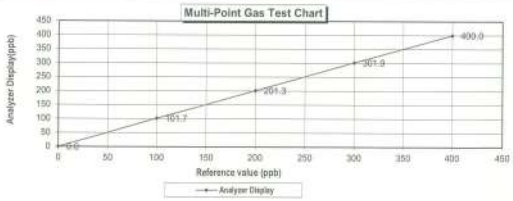
Test Date : May 3,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43C
Manufacturer :	Thermo Environmental Instruments	**Serial Number :**	43C-62236-334

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.7	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
:Acceptable Limit ± 5%						



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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 306 wind speed and wind direction DNA 821

Serial No. : Data Logger 20040002 wind speed and wind direction 20040162

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 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 4 - 12 m/sec

[redacted]

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	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

[redacted]

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 20040164

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 0 - 30 m/sec

[redacted]

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	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

[redacted]

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 0 - 30 m/sec

[redacted]

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	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

[redacted]

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 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 0 - 20 m/sec

[redacted]

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	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

[redacted]

เอกสารไม่ควบคุม

THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 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 1004.6 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 0 - 20 m/sec

[redacted]

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	
Ultrasonic Anemometer	Pressure	Vacomm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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

NSC-TISI-TIS17025 CALIBRATION 0098

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 : [redacted]

Approved by :

( ) Pornthippa Tameyakul

( ) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

Equipment : Electronic Balance

Condition As-Received : Used Item

Reference : 2304-0015OC-1

Cert.No.: 23MM331

Page: 2 of 3

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

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

After Adjustment :

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

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

เอกสารไม่ควบ[redacted]

Equipment : Electronic Balance

Condition As-Received : Used Item

Reference : 2304-0015OC-1

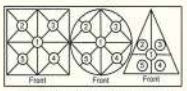
Cert.No.: 23MM331

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

3. Departure from nominal value

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

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

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เอกสารไม่ควบ[redacted]

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

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

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : AB204-S /FACT

Serial No. : B108115858

ID No. : UAE.AIR.016/2555

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

Location : Balance Room 2

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

Calibrated by : [redacted]

Approved by :

( ) Pornthippa Tameyakul
( ) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

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

After Adjustment :

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

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

เอกสารไม่ควบ[redacted]

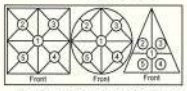
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

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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เอกสารไม่ควบ[redacted]

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

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

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : XP6

Serial No. : B322373893

ID No. : UAE.AIR.019/2556

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

Location : Balance Room 2

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

Calibrated by : [redacted]

Approved by :

( ) Pornthippa Tameyakul
( ) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 6.1 g **Resolution** 0.000001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
3	2.999967	+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)

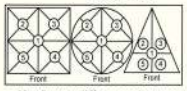
Applied Weight (g)	Standard Deviation of Reading (g)
3	0.0000027
6	0.0000030

เอกสารไม่ควบ[redacted]

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

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

Result of calibration



2. Effect of off center loading

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

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

3. Departure from nominal value

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

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

-o0o-

เอกสารไม่ควบ[redacted]

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

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

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : AB204-S /FACT

Serial No. : B108115858

ID No. : UAE.AIR.016/2555

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

Location : Balance Room 2

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

Calibrated by : [redacted]

Approved by :

( ) Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

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

After Adjustment :

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

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

เอกสารไม่ควบ[redacted]

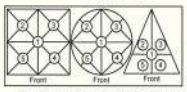
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

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 %.

-o0o-

เอกสารไม่ควบ[redacted]

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

MSC-T181-T181028
CALIBRATION 0048

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 : [redacted]

Approved by :

( ) Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

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

After Adjustment :

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

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

เอกสารไม่ค[redacted]

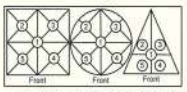
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-1

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

3. Departure from nominal value

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

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

-o0o-

เอกสารไม่ควบ[redacted]

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

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021

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 result is [redacted]

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.

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

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

Certified Reference Materials :

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Calibration Results : Without adjustment

Photometric Accuracy :

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

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Photometric Accuracy :

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

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

- End of Certificate -

เอกสารไม่ควบคุม

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CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021

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 result is [redacted]

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

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

Certified Reference Materials :

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor *k*
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.5742	0.0045	0.0031	2.00
	1.0490	1.0423	0.0067	0.0029	2.00
	2.1900	2.1847	0.0053	0.0075	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5607	0.5577	0.0030	0.0034	2.00
	1.0247	1.0234	0.0013	0.0035	2.00
	2.1229	2.1171	0.0058	0.0088	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
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	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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor *k*
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	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

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

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CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor *k*
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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 -

เอกสารไม่ควบคุม

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

ilac-MRA
NSC-TISI-TIS17025 CALIBRATION 0008

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 : [redacted]

Approved by :

(✓) Malee Butkruea
( ) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 25 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0050217

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	Coverage factor
	pH	mV	mV	pH	(±mV)	k
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

[redacted]

เอกสารไม่ควบคุม

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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เอกสารไม่ควบคุม

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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.: 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 :	2301-0061WSC-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 : [redacted]

Approved by :

(✓) Malee Butkruea
( ) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 6 January 2023

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Cert.No.: 23TW4
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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484

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NSC-TISI-TIS17025 CALIBRATION 0008

