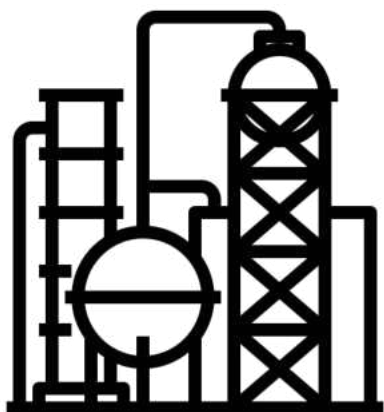


ภาคผนวก ค
เอกสารสอบเทียบเครื่องมือ



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)	ฝุ่นละอองทั้งหมด (TSP) ฝุ่นละอองขนาดเล็กกว่า 10 ไมครอน (PM-10)	Mettler-Toledo	AB204-S / 1128312528	Technology Promotion Association (Thailand-Japan)	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)		Mettler-Toledo	AB204-S/FACT / B108115858	Technology Promotion Association (Thailand-Japan)	23MM332	7 Apr 23	5 Apr 24	-
3	UV-VIS Spectrophotometer		Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 Jan 24	-



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.: 23MM331

Page.: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : AB204-S

Serial No. : 1128312528

ID No. : UAE.AIR.019/2550

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

Location : Balance Room 2

Received order : 07 April 2023

Calibration Date : 07 April 2023

Ambient Temperature : 15 °C to 40 °C

Relative Humidity : 30 % to 90 %

Calibrated by : Suwit Imjai

Approved by : 
Approved Signatory

() Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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:-

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
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 :

<u>Applied Weight</u> (g)	<u>Balance Reading</u> (g)	<u>Correction</u> (g)	<u>Measurement Uncertainty</u> (± mg)	<u>Coverage Factor</u> (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)

<u>Applied Weight</u> (g)	<u>Standard Deviation of Reading (g)</u>
100	0.00007
200	0.00007

เอกสารไม่ควา



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

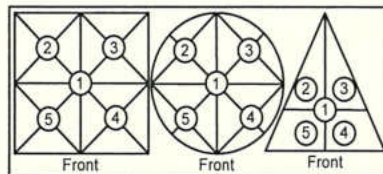
Cert.No.: 23MM331

Page: 3 of 3

Result of calibration

2. Effect of off center loading

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



Maximum difference between
 off-center and central loading

(g)
 0.0005

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

3. Departure from nominal value

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

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

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เอกสารไม่ควม



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



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

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : AB204-S /FACT

Serial No. : B108115858

ID No. : UAE.AIR.016/2555

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

Location : Balance Room 2

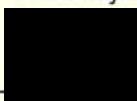
Received order : 07 April 2023

Calibration Date : 07 April 2023

Ambient Temperature : 15 °C to 40 °C

Relative Humidity : 30 % to 90 %

Calibrated by : Suwit Imjai

Approved by : 
Approved Signatory

() Pornthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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:-

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

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

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

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

Before Adjustment :

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
(g)	(g)	(g)	(\pm mg)	(k)
100	100.0002	-0.0002	0.21	2.06
200	200.0003	-0.0003	0.29	2.00

After Adjustment :

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

<u>Applied Weight</u>	<u>Standard Deviation of Reading (g)</u>
(g)	
100	0.00009
200	0.00007

เอกสารไม่คว



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

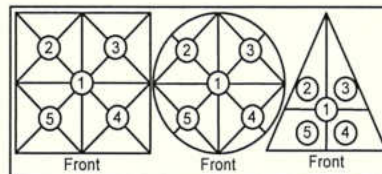
Cert.No.: 23MM332

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



Maximum difference between
off-center and central loading

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	(g)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002	0.0005

3. Departure from nominal value

<u>Applied Weight</u> (g)	<u>Balance Reading</u> (g)	<u>Correction</u> (g)	<u>Measurement Uncertainty</u> (± mg)	<u>Coverage Factor</u> (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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เอกสารไม่คว

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-007

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 315**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** Hitachi**Model :** U-1900**Serial No. :** 2021-064**ID No. :** UAE.WAS.006/2552**Received Date :** 6 January 2023**Calibration Date :** 6 January 2023**Issue Date :** 10 January 2023**Condition Instrument :** Used**Calibrated by :**

(Mr. Panawut Ritudaen)

Technical Manager

Approved by :

(Ms. Chonthicha Sangngern)

Quality Manager

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

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

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °CRelative humidity 55 ± 20 %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

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

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

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 4.0 nm.**Scan Speed of UUC :** 200 nm/min**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

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

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 4 of 5

Photometric Accuracy :

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

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

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

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

- * Indicates non TISI accredited

- End of Certificate -

เอกสารไม่ควบคุม

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพน้ำ									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2201793-001-01	1 Mar 23	28 Feb 24	-
2	pH Meter		Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
3	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (SS) ของแข็งทั้งหมด (TS) ของแข็งละลายน้ำทั้งหมด (TDS)	Mettler-Toledo	XSR205 / C009071872	Technology Promotion Association (Thailand-Japan)	22MM210	26 Apr 22	25 Apr 23	-
4	Analytical Balance (Readability 0.01 mg)		Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	25 Apr 24	-
5	Hot Air Oven		Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23	-
6	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	8 May 24	-
7	BOD Incubator	บีโอดี (BOD)	Arco	UC4-1320 / (UAE.WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	22TM90	17 Feb 22	16 Feb 23	-
8	BOD Incubator		Arco	UR-1320 / (UAE.WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	23TM375	12 Apr 23	10 Apr 24	-
9	COD Reactor (Heating Block)	ซีโอดี (COD)	Hanna	HI839800-02 / H018500I	Hanna Instruments (Thailand) Ltd.	HIT-2209-0184	1 Mar 22	28 Feb 23	-
10	COD Reactor (Heating Block)		Hanna	HI839800 / 1147807	Hanna Instruments (Thailand) Ltd.	HIT-2318-0547	28 Apr 23	26 Apr 24	-
11	UV-VIS Spectrophotometer	ไซยาไนด์ (CN), ฟีนอล (Phenol), ซีโอดี (COD)	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
12	UV-VIS Spectrophotometer		Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 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
13	Atomic Absorption Spectrophotometer (AAS)	ปรอท (Hg) - น้ำทิ้ง	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30 Jan 23	29 Jan 24	-
14	Cold Vapor Atomic Fluorescence Spectrometer (CVAFS)	ปรอท (Hg) - น้ำทะเล	Analytik Jena	mercur DUO plus / K170A0153	Analytik Jena FarEast Thailand Ltd.	Maintenance Protocol	2 Feb 23	1 Feb 24	-

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

Calibration Certificate

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

Page 1 of 5

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

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved by (M)

Specialist, Division of Calibration Laboratory

Date of Issue: 1 March 2022

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement 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.

Calibration Report

Certificate No.: 2201793-001-01

Equipment:

pH Meter

Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER TOLEDO

Model: SevenEasy pH

Serial No.: 1231155210

Type: Bench top

ID No.: UAE.WAT.010/2553

Date of Calibration: 1 March 2022

Page 2 of 5

Location: Chemical 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

<u>Instruments</u>	<u>Serial / ID No.</u>	<u>Manufacturer</u>	<u>Certificate No.</u>	<u>Due Date</u>
2.1 DC Voltage Calibrator	2709007	Fluke	SCL-21F-0687	24 June 2022
2.2 Digital Thermometer	2709007	Fluke	CC-640599-01	30 October 2022
2.3 Thermo-Hygro Meter	NFI.BTH004/18	PONPE	QR22-0195	27 January 2023

<u>Certified Reference Material</u>	<u>Lot. No.</u>	<u>Manufacturer</u>	<u>Ref N</u>	<u>Expire Date</u>
2.4 pH buffer 4.008 (Primary pH buffer Solution)	741339	CPAchem	PH216.L5	19 April 2023
2.5 pH buffer 6.865 (Primary pH buffer Solution)	741340	CPAchem	PH217.L5	19 April 2023
2.6 pH buffer 10.01 (Primary pH buffer Solution)	741342	CPAchem	PH220.L5	19 April 2022
2.7 pH buffer 7.00 (Standard pH buffer Solution)	735836	CPAchem	PH107.L5	16 March 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 Accreditation of Calibration No.0075
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.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.

Calibration Report

Certificate No.: 2201793-001-01

Equipment:

pH Meter

Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER TOLEDO

Model: SevenEasy pH

Serial No.: 1231155210

Type: Bench top

ID No.: UAE.WAT.010/2553

Date of Calibration: 1 March 2022

Page 3 of 5

Calibration Results:

1. Calibration of pH Meter

(Manual Temperature Compensation at 25 °C)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0.00	414.117	414	0.00	0.58	2.00
2.00	295.811	296	2.00	0.58	2.00
4.00	177.462	178	4.00	0.58	2.00
6.00	59.159	59	6.00	0.58	2.00
7.00	-0.001	0	7.00	0.58	2.00
8.00	-59.159	-59	8.00	0.58	2.00
10.00	-177.463	-177	10.00	0.58	2.00
12.00	-295.812	-296	12.00	0.58	2.00
14.00	-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: InLabSolids

Serial No.: 1156882

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	4.00	180	96.25	0.0076	2.00
6.866	6.88	16	-	0.0079	2.00
10.012	10.01	-162	96.13	0.0094	2.00
6.985	7.00	9	-	0.0097	2.00

เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2201793-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH
Serial No.: 1231155210 ID No.: UAE.WAT.010/2553
Manufacturer: METTLER TOLEDO

Date of Calibration: 1 March 2022

Page 4 of 5

Location: Chemical Calibration Laboratory, NATIONAL FOOD INSTITUTE

Environment Condition:
Ambient Temperature 24 °C ± 1 °C
Relative Humidity 53 % ± 2 %

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0851/64	03-Jun-22	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

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

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

6. Condition of Calibrated item :

Good

7. Result of Calibration :

☒

Without adjustment

☐

After adjustment

Calibration Report

Certificate No.: 2201793-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

Serial No.: 1231155210 ID No.: UAE.WAT.010/2553

Manufacturer: METTLER TOLEDO

Date of Calibration: 1 March 2022

Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.
- Description of probe, model : N/A S/N : N/A
- Dimension of probe : Diameter 4 mm., Length 100 mm.,
- Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.006	-0.1	0.099
25.1	25.004	-0.1	0.099
35.1	35.003	-0.1	0.099

Note

- UUC* : Unit Under Calibration

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

----- End -----

Calibration Certificate

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

Page 1 of 5

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

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved by 
(Mr.Nuttapol Niyomchart)