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 :	[redacted]
Approved by :	( ) Pornthippa Tameyakul (✓) Suwit Imjai
Issue Date :	10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : 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	22I1285	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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เอกสารไม่ค[redacted]

National Food Institute, Ministry of Industry, Thailand
2008 Soi 35, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel : +66 (0) 2-52 6588 Fax : +66 (0) 2-452 6588 Website : www.nfi.go.th E-mail : calibration@

Calibration Certificate

Certificate No.:	2202093-001-01
Client name:	UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address:	3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, 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.Manas Somsak
Specialist

Ap[redacted]

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-CS-009 Revision: 00 Date: 14-12-61

เอกสารไม่ควบคุม

National Food Institute, Ministry of Industry, Thailand
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel : +66 (0) 2422 8888 Fax : +66 (0) 2422 9558 Website : www.nfi.or.th E-mail : cal@nfi.or.th

Calibration Report

Certificate No.: 2202093-001-01

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

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

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

ID No.: UAE.WAS.003/2553

Date of Calibration: 16 March 2022 —

Location: Chemical Calibration Laboratory, National Food Institute.

Environment Condition: **Ambient Temperature:** (23.0 ± 1.5) °C **Relative Humidity:** (49.5 ± 5) %

Condition of Equipment: Good Condition

Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	SCL-21F-0687	24 June 2022
2.2 Digital Thermometer	2709007	Fluke	CC-640599-01	30 October 2022
2.3 Thermo-Hygro Meter	ana.#U.BTH 009/58	PONPE	QR21-2787	15 November 2022

Certified Reference Material	Lot. No.	Manufacturer	Ref N	Expire 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 2022
2.7 pH buffer 7.00 (Standard pH buffer Solution)	776840	CPAchem	PH107.L5	8 November 2022

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

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0075
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0292
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter.The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No. 2.7	traceable to	BIM RefN HI-7 LotN 30.04.2020; BIM RefN HI-9 LotN 28.05.2020; BIM RefN HI-8 LotN 30.04.2020; BIM RefN HI-10 LotN 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.

[redacted]

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National Food Institute, Ministry of Industry, Thailand
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel : +66 (0) 2422 8888 Fax : +66 (0) 2422 9558 Website : www.nfi.or.th E-mail : cal@nfi.or.th

Calibration Report

Certificate No.: 2202093-001-01

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

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

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

ID No.: UAE.WAS.003/2553

Date of Calibration: 16 March 2022 —

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	59.159	59	6.00	0.58	2.00
7	-0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.463	-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:** InLab 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 Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	172	98.1	0.0071	2.00
6.866	6.87	6	-	0.0074	2.00
10.015	10.01	-175	97.4	0.0090	2.00
6.963	6.96	-3	-	0.0092	2.00

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National Food Institute, Ministry of Industry, Thailand
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel : +66 (0) 2422 8888 Fax : +66 (0) 2422 9558 Website : www.nfi.or.th E-mail : cal@nfi.or.th

Calibration Report

Certificate No.: 2202093-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C — Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 16 March 2022 —

Location: Chemical Calibration Laboratory, National Food Institute.

Environment Condition: Ambient Temperature (23.0 ± 1.0) °C

Relative Humidity (50 ± 4) %

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

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

Support Equipment : - Low Temperature Bath (ISOCAL-6). Model: Europa-6 Plus Basic, S/N: 341582/2

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

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

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

6. Condition of Calibrated Item : Good

7. Result of Calibration : [x] Without adjustment [ ] After adjustment

[redacted]

เอกสาร[redacted]

National Food Institute, Ministry of Industry, Thailand
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel : +66 (0) 2422 8888 Fax : +66 (0) 2422 9558 Website : www.nfi.or.th E-mail : cal@nfi.or.th

Calibration Report

Certificate No.: 2202093-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C — Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 16 March 2022 —

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 : 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 le[redacted] approximately 95 %.

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เอกสารไม่ควบคุม

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

NSC-TISI-TIS 17025 CALIBRATION 0081

Calibration Certificate

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

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

Calibrated by Mr.Worapob Sooktong
Scientist

Ap[redacted]

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.

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2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel +66(0) 2422 8688 Fax +66(0) 2422 8545

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

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

Location: Calibration Laboratory, National Food Institute
Environment Condition: **Ambient Temperature:** (23.5 ± 1.5) °C **Relative Humidity:** (53 ± 5) %
Condition of Equipment: Good Condition
Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-640599-01	30 October 2022
2.3 Thermo-Hygro Meter	NFI.BTH005/18	PONPE	QR22-0351	18 February 2023
Certified Reference Material	**Lot. No.**	**Manufacturer**	**Ref N**	**Expire Date**
2.4 pH buffer 4.008 (Primary pH buffer Solution)	805203	CPAchem	PH216.LS	21 April 2024
2.5 pH buffer 6.865 (Primary pH buffer Solution)	805204	CPAchem	PH217.LS	21 April 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	805205	CPAchem	PH220.LS	21 April 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)	805206	CPAchem	PH107.LS	21 April 2023

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

3.1 Instruments No.2.1		through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0075
3.2 Instruments No.2.2		through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0081
3.3 Instruments No.2.3		through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0292
3.4 Certified Reference Material No.	2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter.The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7		traceable to	BIM RefN HI-27 LotN 04.06.2021; BIM RefN HI-28 LotN 28.06.2021; BIM RefN HI-27 LotN 04.06.2021; BIM RefN HI-28 LotN 28.06.2021, 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.

[redacted]

2008 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร
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เอกสารไม่ควบคุม

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

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

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	177	4.00	0.58	2.00
6	59.159	59	6.00	0.58	2.00
7	-0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.463	-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:** InLab Expert Pro-ISM
Serial No.: 2210418 — **ID.No.** N/A
Performance of Electrode system (Three-Point Calibration at pH4, pH7 and pH10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.010	182	-	0.0071	2.00
6.865	6.850	14	100.0	0.0075	2.00
10.008	10.016	-169	97.9	0.0093	2.00
6.985	6.990	6	-	0.0087	2.00

[redacted]

2008 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร
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สถาบันอาหาร
กรมส่งเสริมอุตสาหกรรม
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

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

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

Condition of this results of Calibration:

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

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1521	A85997	TE 650057-01	10-Dec-22	NATIONAL FOOD INSTITUTE
Platinum Resistance Thermometer (PRT)	38S	509201			

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

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

[redacted]

2008 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร
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Tel +66(0) 2422 8688 Fax +66(0) 2422 8545

เอกสารไม่ควบคุม

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

NSC-TISI-TIS 17025 CALIBRATION 0061

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

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 [redacted] providing a level of confidence of approximately 95 %.

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

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

เอกสารไม่ควบคุม

2008 ถนนอารีมานิต 36 ถนนอารีมานิต แขวงบางพลัด เขตบางพลัด กรุงเทพมหานคร
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DKSH

NSC-TISI-TIS 17025 Calibration 0061

Certificate of Calibration

Equipment: CONDUCTIVITY METER
Model: Lab 955
Serial No. (or ID.): 16300356
Manufacturer: SI Analytics
Electrode Serial No. 16070067
Condition: In Condition

Certificate No.: C24230059
Issued Date: 16 March 2023
Job No.: KSPR2304472
Page: 1 of 2
Model : LF413T Brand : SI Analytics

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

Environment Condition:

Temperature	23	°C	±	2	°C
Humidity	50	%RH	±	15	%RH

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

Calibration By: Mr.Atachai Ngamchanat

Calibration Date: 16 March 2023

The Method used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14

Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 838312, 838313, 838316

[redacted]

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

เอกสารไม่ควบคุม

Delivering Growth – in Asia and Beyond.

DKSH

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	24.8	µS/cm	0.200	µS/cm	2.00	0.21	µS/cm
1413.0	µS/cm	1413	µS/cm	0.0	µS/cm	2.00	9.0	µS/cm
111.3	mS/cm	108.8	mS/cm	2.50	mS/cm	2.00	0.67	mS/cm

The End of Certificate

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
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ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER รุ่น: Lab 955 หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ) 16 Mar 2023 ปกติ	ตรวจสอบ (รับ) 16 Mar 2023 ไม่ปกติ	รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 16 Mar 2023 ปกติ	ตรวจสอบ (ส่ง) 16 Mar 2023 ไม่ปกติ	หมายเหตุ
		General			
☑	☐	1. ความสมบูรณ์เครื่อง	☑	☐	
☑	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☑	☐	
☑	☐	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth)	☑	☐	
☑	☐	4. ปุ่มกด (Keypad)	☑	☐	
☑	☐	5. หน้าจอ (Display, Screen Contrast)	☑	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☐	☐	8. ความยาวคลื่น (Wavelength Check)	☐	☐	
☐	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☐	☐	
☐	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☐	☐	
☐	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☐	☐	
		pH Meter and Conductivity Meter			
☑	☐	12. อิเล็คโทรด (Electrode and Connection Cable)	☑	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับอิเล็คโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

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

Mr.Atachai Ngamchanat

Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
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เอกสารไม่ควบคุม

Delivering Growth – in Asia and Beyond.

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

NSC-TISI-TIS17025 CALIBRATION 0008

Cert.No.: 23MM113
Page.: 1 of 3

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	XSR205
Serial No. :	C210685394
ID No. :	UAE.WAO.010/2565
Submitted by :	United Analyst and Engineering Consulant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phakhanong, Bangkok 10260
Location :	Balance Room
Received order :	26 April 2023
Calibration Date :	26 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 90 %
Calibrated by :	[redacted]
Approved by :	

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

Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0053700

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 81 g **Resolution** 0.00001 g
81 g to 220 g **Resolution** 0.0001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
80	79.99992	+0.00008	0.15	2.00
200	199.9995	+0.0005	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)
80	0.000007
200	0.00004

เอกสารไม่ควบ[redacted]

a 1159272

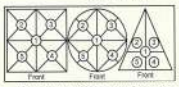
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0459OC-2

Cert.No.: 23MM113
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	-0.0001	0.0000	-0.0001	-0.0001	0.0001

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.11
0.05	0.04999	+0.00001	0.015	2.09
0.1	0.09999	+0.00001	0.015	2.07
1	1.00000	0.00000	0.018	2.04
5	5.00000	0.00000	0.026	2.00
20	20.00002	-0.00002	0.045	2.00
50	50.00002	-0.00002	0.080	2.00
80	80.00002	-0.00002	0.15	2.00
100	100.0000	0.0000	0.17	2.00
150	150.0000	0.0000	0.29	2.00
200	199.9999	+0.0001	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 %.