Specialist, Division of Calibration Laboratory

Date of Issue: 24 March 2023

Responsible for the Technical Management Team

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

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

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



Calibration Report

Certificate No.: 2302181-001-01

Equipment:

pH Meter

Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER TOLEDO

Model: SevenEasy pH

Serial No.: 1230525212

Type: Bench top

ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023

Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: **Ambient Temperature:** (23.4 ± 1.5) °C **Relative Humidity:** (52 ± 3) %

Condition of Equipment: Good Condition

Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

<u>Instruments</u>	<u>Serial / ID No.</u>	<u>Manufacturer</u>	<u>Certificate No.</u>	<u>Due Date</u>
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650555-01	21 September 2023
<u>Certified Reference Material</u>	<u>Lot. No.</u>	<u>Manufacturer</u>	<u>Ref N</u>	<u>Expire Date</u>
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH216.L5	16 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217.L5	16 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220.L5	16 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024

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

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

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

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

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



Calibration Report

Certificate No.: 2302181-001-01

Equipment:

pH Meter

Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER TOLEDO

Model: SevenEasy pH

Serial No.: 1230525212

Type: Bench top

ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023

Page 3 of 5

Calibration Results:

1. Calibration of pH Meter

(Manual Temperature Compensation at 25 °C)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.120	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.158	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

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

Equipment: pH Electrode

Type: Combined Electrode

Manufacturer: METTLER TOLEDO

Model: InLab Solids

Serial No.: 1156883

ID.No. N/A

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

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	187	-	0.0071	2.00
6.865	6.86	22	97.86	0.0075	2.00
10.010	10.01	-160	97.66	0.0086	2.00
6.985	6.99	14	-	0.0093	2.00

Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Page 4 of 5

Location: Chemical Calibration Laboratory, National Food Institute

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

Relative Humidity 55 % ± 5 %

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

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

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

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



Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Page 5 of 5

Calibration point: 15.0, 25.0 and 30.0 °C

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A S/N : N/A
- Dimension of probe : Diameter 3 mm., Length 120 mm.,
- Sheath material : N/A

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

Note

- UUC* : Unit Under Calibration

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

----- End -----

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





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22MM210
Page.: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : XSR205

Serial No. : C009071872

ID No. : UAE.WAO.012/2563

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

Location : Balance Room

Received order : 26 April 2022
Calibration Date : 26 April 2022
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %

Calibrated by : Kunchit Promprat

Approved by : 
Approved Signatory

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

Issue Date : 29 April 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



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

Cert.No.: 22MM210
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:-

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
1) Standard Weight Set (E2)	15884	-	70RC138	MM-0009-21	3 Feb 2023

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 :

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
(g)	(g)	(g)	(\pm mg)	(k)
80	80.00004	-0.00004	0.15	2.00
200	199.9999	+0.0001	0.35	2.00

After Adjustment :

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

<u>Applied Weight</u>	<u>Standard Deviation of Reading (g)</u>
(g)	
80	0.000008
200	0.00005



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

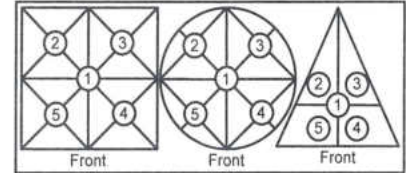
Cert.No.: 22MM210

Page: 3 of 3

Result of calibration

2. Effect of off center loading

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



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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
-0.0002	-0.0001	0.0000	-0.0002	-0.0002

3. Departure from nominal value

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

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

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Cert.No.: 23MM113

Page.: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : XSR205

Serial No. : C210685394

ID No. : UAE.WAO.010/2565

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

Location : Balance Room


Received order : 26 April 2023

Calibration Date : 26 April 2023

Ambient Temperature : 15 °C to 40 °C

Relative Humidity : 30 % to 90 %

Calibrated by : Man Pattanapongpaiboon

Approved by : 

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

Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



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:-

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

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

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

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

Before Adjustment :

<u>Applied Weight</u> (g)	<u>Balance Reading</u> (g)	<u>Correction</u> (g)	<u>Measurement Uncertainty</u> (± mg)	<u>Coverage Factor</u> (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)

<u>Applied Weight</u> (g)	<u>Standard Deviation of Reading (g)</u>
80	0.000007
200	0.00004

เอกสารไม่



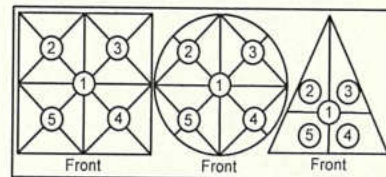
Equipment : Electronic Balance
 Condition As-Received : Used Item
 Reference : 2304-0459OC-2

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



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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
-0.0001	-0.0001	0.0000	-0.0001	-0.0001

3. Departure from nominal value

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

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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1490

Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UF 55

Serial No. : B216.1666

ID No. : UAE.WAO.027/2559

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

Location : Lab Floor 2

Received Order : 19 October 2022
Calibration Date : 19 October 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hlahib

Approved by :

Approved Signatory

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

Issue Date : 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0046800



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

Cert. No.: 22TM1490

Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

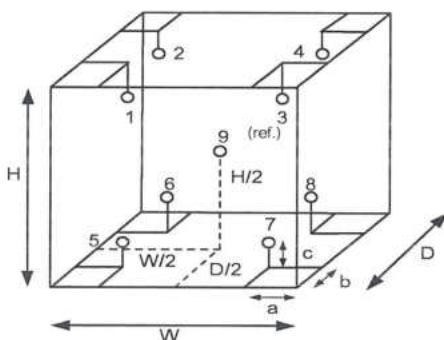
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



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

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

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

เอกสารไม่ควบคุม

a 1133252



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

Cert. No.: 22TM1490

Page : 3 of 3

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

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	178.643	179.753	181.011	180.093	179.496	179.743	181.278

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

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

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

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

UUC* : Unit Under Calibration

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

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

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เอกสารไม่ควบ

a 1133251

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

Page 1 of 4

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR204
Serial No.: C117635043
ID No.: UAE.WAS.012/2564
Order No.: 2302827
Operation No.: 2302827-001
Date of Receipt: 10 May 2023
Date of Calibration: 10 May 2023

Calibrated by Mr.Manas Somsak
Specialist

Approved by 
(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 18 May 2023

Responsible for the Technical Management Team

The uncertainties are for a confidence probability of approximately 95%

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

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

Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR204

Resolution: 0.0001 g

Serial No.: C117635043

ID No.: UAE.WAS.012/2564

Capacity: 220 g

Date of Calibration: 10 May 2023

Page 2 of 4

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

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

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	M2304053S	8 April 2024

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

3. This certification is traceable to SI UNIT

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

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

Calibration Results:

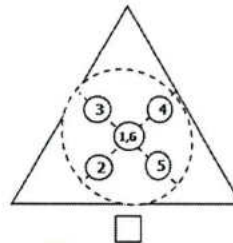
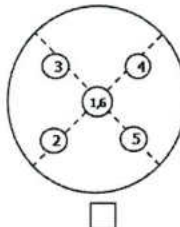
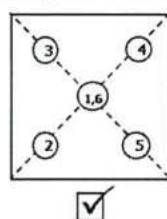
1. Repeatability of Reading:

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

2. Off-Center Error:

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

The balance reading obtained is given in the table.



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

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

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

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 -----

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



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



Cert. No.: 22TM90

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 : 17 February 2022

Calibration Date : 17 February 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Kunchit Promprat

Approved by :

Approved Signatory

(/) Pornthippa Tameyakul

(/) Malee Butkruea

() Suwit Imjai

Issue Date : 22 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม
A 0038099



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2202-0446OC-1

Cert. No.: 22TM90

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	34970A	MY44035217	21LM30	23 Dec 2022

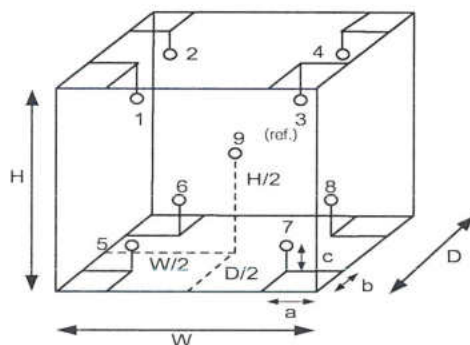
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	28
REL.Humid. (%)	68	75
AC Supply (Volt)	226	226

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	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	22-10RTD-10
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2202-0446OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 22TM90

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 <i>k</i>
20.0	19.5	19.4	0.30	0.58	1.0	0.55	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.154	20.013	20.356	19.939	19.834	19.761	19.817	19.824	19.922

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

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

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

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

UUC* : Unit Under Calibration

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

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

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



Cert. No.: 23TM375

Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator

Manufacturer : ARCO

Model : UR-1320

Serial No. : -

ID No. : UAE.WAO.018/2551

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

Location : Lab Floor 2

Received Order : 11 April 2023

Calibration Date : 12 April 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :

Approved Signatory

- () 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

A 0053360



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2304-0156OC-2

Cert. No.: 23TM375

Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

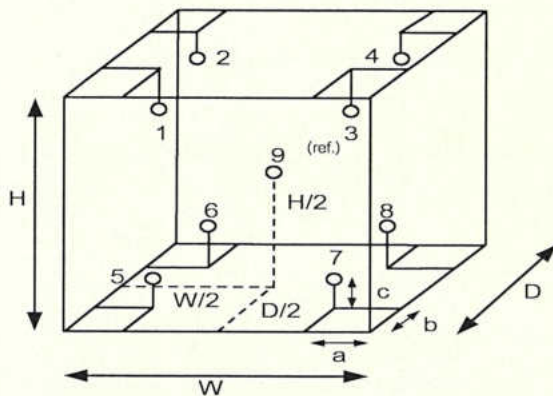
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	27
REL.Humid. (%)	42	45
AC Supply (Volt)	219	220



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

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

เอกสารไม่ควบคุม

a 1158259



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2304-0156OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 23TM375

Page : 3 of 3

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

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.040	20.170	20.263	20.093	19.749	19.704	19.920	20.191	20.020	0.66

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

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

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

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

UUC* : Unit Under Calibration

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

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



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เอกสารไม่ควบคุม

a 1158258

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02 **Serial No. :** H018500I
Manufacturer : Hanna Instruments
Made in : Romania
Condition As-Received : Used Product
Reference : RE220234
Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,
Phrakhanong, Bangkok 10260
Received date : 21 February 2022
Calibrate date : 1 March 2022
Issue date : 2 March 2022
Ambient Temperature : (25 ± 2)°C
Relative Humidity : (50 ± 15)% RH
Calibrated Location : Hanna Instruments (Thailand) Ltd.