-o0o-

เอกสารไม่[redacted]

a 1159271

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

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

Page 1 of 3

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

Calibrated by Mr.Worapob Sooktong, Scientist **App**[redacted]

Date of Issue: 16 October 2023

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

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

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

เอกสารไม่ควบคุม

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2400141-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF 55 Serial No.: B216.1666

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

Manufacturer: MEMMERT

Date of Calibration: 11 October 2023

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

Environment Condition:
Ambient Temperature (28 ± 1) °C
Relative Humidity (63 ± 2) %
Line Voltage (228 ± 1) Volt

Condition of this results of Calibration:

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

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

3. This certificate is traceable to International System of Units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.
6. Condition of Calibrated Item : Good

UUC Description :

Time of Record 1 Hour 9 Minute At 104.0, 140.0 and 180.0 °C

Fresh air Damper [ ] Open Position [ ]
[X] Close
[ ] Not Available

7. Result of Calibration : [X] Without adjustment [ ] After adjustment

[redacted]

เอกสารไม่ควบคุม

2008 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
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ศูนย์บริการห้องปฏิบัติการสุสลาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2400141-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF 55 Serial No.: B216.1666

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

Manufacturer: MEMMERT

Date of Calibration: 11 October 2023

Calibration point: 104.0, 140.0 and 180.0 °C

Calibration result:

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

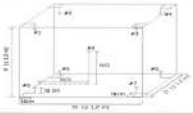

Table1 : Reporting of Temperature

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

Table 2 : Reporting of Characterization Result

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

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "
UUC* = Unit Under Calibration
Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.
Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.
Overall Variation = The difference of the maximum and minimum measured temperatures througout observation time.

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

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

[redacted]

เอกสารไม่ควบคุม

2008 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

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

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR204

Serial No.: C117635043

ID No.: UAE.WAS.012/2564

Order No.: 2302827

Operation No.: 2302827-001

Date of Receipt: 10 May 2023

Date of Calibration: 10 May 2023

Calibrated by Mr.Manas Somsak
Specialist

[redacted]

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.

เอกสารไม่ควบคุม

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302827-001-01

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

Date of Calibration: 10 May 2023

Environment Condition: Ambient Temperature 21.4 ± 0.2 °C Relative Humidity: 43.4 ± 0.9 %
Place of Calibration: Balance room (Water Analysis Unit), UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Condition of Equipment Good Condition

Condition of This Results of Calibration:

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

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	M23040535	8 April 2024

Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 016/23	Quality Reborn	QR23-0489	21 February 2024

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

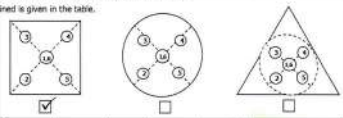
Calibration Results:

1. Repeatability of Reading:

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

2. Off-Center Error:

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



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

[redacted]

เอกสารไม่ควบคุม

2008 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel +66(0) 2422 8688 Fax +66(0) 2422 8545
nfi.or.th

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302827-001-01

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

Date of Calibration: 10 May 2023 — **Page 3 of 4**

Calibration Results: **(Continued)**
Calibration Range: 0 - 200 g
Calibration Adjustment: Internal Calibration
3. Departure from Nominal Value:

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

[redacted]

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

เอกสารไม่ควบคุม

2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
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มูลนิธิการพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302827-001-01

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

Date of Calibration: 10 May 2023 — **Page 4 of 4**

Calibration Results: **(Continued)**
Calibration Range: 0 - 200 g
Calibration Adjustment: Internal Calibration
3. Departure from Nominal Value:

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

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

---------- **End** ----------

[redacted]

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

เอกสารไม่ควบคุม

2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
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nfi.or.th

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

NSC-TISI-TIS17025 CALIBRATION 0008

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

Certificate of Calibration

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

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

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0051476

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

Cert. No.: 23TM249
Page : 2 of 3

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

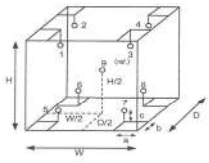
Condition of this result of calibration
1. Reference standard instrument:-

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

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

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



Probe Installation Details :
a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :
D = 0.62 m
W = 1.2 m
H = 1.2 m
Capacity = 0.89 m³

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

เอกสารไม่ควบ[redacted]

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

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

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

Calibration Point (°C)	Measured Temperature (°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 %.

-o0o-

[redacted]

เอกสารไม่ควบคุม

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. 0-2719-9484

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

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URC4S013201
ID No. : UAE.WAO.015/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2

Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : [redacted]

Approved by :

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

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0051476

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

Cert. No.: 23TM249
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

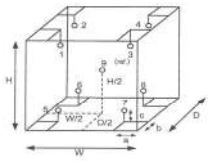
1. Reference standard instrument:-

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

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

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



Probe Installation Details :

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

Dimension of Chamber :

D =	0.62	m
W =	1.2	m
H =	1.2	m
Capacity =	0.89	m^3

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

เอกสารไม่ควบ[redacted]

a 1140517

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

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

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

Calibration Point (°C)	Measured Temperature (°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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เอกสารไม่ควบ[redacted]

a 1149512

HANNA instruments
Hanna Instruments (Thailand) Ltd.
410/67-68 Soi Ratchadapisek 24, Ratchadapisek Rd., Samsen-nok, Huaykwang, Bangkok 10310 Tel: 0-2541-4199 Fax: 0-2541-4198

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-3061

Certificate No. : HIT-2312-0342

CERTIFICATE OF CALIBRATION

Equipment :	COD Test Tube Heater		
Meter Model :	HI839800-02	**Serial No. :**	H018500I
Tube Heater :	25 Vial Capacity	**Accuracy :**	±2°C
Temperature Range :	-10 °C to 160 °C	**Temperature of Reaction :**	150°C
Ambient Temperature :	(25 ± 2)°C	**Relative Humidity :**	(50 ± 15)% 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 : [redacted] **Approved by :** [redacted]

(Thailand) Limited

This certificate was certified only for the instrument we calibrated.

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

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

เอกสารไม่ควบคุม

HANNA instruments

Certificate No. : HIT-2312-0342

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 (°C)	Average Value (°C)	±Uncertainty (°C)	±Tolerance of UUC (°C)	Acceptance Criteria
25 Vial	150.0	150.3	0.59	2	Pass

Figure: Shows the location of the temperature source.

(1A) 149.78°C	(2A) 150.31°C	(3A) 150.63°C	(4A) 149.93°C	(5A) 150.31°C
(1B) 150.35°C	(2B) 150.18°C	(3B) 149.93°C	(4B) 150.18°C	(5B) 150.21°C
(1C) 150.24°C	(2C) 151.10°C	(3C) 150.80°C	(4C) 150.36°C	(5C) 150.86°C
(1D) 150.16°C	(2D) 149.77°C	(3D) 150.22°C	(4D) 150.67°C	(5D) 150.43°C
(1E) 149.94°C	(2E) 150.44°C	(3E) 150.06°C	(4E) 150.63°C	(5E) 149.29°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 **

เอกสารไม่ควบคุม

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

NSC-T88-TS 17025 CALIBRATION 0494

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021

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 [redacted]

The calibration [redacted]

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

NSC-T88-TS 17025 CALIBRATION 0494

REPORT OF CALIBRATION

Certificate No. : SP23-021

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

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

Certified Reference Materials :

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-708-02 R01 1/11/2021

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Calibration Results : Without adjustment

Photometric Accuracy :

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

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Photometric Accuracy :

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

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

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

- End of Certificate -

เอกสารไม่ควบคุม

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

Verification Certificate

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

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.Nuttapol Niyomchat, Specialist **Approv**[redacted]

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.

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

2008 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2008 Soi 36, Sukhumvit Road, Bang Chak Sub-district, Bang Phli District, Bangkok 10260, Thailand
Tel +66(0) 2420 6868 Fax +66(0) 2420 6545
nfi.or.th

เอกสารไม่ควบคุม

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

Verification Report

Certificate No.: 2302413-001-01

Equipment: HEATING BLOCK DIGESTION

Model: 2520 Serial No.: 91794469

Resolution: 1 °C ID No.: UAE.WAS.011/2560

Manufacturer: FOSS

Date of Calibration: 30-31 March 2023

Location: Laboratory Room, NATIONAL FOOD INSTITUTE

Environment Condition:
Ambient Temperature (25 ± 3) °C
Relative Humidity (55 ± 15) %
Line Voltage (220 ± 10) Volt

Condition of this results of Calibration:

1. This instrument was calibrated by insert standard thermocuples type R into its heating block digestion and compared to temperature obtained from reference standards thermometer at calibrated point.
   - The temperature scale used was based on ITS - 90 .
   - All data show below were final values and the initial data may be obtained upon request.
2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34970A	MY44045576/MY41194453	TC22/0044	5-May-2023	N.M. Technical Center Laboratory
	Type R	TC#101-103 / CH#101-103			

3. This certificate is traceable to international system of units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.
6. Condition of Calibrated Item : Good
   UUC* Description
   Time of Record - Hour 30 Minute At 380 °C
7. Result of Calibration : [X] Without adjustment [ ] After adjustment

[redacted]

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

2008 ถนนพระรามที่ 4 แขวงบางจักร์ เขตบางรัก กรุงเทพมหานคร 10700
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เอกสารไม่ควบคุม

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

Verification Report

Certificate No.: 2302413-001-01

Equipment: HEATING BLOCK DIGESTION

Model: 2520 Serial No.: 91794469

Resolution: 1 °C ID No.: UAE.WAS.011/2560

Manufacturer: FOSS

Date of Calibration: 30-31 March 2023

Calibration point: 380 °C

Calibration result:

Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	380	0.96	377.74	2.1
2	380	380	0.40	377.28	2.1
3	380	380	1.18	377.82	2.1
4	380	380	0.44	377.19	1.6
5	380	380	0.11	377.30	1.6
6	380	380	0.14	377.90	1.6
7	380	380	1.17	373.85	2.1
8	380	380	0.33	376.96	2.1
9	380	380	0.14	374.18	2.1
10	380	380	0.96	378.56	2.0
11	380	380	1.04	378.34	2.0
12	380	380	0.35	378.06	2.0
13	380	380	0.48	377.05	1.6
14	380	380	0.38	379.19	1.6
15	380	380	0.50	377.48	1.6
16	380	380	0.48	378.33	1.7
17	380	380	0.71	377.60	1.7
18	380	380	0.35	376.77	1.7
19	380	380	0.84	377.06	1.8
20	380	380	0.41	378.58	1.8

Note:
- UUC* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

[redacted]

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

Verification Report

Certificate No.: 2302413-001-01

Equipment: HEATING BLOCK DIGESTION

Model: 2520 Serial No.: 91794469

Resolution: 1 °C ID No.: UAE.WAS.011/2560

Manufacturer: FOSS

Date of Calibration: 30-31 March 2023

Calibration point: 380 °C

Calibration result: Continued

Figure 1. Location of Reference Standard and Block Diagram of Digestion Unit

TOP VIEW

Sensor Installation Location

Note:
- UUC* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

The report uncertainty of measurement was based on standard uncertainty multiplied by coverage fac[redacted] providing a level of confidence of approximately 95 %.