Calibrated by :
Mr. Pichit Petthong
Calibration Engineer**Approved by :**
Mr. Anan Suwanchaisakul
Authorized Signatory

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

Condition of this result of calibration
Reference Standard Instruments :

Instruments	Model	Serial No.	Certificate No.	Traceable
Thermometer With Sensor	HI935005	03250060101	21T167	Technology Promotion Association (Thailand-Japan)

Reference / Procedure :

This equipment was calibration by comparison to the reference standard (Standard platinum resistance thermometer) whose accuracy is traceable to the national standard. The calibration was performed by generating the specified working point of temperature then recorded the temperature reading values against the reference standard according to Hanna Calibration Laboratory work Instruction No. 141.

This temperature scale used was based on ITS-90

All data shown below were as-received values without adjustment.

SITE CALIBRATION

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Result of Calibration :

Calibration Point	Unit Under Calibration Setting	Unit Under Calibration Reading	Temperature Stability	Uncertainty of Measurement
150.0 (°C)	- (°C)	150.6 (°C)	1.3 (°C)	± 0.39 (°C)

Calibration Point (°C)	Average Standard Reading (°C)				
	Position				
150.0	1	2	3	4	5
	150.2	150.4	150.4	150.3	150.2
	6	7	8	9	10
	150.4	150.9	151.1	151.1	150.6
	11	12	13	14	15
	150.4	151.0	151.5	151.3	150.5
	16	17	18	19	20
	150.3	150.8	151.2	151.2	150.5
	21	22	23	24	25
	150.2	150.3	150.5	150.4	150.3

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

Certificate No. : HIT-2318-0547

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater

Meter Model : HI839800-02 **Serial No. :** 1147807

Tube Heater : 25 Vial Capacity **Accuracy :** $\pm 2^{\circ}\text{C}$

Temperature Range : -10°C to 160°C **Temperature of Reaction :** 150°C

Ambient Temperature : $(25 \pm 2)^{\circ}\text{C}$ **Relative Humidity :** $(50 \pm 15)\% \text{ RH}$

Manufacturer : Hanna Instruments **Made in :** Romania

Condition As-Received : Used Product **Reference :** RE230642

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

Received date : 21 April 2023


Calibrate date : 28 April 2023

Issue date : 2 May 2023

Calibrated Location : Hanna Instruments (Thailand) Ltd.

Calibration Procedure : This calibrator was conducted by using in-house: calibration procedure
CP-04 by using certified reference material

Calibrated by : ☒ Mr. Pichit Petthong
☐ Mr. Jakkapob Pentisan
☐ Mr. Channarong Soinak

Approved by : 
Mr. Anan Suwanchaisakul
Authorized Signatory



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

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	150.1	0.60	2	Pass

Figure: Shows the location of the temperature source.

(1A)	(2A)	(3A)	(4A)	(5A)
149.32°C	150.07°C	150.50°C	149.79°C	150.07°C
(1B)	(2B)	(3B)	(4B)	(5B)
149.68°C	149.85°C	150.84°C	150.52°C	149.69°C
(1C)	(2C)	(3C)	(4C)	(5C)
149.99°C	150.71°C	151.35°C	151.05°C	150.46°C
(1D)	(2D)	(3D)	(4D)	(5D)
150.00°C	150.50°C	150.08°C	149.90°C	149.85°C
(1E)	(2E)	(3E)	(4E)	(5)
149.44°C	150.06°C	150.56°C	150.11°C	149.51°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

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,

Bangkok 10260

Location of calibration : Laboratory 315**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** Agilent Technologies**Model :** Cary 60**Serial No. :** MY15410009**ID No. :** N/A**Received Date :** 20 May 2023**Calibration Date :** 20 May 2023**Issue Date :** 23 May 2023**Condition Instrument :** Good**Calibrated by :**

(Mr.Tanawut Rittidach)

Technical Manager

Approved by :

(Ms. Chonticha Sangngern)

Quality Manager

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °CRelative humidity 55 ± 20 %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

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

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

Institute of Standards and Technology (NIST) through Sarna 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.

REPORT OF CALIBRATION

Certificate No. : SP23-021

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Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
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

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Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor <i>k</i>
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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Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor <i>k</i>
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%

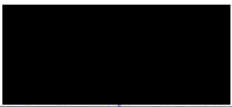
- * Indicates non TISI accredited

- End of Certificate -

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-007

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Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 315**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** Hitachi**Model :** U-1900**Serial No. :** 2021-064**ID No. :** UAE.WAS.006/2552**Received Date :** 6 January 2023**Calibration Date :** 6 January 2023**Issue Date :** 10 January 2023**Condition Instrument :** Used**Calibrated by :**
(Mr.Tanawut Rittidach)

Technical Manager

Approved by :
(Ms. Chonthicha Sangngern)

Quality Manager

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

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

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REPORT OF CALIBRATION

Certificate No. : SP23-007

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Environment Condition : Ambient Temperature 25 ± 5 °CRelative humidity 55 ± 20 %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

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

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

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 4.0 nm.**Scan Speed of UUC :** 200 nm/min**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.

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REPORT OF CALIBRATION

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Calibration Results : Without adjustment

Photometric Accuracy :

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

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REPORT OF CALIBRATION

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Photometric Accuracy :

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

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REPORT OF CALIBRATION

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Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

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

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

- * Indicates non TISI accredited

- End of Certificate -

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Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

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

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the installation.

Note: While non-current production AA instrument and or accessory models are not covered specifically in this document it can be used as a basic reference.

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

Introduction

Customer Information

- 1 Customers should provide all necessary operating supplies upon request of the engineer.
- 2 A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- 3 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.
- 4 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.

Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- 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.
- A useful *Agilent Resource Center* web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our *Support Home page* at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections:
Join the *Agilent Community* at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. **(Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)**
- 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 "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance 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
- Complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Completion section including the customer's and your signature.

This information is subject to change without notice.

Instrument Maintenance

System Information

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

Instrument System Name and ID	240 FS AA / MY13160001 / UAE-HEM.2558
Instrument System Site and Location	Heavy metal Analysis Unit / UNITED ANALYST AND ENGINEERING

List System Component Product Numbers	List the Serial Numbers of each Component
1. 07432A	MY13160001
2. 08444A	MY18150001
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

Revision: 10 00, Issued: November 2021

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- ☒ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. *N/A*
- ☒ 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, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

Preventive Maintenance Procedures

FLAME SYSTEM section

☐ *Section not applicable*

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the *SVD Power Supply diagnostic*.
- ☒ For Dual Beam instruments - Confirm RBC frequency using the *SVD RBC frequency diagnostic*.

Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector
 - ☐ ABA *N/A*

Optics components

- ☒ Check that external optical surfaces are clean – Clean or replace as required.
- ☒ Use SVD and perform *Mono Wavelength Correction*.
- ☒ Use SVD and perform *Slit Calibration*.
- ☒ Use SVD and perform *Grating Squareness Diagnostic*.
- ☒ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☒ Use SVD and perform *Wavelength Repeatability*.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.
- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery barbs.
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☒ Check and clean the igniter electrode

Gas handling components and safety interlocks

- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the *SVD interlock monitoring diagnostic*.

Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing "
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

FURNACE SYSTEM section

☒ *Section not applicable*

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the *SVD Power Supply diagnostic*.

Mechanical components

- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector

Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform *Mono Wavelength Correction*.
- ☐ Use SVD and perform *Slit Calibration*.
- ☐ Use SVD and perform *Grating Squareness Diagnostic*.
- ☐ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☐ Use SVD and perform *Wavelength Repeatability*.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workhead component checks

- ☐ Inspect the GTA workhead gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workhead water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☐ Check and clean the end windows on the workhead.
- ☐ Check safety interlock operation.

Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

☒ *Section NOT Applicable*

- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

☒ *Section NOT Applicable*

- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

☒ *Section NOT Applicable*

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking 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 edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

☒ *Section NOT Applicable*

- ☐ Check the x-axis and z-axis timing belts – Replace if there is are any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 ® Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Vapor generation accessory VGA (hydride generator)

☒ *Section NOT Applicable*

- ☒ Inspect VGA gas supply hose.
- ☒ Inspect/replace VGA pump tubing.
- ☒ Check low gas pressure interlock setting – adjust if required.
- ☒ Check precision orifice gas flow setting – adjust if required.
- ☒ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☒ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltrAA lamp accessory (external)

☒ *Section NOT Applicable*

- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Restore System

- ☒ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

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.

Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ 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 or if necessary, in the customer's IQ records.

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	45 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.5516
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0	0.4 %
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	-
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.15	-
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.10	-
MSR%	≥ 70 %	-

AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution – Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hivac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica – round (right side)	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica – rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM

Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

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 Completion

Service request number 6005686733

Date service completed Jan 30, 2023

Agilent signature [REDACTED]

Customer signature [REDACTED]

Total number of pages in this document 13

SVD Results Report



Report ID: 7 **Diagnostic Start Time:** 30/01/2023 9:07:52 AM **Diagnostic End Time:** 30/01/2023 9:53:18 AM

Customer: UNITED ANALYSIS AND ENGINEERING CONSULTANT: Nukoon Lueangsangwan

Address:

Contact Details: 02-637-6363

Instrument Configuration

Configuration:

Serial Number: MY13160001	Turret Type: Automatic
Instrument Model: Varian AA140/240/280	Number Of Lamps: 4
Flame Instrument: True	Mono Type: Automatic
Furnace Instrument: True	Gasbox Type: 'Y' Gas Box
Zeeman Present: False	Auto Burner Adjuster: False
Internal Zeeman: False	Mains Frequency: 50
Internal UltraAA: False	Firmware Version: 2.11
Optics Type: Double Beam	Photomultiplier Type: Normal(900nm)
D2 BG Correction Fitted: True	PWB Version: 45
Boot Block Version:	

EEPROM Data:

Instrument Run Hours: 59326.383	D2 Run Hours: 46984.500
Zero Wavelength Offset: 30.175	D2 Serial Number: not set !
Mono Correction: 0.760	D2 Install Date: 01/01/1970
Flame Hours: 28887.084	D2 Original Intensity: 1.000
	D2 Last Intensity: 475.000

Frequency:

Averaging Period: 30.0	
Datapoint Count: 20	
Upper Limit: 51.00	Highest Measured Frequency: 50.00
Average Frequency: 50.00	
Lower Limit: 49.00	Lowest Measured Frequency: 50.00

Result: **Passed**

Power Supply:

Averaging Period: 30.0

Datapoint Count: 20

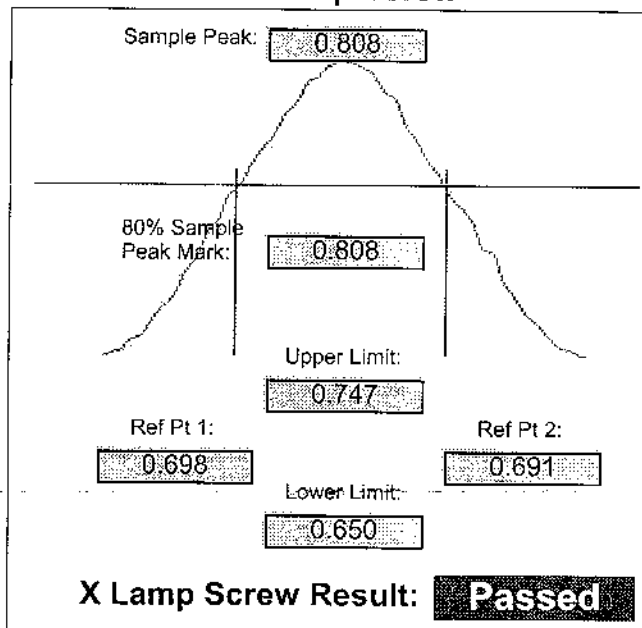
	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.17	13.20	Passed
-12.00 V Rail	-13.20	-11.90	-10.80	Passed
5.00 V Rail	4.50	5.02	5.50	Passed
310.00 V Rail	279.00	320.00	341.00	Passed

Beam Balance:

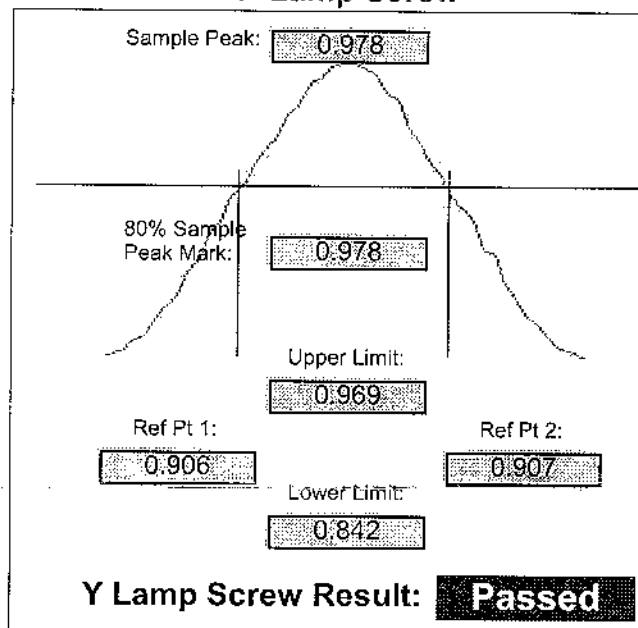
Lamp Type:
Lamp Socket Used:

Peak Selected:
Lamp Alignment: **Performed**

'X' Lamp Screw



'Y' Lamp Screw



Grating Squareness:

Lamp Element(s): Cobalt/Chromium/Copp

Lamp Turret Position: 3

Lamp Current(mA): 10.00

Slit Width(nm): 0.2

1st Order Wavelength(nm): 324.80

Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.45	324.80	325.15	Passed
Second Order	649.23	649.55	649.97	Passed

Wavelength Repeatability:

Lamp Used: Copper	Lamp Current(mA): 4
Peak Used(nm): 324.750	Slit Width(nm): 0.2
Connected to Socket: 3	Slit Height: Normal

Lamp Alignment: **Performed**

Lower Limit(nm) 324.768	324.888 Upper Limit(nm)
--------------------------------	--------------------------------

(Approach from Zero Order)

(Approach from end)

Sample 1: **324.828**

Sample 2: **324.828**

Sample 3: **324.823**

Sample 4: **324.823**

Sample 5: **324.823**

Sample 6: **324.823**

Sample 7: **324.823**

Sample 8: **324.819**

Sample 9: **324.823**

Sample 10: **324.819**

Mean: 324.824

Standard Deviation: 0.002

Result: **Passed**

Mechanical

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Drive:

Untested

Miscellaneous

Signal Processing Linearity:

Calculate Mode: New Calc Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	261	297	Passed
S1	156	164	191	Passed
S2	271	296	332	Passed
S3	474	507	579	Passed
S4	825	917	1008	Passed
S5	1435	1528	1754	Passed
S6	2498	2768	3053	Passed
S7	4347	4749	5313	Passed

Interlocks:

Burner Fitted: Working

Flame Detect: Working

N2O Burner Fitted: Untested

GCU Active: Working

Flame Shield Closed: Working

Oxidant Pressure: Working

Gas Control Fitted: Untested

Oxidant Changeover: Untested

Pressure Release Bung Fitted: Working

Ignition: Working

Liquid Trap Fitted: Working

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected

Lamp 5: Not Supported

Lamp 2: 87 - Silver/Cadmium/Lead/Zinc(UltrAA) (Ag/CLamp 6: liNot Supported

Lamp 3: 76 - Cobalt/Chromium/Copper/Iron/Manganese: Lamp 7: (Not Supported/Ni)

Lamp 4: Uncoded Lamp/Not Connected

Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Not Performed

Notes:

Signatures:

UNITED ANALYSIS AND ENGINEERING CONSULTANukoon Lueangsangwan

Date

Analyst
Date Started 30/01/2023 10:56 AM GMT: 30/01/2023 3:56 AM
Worksheet Cu 5 ppm Sensitivity
Comment
Methods Cu
Computer name HEM-212
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc mg/L	%RSD	Mean Abs
Cu 5 ppm PreTest	UNCAL	0.1	0.5516 ✓
	Readings		
	0.5524	0.5512	0.5510
			30/01/2023

เอกสารไม่ควบคุม

Analyst**Date Started** 30/01/2023 11:00 AM GMT: 30/01/2023 4:00 AM**Worksheet** Cu 5 ppm Sensitivity 01**Comment****Methods** Cu**Computer name** HEM-212**Serial Number:** MY13160001**Method: Cu (Flame)**

Sample ID	Conc mg/L	%RSD	Mean Abs
Cu 5 ppm Precision ✓	UNCAL	0.4 ✓	0.5394
	Readings		
	0.5383	0.5418	0.5407
	0.5406	0.5429	0.5410
			0.5358
			0.5383
			0.5375
			30/01/2023

เอกสารไม่ควบคุม

Analyst

Date Started 30/01/2023 12:22 PM GMT: 30/01/2023 5:22 AM

Worksheet Hg

Comment

Methods Hg

Computer name HEM-212

Serial Number: MY13160001

Method: Hg (Vapor)

Sample ID	Conc ug/L	%RSD	Mean Abs	
Hg 10 ppb	UNCAL	0.2	0.1713	
	Readings			
	0.1710	0.1716	0.1712	30/01/2023

เอกสารไม่ควบคุม

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur DUO /
mercur DUO plus

Serial-No.: K170A0153 Customer-No.: _____
Date: 2 February 2023 Carried out by: Mr. Srichai Fak-On

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



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

Maintenance works basic unit

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

Maintenance works Autosampler

Serial No.: N/A

lubricate the dosing-winding (Teflon-grease-spray)	<input type="checkbox"/>
clean the dosing cylinder, if necessary exchange it	<input type="checkbox"/>
lubricate the winding system of the height drive with some drops of oil	<input type="checkbox"/>
check the toothed belt	<input type="checkbox"/>
check the position of the mechanical stopper (height: 13mm)	<input type="checkbox"/>
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	<input type="checkbox"/>
check the pump rate of washing cup	<input type="checkbox"/>
check the electrical hose connections for good contact	<input type="checkbox"/>
check the connectors of the magnetic valves	<input type="checkbox"/>
check the dosing hose for buckling, if necessary exchange it	<input type="checkbox"/>

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

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

[Redacted Signature]

3 February 2023

Place, Date (DD/MM/YYYY)

[Redacted Signature]

Signature Customer

3 February 2023

Place, Date (DD/MM/YYYY)

Mercur

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

Remarks:

Method parameters**Hg**

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

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		

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

QC parameters

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

Calibration settings

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

Sample statistics

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

Calibration standards

Hg

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

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

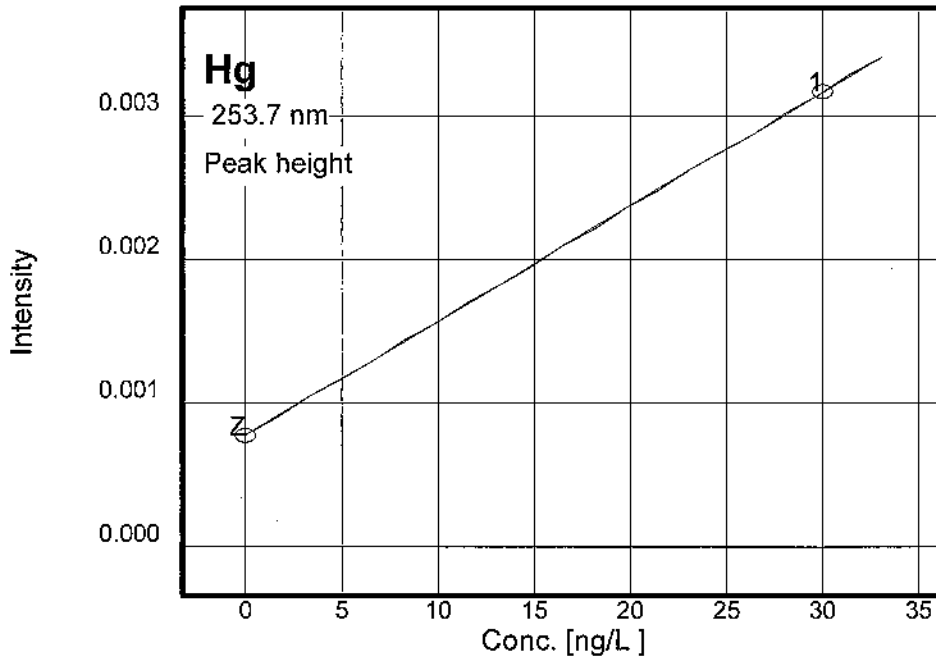
$$\text{Ints} = k_1 + k_2 \cdot \text{conc}$$

k1=0.000775

k2=0.000080

Recal. factor:

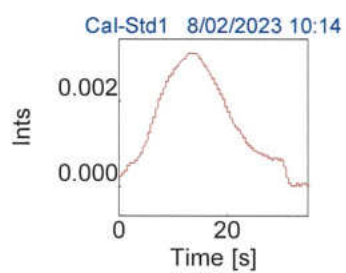
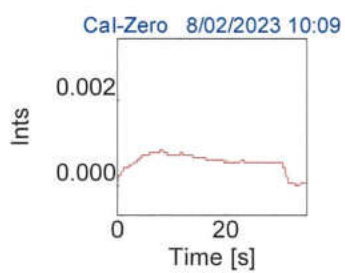
Slope	0.00008 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

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

Hg	Without Enrichment / FBR / 30 µg/L_PM_3-02-2023					8/02/2023	10:07
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000816				PkH	10:09
		0.000765					10:10
		0.000741					10:11
	0ng/L	0.000774		0.000038690	4.995		10:11
Cal-Std1		0.003130				PkH	10:14
		0.003177					10:15
		0.003201					10:16
	30.00ng/L	0.003169		0.000036050	1.137		10:16
Calibration	Calibration function: 01						10:16

Peak plots

Hg



Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_017
 Program version: 4.7.9.0 Printed on: 3/02/2023 14:44
 Recording started on 3/02/2023 14:25 GMT+7.0
 Operator:
 Laboratory:
 Code:

Remarks:

Method parameters**Hg**

Method Enrichment / FBR /30 µg/L_PM 3-02-2023
 Created on 3/02/2023 Time 13:41
 Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	20 s
PMT	444 V		
AZ time	5 s	Peak smoothing	8/5
Delay	0 s		

Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	20 s		
Purge time2	15 s	Gas wash time2	10 NL/h
Purge time3	10 s	Gas wash time3	10 NL/h
Heat.time coll.1	20 s	Cool. time coll.1	30 s

QC parameters

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

Calibration settings

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

Sample statistics

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

Calibration standards**Hg**

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

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

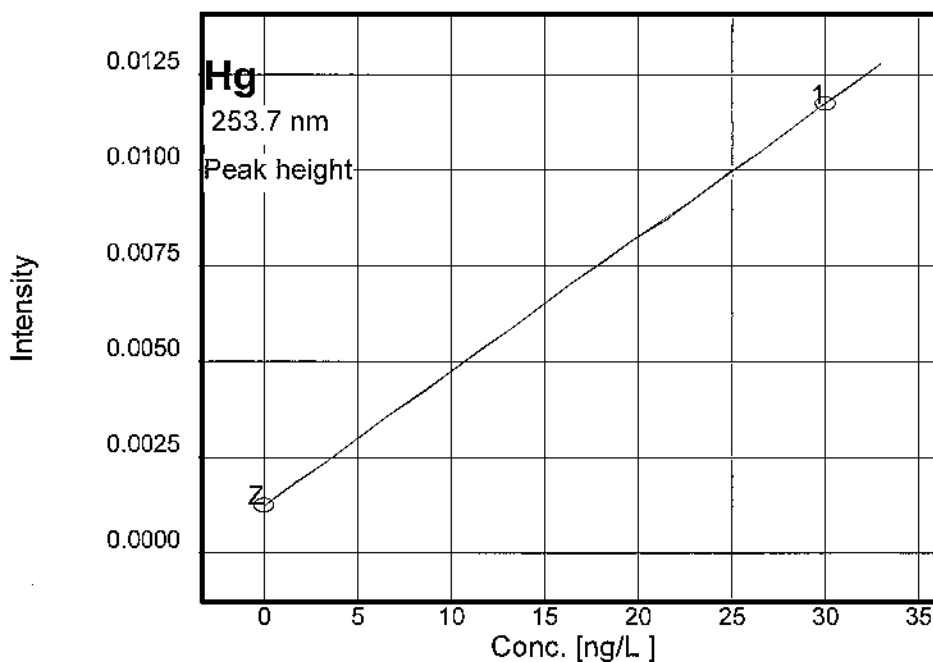
$$\text{Ints} = k_1 + k_2 \cdot \text{conc}$$

k1=0.001256

k2=0.000349

Recal. factor:

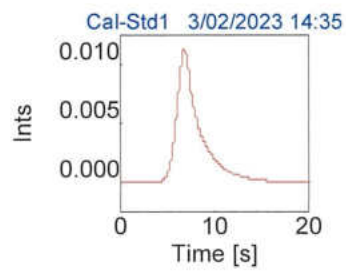
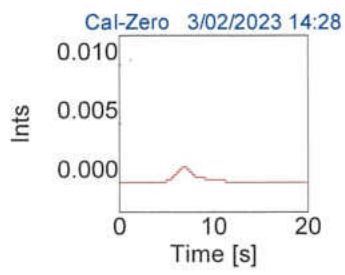
Slope	0.00035 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

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

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

Peak plots

Hg



Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_025
 Program version: 4.7.9.0 Printed on: 8/02/2023 11:44
 Recording started on 8/02/2023 11:31 GMT+7.0

Operator:
 Laboratory:
 Code:

Remarks:

Method parameters**Hg**

Method Without enrichment / FBR 100 ng/L PM_3-02-2023
 Created on 3/02/2023 Time 11:53
 Program ---

Parameters Mercur Technique: Hg absorption

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

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

QC parameters

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

Calibration settings

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

Sample statistics

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

Calibration standards**Hg**

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

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

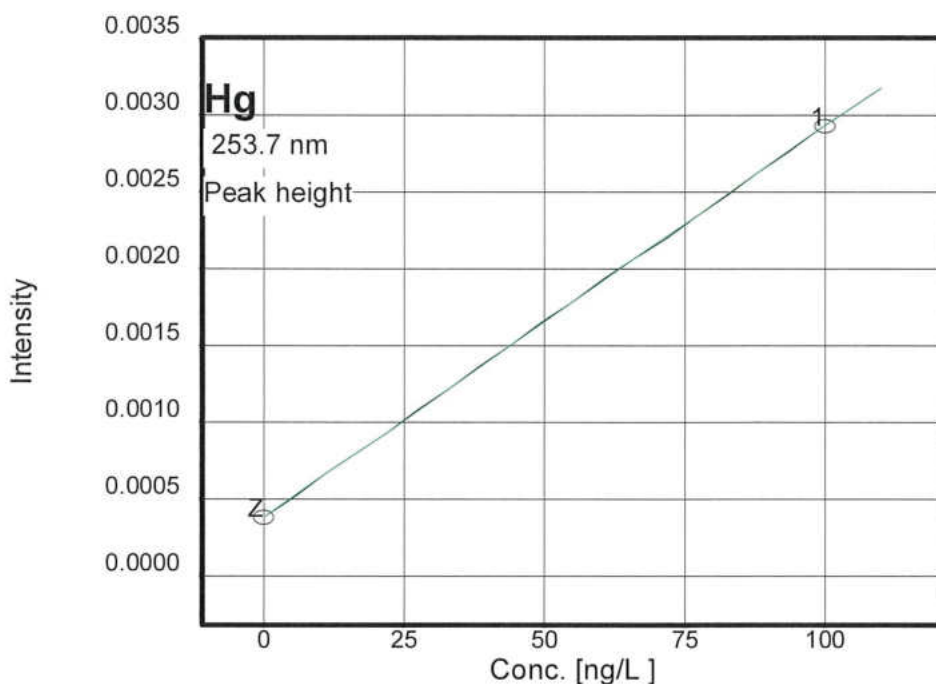
Abs=k1+k2*conc

k1=0.000383

k2=0.000025

Recal. factor:

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

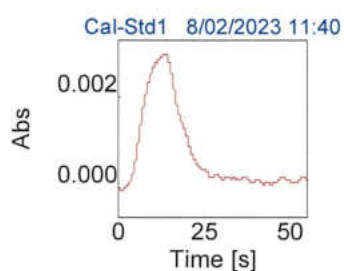
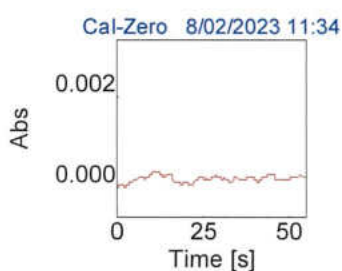


Measurements and events (sorted by time)

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

Peak plots

Hg



Mercur

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

Remarks:

Method parameters**Hg**

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

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		

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

QC parameters

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

Calibration settings

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

Sample statistics

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

Calibration standards**Hg**

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

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

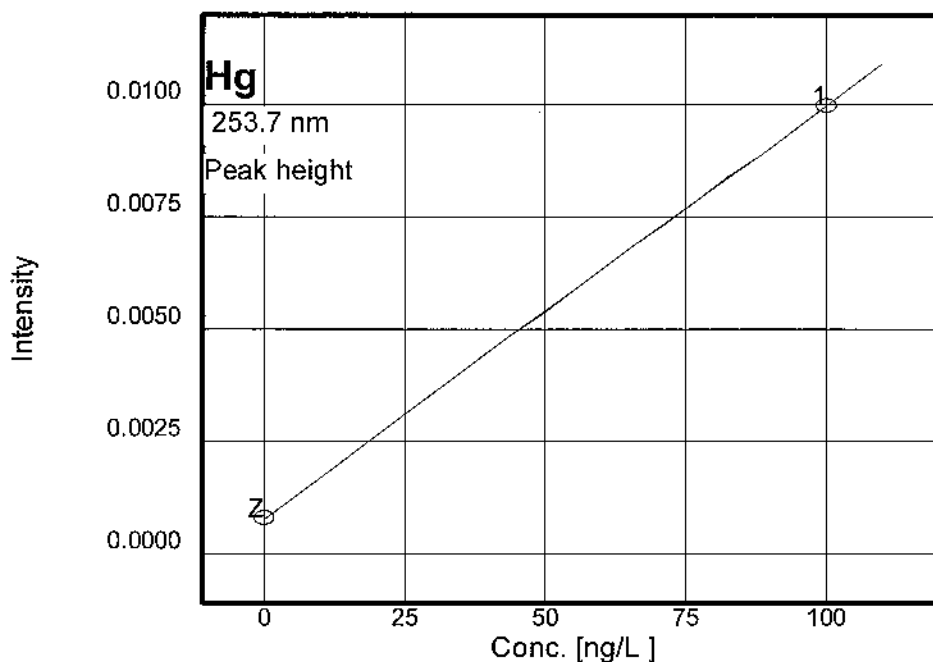
$$\text{Ints} = k_1 + k_2 \cdot \text{conc}$$

k1=0.000812

k2=0.000092

Recal. factor: ---

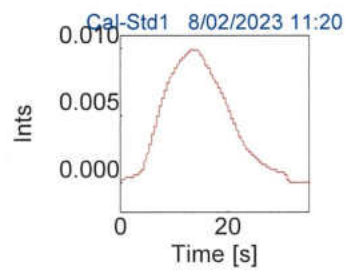
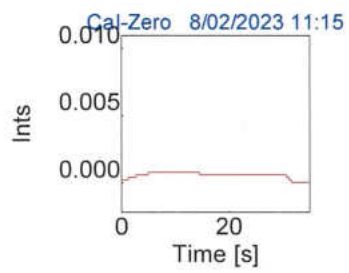
Slope	0.00009 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