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

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

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เอกสารไม่ควบคุม

FOSS

Customer Service Report

FOSS South East Asia
3388 Sirinrat Building, 25th – 26th Floor, Unit No. 3388/90,
Rama IV Road, Klongton, Klongtoey, Bangkok, Thailand 10110

Report No: 8411

Date: 29/05/23
Customer: UAE
Instrument: KT8100
Address: Bangkok, Thailand
Serial: 91824052

Hours	Travel To Customer		Labour		Travel From Customer	
Start	07:00	1.5hr	09:00	6hr.	16:30	2hr
Finish	08:30		15:00		18:30	

Job Type

Application		Special		Standard			
Normal	x	Courtesy Visit	x	Installation	x	Training	x
Distributor	x	PMA Onboarding	x	Quote	x	In House	x
Internal	x	Warranty	x	Repair	x	PM	☒
Digital Service	x	Sales Support	x	Remote	x	Other	x

PO/Quote Number: If applicable

PMA Type: Monsoon If applicable | Contract No.: If applicable

Details of Work / Test	Condition / Status
- ทดสอบ Function Test หลังทำ PM	OK
- ทำการเปลี่ยน Part ตามรอบ PM - kit 8100/8200 12 Mo	OK
- ทดสอบอุณหภูมิของ Heating Coil = 32.3 °C	OK
- ทำความสะอาด Splash Wand Steam Generator	OK
- ทดสอบการทำงานของ Steam Valve = 54.8 °C	OK
- ทดสอบการทำงานของ Condenser Water Cooling Valve A, B, Safe	OK
- ทดสอบการวัดปริมาณ Water 100 ml → 100 ml Aliquot 50 ml → 51 ml	OK
- ทดสอบปริมาณกรดที่ใช้ ระหว่าง 170 ml	OK
- ทดสอบ Blank + DIR Recovery = 100 %	

Instrument Ready for Use: (OK) Not OK — If not OK - Comment

Part No:	Batch	Description	Qty
60031807	18.07.2022	Foss PM kit KT8100/8200 12 Mo.	1

I confirm this report is accurate and complete

Signed FOSS [redacted]

Name

Would you be [redacted]

เอกสารไม่ควบคุม

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

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies" Model AA240FS, Serial No. MY13160001
2. Working standard solution "Inorganic Ventures" Multi Analyte Custom Grade Solution, Lot No. S2-MEB708640

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

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

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

CALIBRATION DATE : 2 February 2023

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

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated b [redacted]

The results relate only to the items tested/calibrated or value assigned.
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E-mail : sumalee@tistr.or.th

เอกสารไม่ควบคุม

Request No. 25-66 / 0323 1 / 5 MTC. ACL. No. 387 / 66

CALIBRATION DATA

1. Noise Level

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

Continue 2 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE [redacted]

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E-mail : sumalee@tistr.or.th

เอกสารไม่ควบคุม

Request No. 25-66 / 0323 2 / 5 MTC. ACL. No. 387 / 66

2. Precision

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

Continue 3 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE [redacted]

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E-mail : sumalee@tistr.or.th

เอกสารไม่ควบคุม

Request No. 25-66 / 0323 3 / 5 MTC. ACL. No. 387 / 66

3. Trueness

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

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

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

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

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

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

Continue 4 / 5

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

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

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

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

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

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

Continue 5 / 5

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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 [redacted] Approve[redacted]

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE
End of Certificate

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Agilent CrossLab
From Insight to Outcome

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 CrossLab
From Insight to Outcome

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.**

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Instrument Maintenance

System Information

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

Instrument System Name and ID	5110 VDV ICP-OES
Instrument System Site and Location	UAE

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8015A	MY 18030001
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) Conikal | 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. N/A
- ☑ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

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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. N/A
- ☑ 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

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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. N/A
- ☑ Leave system in an idle state: on and purging.
- ☑ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

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

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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	4190.5	6649.9	4700.8	7564.2
Mn 257.610 nm SRBR	13681.0	27295.3	14569.1	29992.5
Al 396.152 nm SBR	12.1	14.6	11.5	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

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ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	225.155	VAC	220.615	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		1.59	L/min
Water Flow Detector	0.84	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		11.98	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1199.5	W
RF Supply Current	No measurement		8.223	A
RF Supply Voltage	No measurement		194.481	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,8mm od x 5mm id, 2m	G8410-80122	SPS 4	-
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	-
Z axis drive belt	5410047400	SPS 3	-
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	-

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

☐ Section Not Applicable

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

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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

[redacted]

Date Service Completed: 13 Nov 2023

Customer Name: Aphorn Onkong

Customer Signature: Aphorn Onkong

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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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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 (614.171 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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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	2294372.8	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	135760.6	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 **Pass**

	Radial	Axial
Intensity	3522064	4003312
Wavelength	737.212	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

เอกสารไม่ควบคุม

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

เอกสารไม่ควบคุม

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

เอกสารไม่ควบคุม

Report Summary

Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	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)	Water Inlet Temperature (°C)
1.27	0.81	20.37

เอกสารไม่ควบคุม

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

เอกสารไม่ควบคุม

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 [redacted]

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

เอกสารไม่ควบคุม

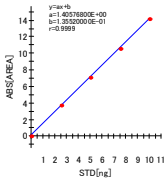
Inspection result

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 (r) ≥ 0.9990	1.0000	OK
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

เอกสารไม่ควบคุม

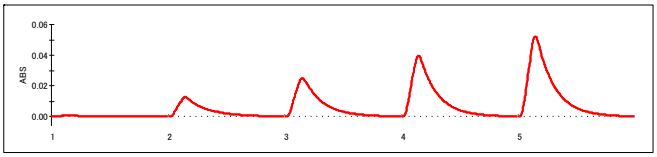
Title : Preventive Maintenance RA-4500 sn:17780278
Date : 7/11/2023
Name : Coax Group
Memo : Calibration Curve 0-10ng

Calib



STD

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	



SMP

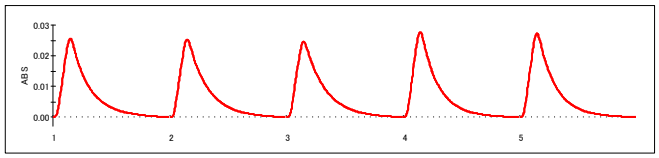
No.	NAME	SVOL [mL]	CVOL [mL]	DVOL [mL]	AREA [ON]	MEAS [ng]	CONC [ug/L]	Note
1	hg 100 ppb	0.050	5.000	5.000	7.1027	4.9561	99.122	
2	hg 100 ppb	0.050	5.000	5.000	7.2687	5.0742	101.484	
3	hg 100 ppb	0.050	5.000	5.000	7.2514	5.0619	101.238	
4	hg 100 ppb	0.050	5.000	5.000	7.3285	5.1168	102.336	
5	hg 100 ppb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

Statistics

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

เอกสารไม่ควบคุม

NIPPON INSTRUMENTS CORPORATION



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)

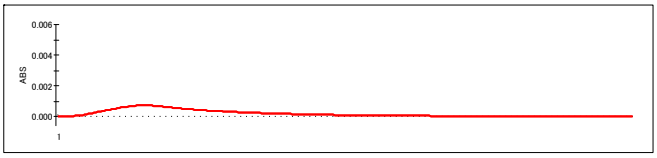
เอกสารไม่ควบคุม

NIPPON INSTRUMENTS CORPORATION

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

SMP

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



เอกสารไม่ควบคุม

NIPPON INSTRUMENTS CORPORATION

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

NSC-T181-T181739
CALIBRATION 0088

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

Location : Microbiology Laboratory

Received Order : 11 April 2023
Calibration Date : 12 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : [redacted]

Approved by :

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

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

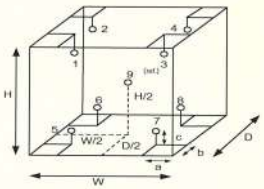
1. Reference standard instrument:-

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 :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :

D = 0.50 m
W = 0.64 m
H = 0.80 m
Capacity = 0.26 m³

เอกสารไม่ค[redacted]

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

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

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

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) Position 1	2	3	4	5	6	7	8	9 (ref.)	Uncertainty (±°C)
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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เอกสารไม่ค[redacted]

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

ilac-MRA
NSC-T80-T1017020
CALIBRATION 0038

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 : [redacted]
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.

เอกสารไม่ควบคุม

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2302-0295OC-2

Cert. No.: 23TM193
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

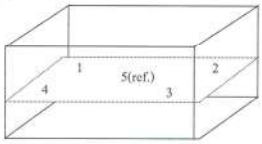
1. Reference standard instrument:-

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

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

	Environmental (°C)	(%R.H.)	AC Voltage Supply (Volt)
Beginning of Calibration	22	65	231
Finished of Calibration	23	61	231



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

เอกสารไม่ค[redacted]

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2302-0295OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 23TM193
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C) Position 1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.453	44.437	44.428	44.477	44.459

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
44.5	0.079	0.038	0.15	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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เอกสารไม่ควบคุม [redacted]

สุสลาหารแห่งชาติ
กรมอุตสาหกรรม
ศูนย์บริการห้องปฏิบัติการสุสลาหารแห่งชาติ
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2304203-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, 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, Scientist **Approv** [redacted]

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

2006 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260
2006 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
Tel. +66(0) 2422 8668 Fax. +66(0) 2422 8545

เอกสารไม่ควบคุม

สุสลาหารแห่งชาติ
กรมอุตสาหกรรม
ศูนย์บริการห้องปฏิบัติการสุสลาหารแห่งชาติ
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

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:

1. 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	MADGETECH INC.
	HiTemp140-2	S25602	NC-22-11-22-175	9-Nov-23	MADGETECH INC.
	HiTemp140-2	R54918	TE 660383-01	8-Apr-24	NATIONAL FOOD INSTITUTE