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

Hg	Without Enrichment / FBR / 100 µg/L_PM_3-02-2023					8/02/2023	11:13
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000796				PkH	11:15
		0.000803					11:16
		0.000835					11:17
	0ng/L	0.000811		0.000020660	2.545		11:17
Cal-Std1		0.009957				PkH	11:20
		0.009921					11:21
		0.01006					11:21
	100.0ng/L	0.009981		0.000073720	0.739		11:21
Calibration	Calibration function: 01						11:22

Peak plots

Hg



Service Report

Customer's address :	Customer's Ref. No.	DISTRIBUTOR AJ-TH.																																					
<div style="font-family: monospace; font-size: 1.2em; color: blue;"> 35 มอ 5 ถนน 345 แขวง คลองข่อย เขต ปากเกร็ด กรุงเทพมหานคร 10620 </div>																																							
Fault / Claim :		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Error Code																																					
Action taken : <ul style="list-style-type: none"> - Maintenance work Basic Unit - Check Device parameter. - Check gas flow. - Check liquid flow. - Check Adventitious light - values <div style="margin-top: 10px;"> # Test run Analytical parameter Fluorescence cell Test run Analytical parameter Absorption cell </div>		<div style="color: red; font-weight: bold;"># ส่วนการทดสอบ (0.00288-0.00432)</div> <div style="color: red; font-weight: bold;">Meth: Without Enrichment.</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> 0.03 µg/L > 0.0015 0.0015 - 0.0036 - 0.00432 </div> <div style="color: red; font-weight: bold;"># ส่วนการทดสอบ (0.00288-0.00432)</div> <div style="color: red; font-weight: bold;">Meth: Without Enrichment.</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> 0.10 µg/L > 0.0040 0.0040 - 0.0080 - 0.0120 0.0080 + 0.0001 - 0.0009 </div>																																					
Action Pending / Recommendation :		<div style="font-family: monospace; font-size: 1.2em; color: blue;"> ตรวจเช็คค่าการสอบเทียบ </div>																																					
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Spare Part <input type="checkbox"/> Instrument Configuration </div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 10%;">Item No.</th> <th style="width: 60%;">Name</th> <th style="width: 15%;">Quantity</th> <th style="width: 15%;">Unit Price</th> </tr> </thead> <tbody> <tr><td>1.</td><td></td><td></td><td></td></tr> <tr><td>2.</td><td></td><td></td><td></td></tr> <tr><td>3.</td><td></td><td></td><td></td></tr> <tr><td>4.</td><td></td><td></td><td></td></tr> <tr><td>5.</td><td></td><td></td><td></td></tr> <tr><td>6.</td><td></td><td></td><td></td></tr> <tr><td>7.</td><td></td><td></td><td></td></tr> <tr><td>8.</td><td></td><td></td><td></td></tr> </tbody> </table>				Item No.	Name	Quantity	Unit Price	1.				2.				3.				4.				5.				6.				7.				8.			
Item No.	Name	Quantity	Unit Price																																				
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Herewith the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.		Date / Signature of Customer	Date / Signature of Service Engineer																																				
		Work completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No																																					

Services are subject to the General Terms and Conditions of Analytik Jena AG, which will be sent on request.

เอกสารไม่ควบคุม

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Thermo Scientific	G25A 158M	Tisch Environmental,Inc.	05072022	5 Jul 22	4 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	22P918	11 Jul 22	10 Jul 23	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1583	27 Jul 22	26 Jul 23	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42C 42C-78933-390	UAE Consultant Co.,Ltd.	09022023	9 Feb 23	8 Feb 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42i 1180540064	UAE Consultant Co.,Ltd.	02052022	2 May 22	1 May 23	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42C 0517512001	UAE Consultant Co.,Ltd.	20042023	20 Apr 23	19 Apr 24	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778108	UAE Consultant Co.,Ltd.	28032023	28 Mar 23	27 Mar 24	-
9	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778116	UAE Consultant Co.,Ltd.	04042023	4 Apr 23	3 Apr 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-62236-334	UAE Consultant Co.,Ltd.	17102022	17 Oct 22	16 Oct 23	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1200906874	UAE Consultant Co.,Ltd.	07032023	7 Mar 23	6 Mar 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	43i 1200906875	UAE Consultant Co.,Ltd.	17012023	17 Jan 23	16 Jan 24	-
14	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
15	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 21020224	Thai Meteorological Department	414/22	12 Jul 22	11 Jul 23	-
16	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 19040403	Thai Meteorological Department	415/22	12 Jul 22	11 Jul 23	-
17	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 19040406	Thai Meteorological Department	429/22	20 Jul 22	19 Jul 23	-
18	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20120283	Thai Meteorological Department	432/22	25 Jul 22	24 Jul 23	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35 44783	Innovative Instrument Co.,Ltd.	22-ACT-524	19 Aug 22	18 Aug 23	-
20	Sound Level Meter	L _{Aeq} 24 hr, L _{A90}	ACO	6236 172113	Quality Calibration Co.,Ltd.	21E8625	1 Sep 21	1 Sep 23	-
21	Sound Level Meter	L _{Aeq} 24 hr, L _{A90}	Larson Davis	LxT2 0005289	Sithiporn Associates Co., Ltd.	ACL22082	26 Jan 22	25 Jan 24	-

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: 1270

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3750	3.2	2.00
2	3	4	1	0.9760	6.4	4.00
3	5	6	1	0.8720	7.9	5.00
4	7	8	1	0.8330	8.8	5.50
5	9	10	1	0.6850	12.7	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)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9907	0.7205	1.4106	0.9958	0.7242	0.8878
0.9865	1.0107	1.9949	0.9915	1.0159	1.2555
0.9845	1.1290	2.2304	0.9895	1.1348	1.4037
0.9833	1.1805	2.3393	0.9883	1.1865	1.4723
0.9782	1.4280	2.8213	0.9831	1.4353	1.7756
QSTD	m=	1.99661	QA	m=	1.25025
	b=	-0.02450		b=	-0.01542
	r=	0.99996		r=	0.99996

Calculations

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

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



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

Reference: 2202-0083WSC

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

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1012 mbar

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
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 Signatory : _____

[] Nopparat Phongam

[] Sura Suwannasri

[x] Attapol Panurach

เอกสารไม่ควบคุม

B 0250402

Result of calibration:- Without adjustment

Range : 0 inH₂O to 36 inH₂O

Function:- Pressure Measurement

Scale Interval : 0.1 inH₂O(The Fifth Estimate)

Increasing Pressure

UUC Indication				
Applied Pressure	High-port side	Low-port side	ΔP	Error
(inH ₂ O)	(inH ₂ O)	(inH ₂ O)	(inH ₂ O)	(inH ₂ O)
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-1.02	2.02	0.02
4.00	2.00	-2.00	4.00	0.00
6.00	3.02	-2.98	6.00	0.00
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.02	-6.00	12.02	0.02
14.00	7.00	-6.98	13.98	-0.02
16.00	8.00	-7.98	15.98	-0.02
18.00	9.00	-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 inH₂O

* UUC = Unit Under Calibration

* ΔP = High-port side - Low-port side

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

-ooo-



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. : 22P2722

Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.ANV.013/2547

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

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

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
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 Aussarree
Issue Date : 25 July 2022

Approved Signatory :

[] Thamee Prabpai
[] Sura Suwannasri
[x] Attapol Panurach

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B 0293205



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 %.

-o0o-



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. : 22H1583

Page : 1 of 2

Equipment : Dial Thermo-Hygrometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE.ANV.016/2547

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022
to 27 July 2022

Reference: 2207-0586WSC

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 20) %

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

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
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 :

[✓] Chakrit Waewanjua
[] Pornthippa Tameyakul
[] Viporn Tantiyawutti

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B 0293719



Cert. No.: 22H1583

Page.: 2 of 2

Result of Calibration:-

Without Adjustment

Function:

Humidity measurement.

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

Result of Calibration:-

Without Adjustment

Function:

Temperature measurement.

<u>Standard</u> <u>Temperature</u> (°C)	<u>UUC*</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> <u>of Measurement</u> (±°C)
20.00	20.0	0.00	0.72
30.01	30.0	-0.01	0.72
35.04	35.0	-0.04	0.72
39.98	40.0	0.02	0.72

UUC* : Unit Under Calibration

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

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MULTI-POINT GAS TEST REPORT

Test Date : Feb 9, 2023

Equipment : Gas Analyzer (NO₂) **Model :** 42C
Manufacturer : Thermo Environmental Instruments **Serial Number :** 42C-78933-390

Standard Gas Concentration

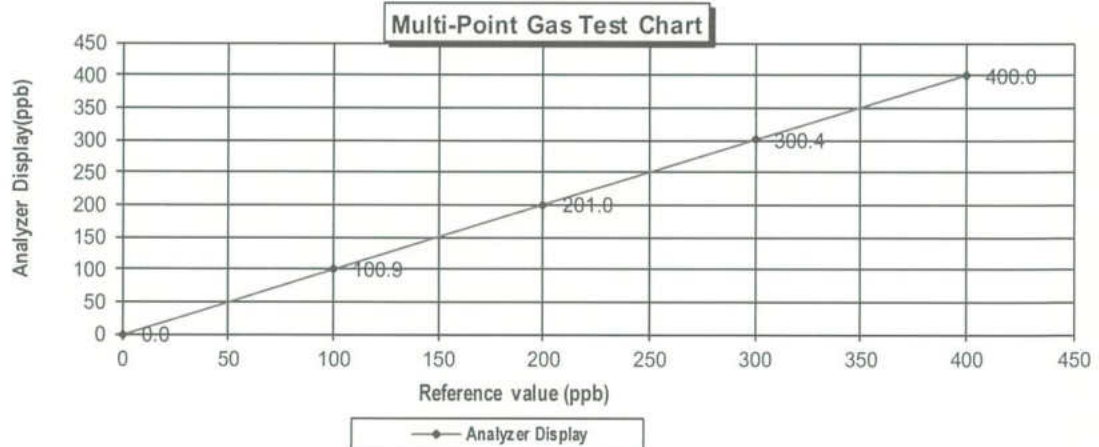
Sulphur Dioxide (SO₂) 44.68
Nitric Oxide (NO) 45.94
Methane (CH₄) -
Carbon Monoxide (CO) 984.8
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.9	0.90	0.89	0.89
Level 3	40.00%	200.0	201.0	1.00	0.50	0.50
Level 4	60.00%	300.0	300.4	0.40	0.13	0.13
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.30