3. This certificate is traceable to International System of Units (SI Units).
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.
6. This standard does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical.
7. Condition of Calibrated item : Good
   UUC Description : Setting program function sterilization : STERILIZE/NORMAL
   Time of sterilization 15 Minute At 121 °C
8. Result of Calibration : [X] Without adjustment [ ] After adjustment

[redacted]

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

2006 ซอยอุดมสุข 36 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260
2006 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand
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เอกสารไม่ควบคุม

สุสลาหารแห่งชาติ
กรมอุตสาหกรรม
ศูนย์บริการห้องปฏิบัติการสุสลาหารแห่งชาติ
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

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 3 of 3

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

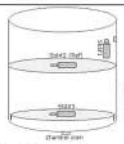

Table1 : Reporting of Temperature

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

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading Min (°C)	Max (°C)	Average (°C)	MPa	Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
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 througout observation time.
The report uncertainty of measurement was based on standard uncertainty multiplied by coverage factor k= 2, providing a level of confidence of approximately 95 %.

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

[redacted]

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

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DKSH

Certificate of Calibration

Equipment:	Balance	Certificate No.:	C01234158
Model:	PX623	Issued Date:	08 December 2023
Serial No. (or ID.):	C236754745 (UAE.MIC.055/2565)	Job No.:	WO-00011251
Manufacturer:	Ohaus	Page:	1 of 3
Condition:	In condition		

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 Mircobiology 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

[redacted] [redacted]

[redacted]nt according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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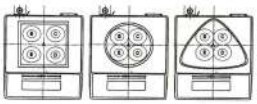
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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 200 (g)

Reference Points (g)				
A	B	C	D	E
-	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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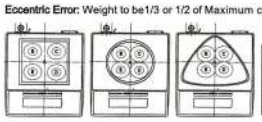
CAL-FM-C01-14: 12 Sep 2022

After Adjustment

Eccentric Error: Weight to be1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value 200 (g)

Reference Points (g)				
A	B	C	D	E
-	0.001	-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

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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

[redacted]

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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 (±) 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.

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Statements of conformity:

After Adjustment

Readability: 0.001 g

Nominal Value g	Error of indication g	Guard band (w) g	Tolerance (±) 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

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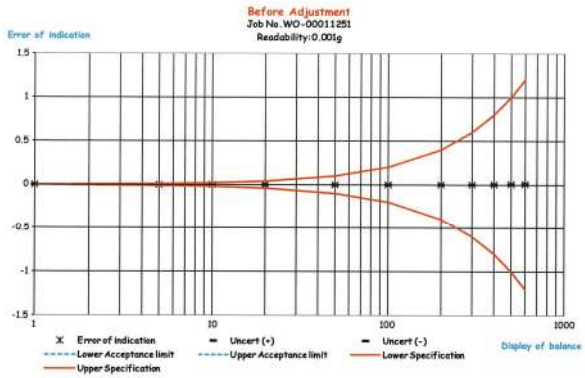

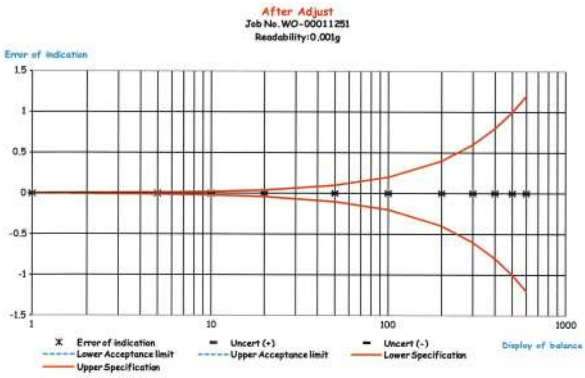

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ใบตรวจสอบสภาพเครื่องชั่ง

เลขที่ใบงาน: WO-00011251

ชนิดเครื่องมือ: Balance รุ่น: PX623 หมายเลขเครื่อง: C236754745

ตรวจสอบ (รับ) 07 Dec 2023 ปกติ	ตรวจสอบ (รับ) 07 Dec 2023 ไม่ปกติ	รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 07 Dec 2023 ปกติ	ตรวจสอบ (ส่ง) 07 Dec 2023 ไม่ปกติ	หมายเหตุ
		General			
☑	☐	1. สายไฟ/Adapter, power supply 220/110V	☑	☐	
☑	☐	2. ความสมบูรณ์ชุดกระจกกันลม (Cover)	☑	☐	
☑	☐	3. ความสมบูรณ์ชุดของระดับน้ำ	☑	☐	
☑	☐	4. การปรับระดับของขาตั้งเครื่อง	☑	☐	
☑	☐	5. การตอบสนองของปุ่มกด	☑	☐	
☑	☐	6. ความสมบูรณ์ของ Display	☑	☐	
☑	☐	7. การแสดงผลของ Display หลังวางน้ำหนัก	☑	☐	
☑	☐	8. ชุดรองจานชั่ง (Stopper) / pan support	☑	☐	
☑	☐	9. การทำงานของ Function Internal / External	☑	☐	
☑	☐	10. ความสะอาดของตัวเครื่องภายนอกและแกน load cell	☑	☐	
☑	☐	11. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☑	☐	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Adisai Maknoi

Service Engineer

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