Calculate by

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9 / Feb / 2023

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9 / Feb / 2023

MULTI-POINT GAS TEST REPORT

Test Date : May 2, 2022

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : 1180540064

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.75

Nitric Oxide (NO) 45.35

Methane (CH₄) -

Carbon Monoxide (CO) 1007

Cylinder No. : CC159599

Expiration Date : Jul 30, 2022

Dilutor Detail

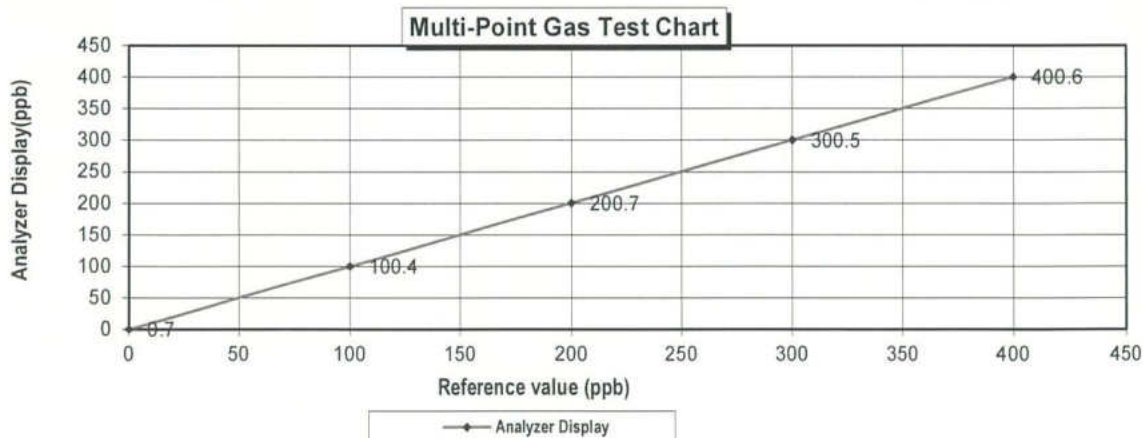
Manufacturer : Thermo Scientific

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	0.7	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	200.7	0.70	0.35	0.35
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 (%)		0.35



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02 / May / 2022
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MULTI-POINT GAS TEST REPORT

Test Date : Apr 20, 2023

Equipment : Gas Analyzer (NO₂)

Model : 42C

Manufacturer : Thermo Electron Corporation

Serial Number : 0517512001

Standard Gas Concentration

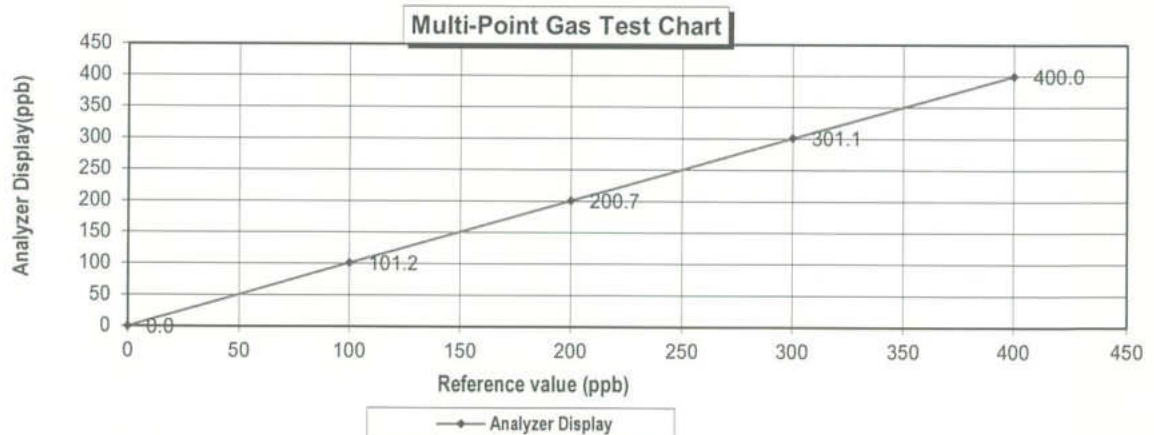
Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

Dilutor Detail

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

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	101.2	1.20	1.19	1.19
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	301.1	1.10	0.37	0.37
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb :Acceptable Limit $\pm 5\%$				Average Difference (%)		0.38



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20 / Apr / 2023
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MULTI-POINT GAS TEST REPORT

Test Date : Mar 28,2023

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : 1201778108

Standard Gas Concentration

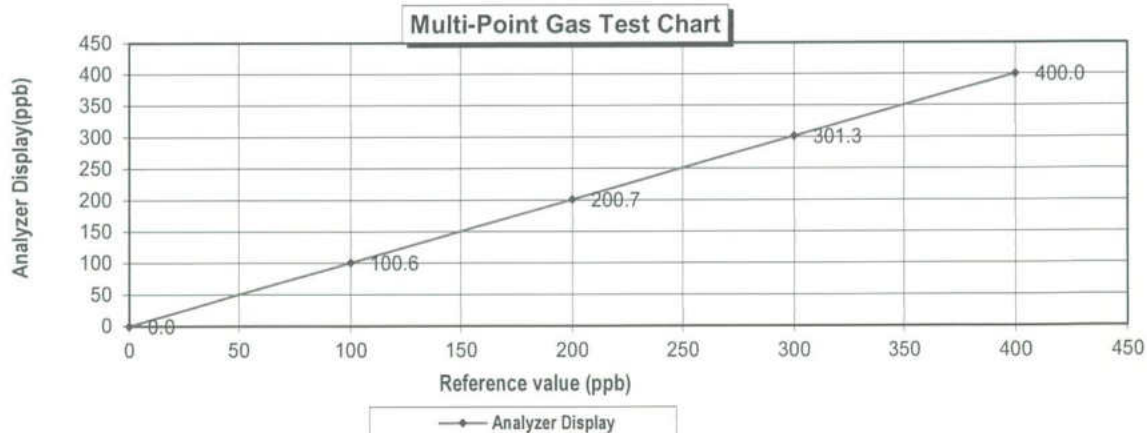
Sulphur Dioxide (SO ₂)	44.68
Nitric Oxide (NO)	45.94
Methane (CH ₄)	-
Carbon Monoxide (CO)	984.8
Cylinder No. :	EB0143262
Expiration Date :	Jun 21,2024

Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.6	0.60	0.60	0.60
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	301.3	1.30	0.43	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.28



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28 / Mar / 2023
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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A01D3	Reference Number:	122-402135167-1
Cylinder Number:	EB0143262	Cylinder Volume:	144.4 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number:	B22021	Valve Outlet:	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. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

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

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of 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 #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



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



Approved for Release



CERT 3082.01

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Apr 4, 2023

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : 1201778116

Standard Gas Concentration

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

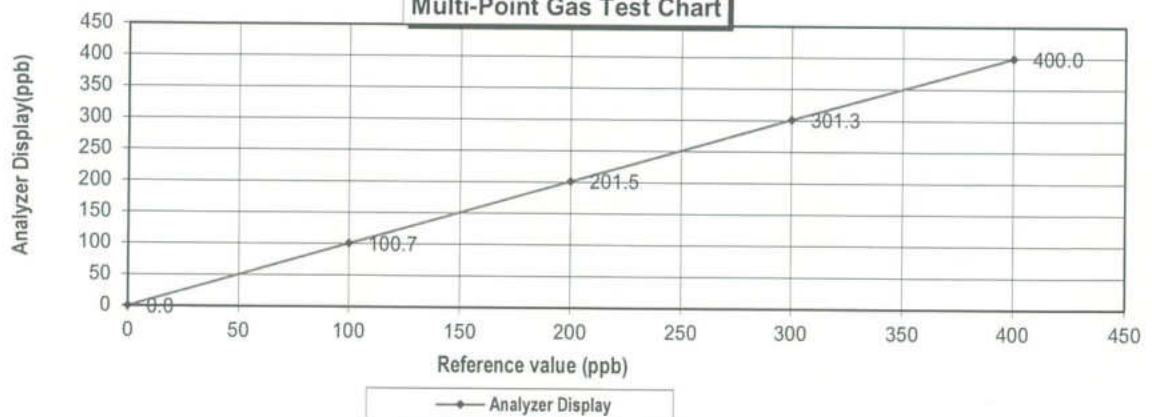
Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70	0.70
Level 3	40.00%	200.0	201.5	1.50	0.74	0.74
Level 4	60.00%	300.0	301.3	1.30	0.43	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb			Average Difference (%)		0.37	

Multi-Point Gas Test Chart



Calculate by

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Approved by

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4 / Apr / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Oct 17, 2022

Equipment :	Gas Analyzer (SO ₂)	Model :	43C
Manufacturer :	Thermo SCIENTIFIC	Serial Number :	43C-62236-334

Standard Gas Concentration

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

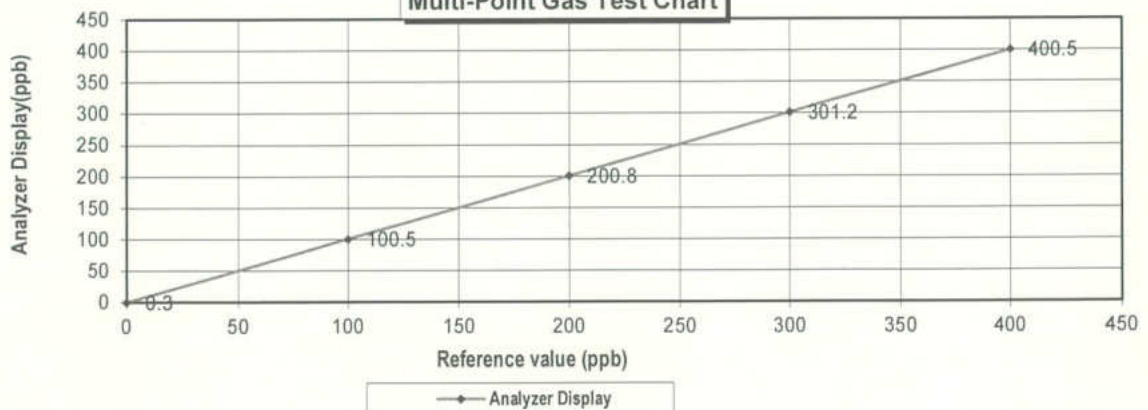
Dilutor Detail

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

Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.3	0.30	0.30	0.30
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	200.8	0.80	0.40	0.40
Level 4	60.00%	300.0	301.2	1.20	0.40	0.40
Level 5	80.00%	400.0	400.5	0.50	0.12	0.12
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.34

Multi-Point Gas Test Chart



Calculate by

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MULTI-POINT GAS TEST REPORT

Test Date : Mar 7, 2023

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : 1200906874

Standard Gas Concentration

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

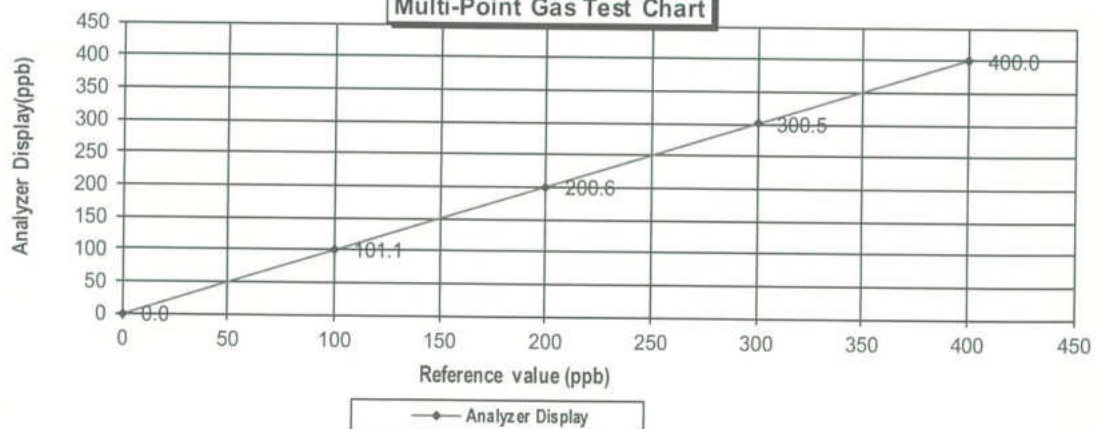
Dilutor Detail

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

Multi-point gas test data

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

Multi-Point Gas Test Chart



Calculate by

[Redacted Signature]

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[Redacted Signature]

7 / Mar / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Jan 17, 2023

Equipment : Gas Analyzer (SO₂)
Manufacturer : Thermo SCIENTIFIC

Model : 43i
Serial Number : 1200906875

Standard Gas Concentration

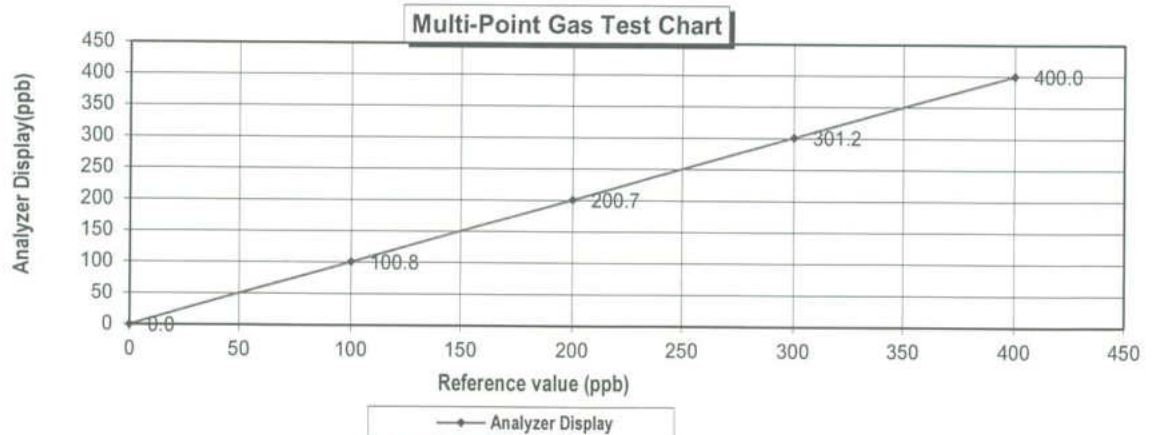
Sulphur Dioxide (SO₂) 44.68
Nitric Oxide (NO) 45.94
Methane (CH₄) -
Carbon Monoxide (CO) 984.8
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

Dilutor Detail

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

Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79	0.79
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	301.2	1.20	0.40	0.40
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb : Acceptable Limit $\pm 5\%$				Average Difference (%)	0.31	



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17 Jan, 2023
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THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 12 July, 2022

Certification No. 414/22

Page : 1 of 7

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : LSI

Type : Dato Logger E-LOG 305 wind speed and wind direction DNA 821
Thermoigrometers DMA875 Barometer DQA 801
Mfg Code : Dato Logger 21020224 wind speed and wind direction 20010221
Thermoigrometers 19100298 Barometer 20030067
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 1014.6 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

Calibrated by

Sig

Mr. Watcharapol Subwat

M

Mechanical Engineer

Sub-Standard Instrument

LOGICAL DE



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Wind Speed And Wind Direction

Certification No. 414/22

12 July, 2022

Model DNA821 S/N 20010221

Page : 2 of 7

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

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

Calibrated by :

Mr. Wat

Mechanical Engineer

Ca
Meter

ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 414/22

12 July, 2022

Page : 3 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.77	1011.0	-0.23
1008.67	1008.9	-0.23
1010.49	1010.8	-0.31
1010.67	1011.0	-0.33
1010.78	1011.1	-0.32
1011.09	1011.5	-0.41
1011.21	1011.7	-0.49
1011.06	1011.5	-0.44
1010.80	1011.1	-0.30
1010.62	1011.0	-0.38
1010.45	1010.8	-0.35
1009.93	1010.3	-0.37
1009.78	1010.2	-0.42
1009.43	1009.8	-0.37
1009.29	1009.9	-0.61
1008.93	1009.4	-0.47
1008.66	1009.0	-0.34
1008.33	1008.7	-0.37
1008.15	1008.5	-0.35
1007.28	1007.6	-0.32

Average

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibrated by :

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 414/22

12 July, 2022

Page : 4 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
758.14	758.3	-0.17
756.56	756.7	-0.17
757.93	758.2	-0.23
758.06	758.3	-0.25
758.15	758.4	-0.24
758.38	758.7	-0.31
758.47	758.8	-0.37
758.36	758.7	-0.33
758.16	758.4	-0.23
758.03	758.3	-0.29
757.90	758.2	-0.26
757.51	757.8	-0.28
757.40	757.7	-0.32
757.13	757.4	-0.28
757.03	757.5	-0.46
756.76	757.1	-0.35
756.56	756.8	-0.26
756.31	756.6	-0.28
756.17	756.4	-0.26
755.52	755.8	-0.24

Average

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

M

ureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19100298

Certification No. 414/22

12 July, 2022

Page : 5 of 7

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.24	45.31	-0.07
30.36	30.46	-0.10
15.12	15.19	-0.07

Calibrated by

Mr. Watchapol Subwat
Mechanical Engineer

Calibrated by
Mr. Watchapol Subwat
Mechanical Engineer

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19100298

Certification No. 414/22

12 July, 2022

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading	Correction
	% R.H.	% R.H.
84.25	82.3	1.95
62.14	62.0	0.14
41.32	42.3	-0.98

Calibrated by

Mr. Watcharapol Subwat
Mechanical Engineer

Cali
Meteorol

เอกสารไม่ควบคุม



Date of Issue 12 July, 2022

Certification No.414/22

Page : 7 of 7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET ขนาด 324 cm² Model DQA 230.1 Serial 20020189 ทำการสอบเทียบกับแก้วฝนแบบ แก้วดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/ TIP)



ลงชื่อ

(นายวัชรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ

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. 415/22

Page : 1 of 7

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : LSI

Type : Dato Logger E-LOG 305 wind speed and wind direction DNA 827
Thermoigrometers DMA875 Barometer DQA 801
Mfg Code : Dato Logger 19040403 wind speed and wind direction 19050233
Thermoigrometers 19050004 Barometer 19040191
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 1014.1 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

Barometer Vaisala Type PTB220 No. V1220015

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Sig

Mr

Au

Sub-Standard Instrument

ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Wind Speed And Wind Direction

Certification No. 415/22

12 July, 2022

Model DNA827 S/N 19050233

Page : 2 of 7

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacumm inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.8	0.22
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.5	0.52
11.02	-	-	-	10.8	0.22
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

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

Calibrated by :

Mr. Watcharapoi Subwat

Mechanical Engineer

Calibr

Meteorol

u

รไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 19040191

Certification No. 415/22

12 July, 2022

Page : 3 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.77	1008.3	2.47
1008.67	1006.2	2.47
1010.49	1008.2	2.29
1010.67	1008.4	2.27
1010.78	1008.5	2.28
1011.09	1008.6	2.49
1011.21	1008.8	2.41
1011.06	1008.7	2.36
1010.80	1008.4	2.40
1010.62	1008.3	2.32
1010.45	1008.2	2.25
1009.93	1007.7	2.23
1009.78	1007.5	2.28
1009.43	1007.2	2.23
1009.29	1006.9	2.39
1008.93	1006.6	2.33
1008.66	1006.4	2.26
1008.33	1006.1	2.23
1008.15	1005.9	2.25
1007.28	1004.8	2.48

Average

Calibrated by

Mr. Watchapol Subwat

Mechanical Engineer

Calibrated by
Meteorological Bureau



เอกสารควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 19040191

Certification No. 415/22

12 July, 2022

Page : 4 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
758.14	756.3	1.85
756.56	754.7	1.85
757.93	756.2	1.72
758.06	756.4	1.70
758.15	756.4	1.71
758.38	756.5	1.87
758.47	756.7	1.81
758.36	756.6	1.77
758.16	756.4	1.80
758.03	756.3	1.74
757.90	756.2	1.69
757.51	755.8	1.67
757.40	755.7	1.71
757.13	755.5	1.67
757.03	755.2	1.79
756.76	755.0	1.75
756.56	754.9	1.70
756.31	754.6	1.67
756.17	754.5	1.69
755.52	753.7	1.86

Average

1.75

Calibrated by :

Mr. Wa

Mechanical Engineer

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Met
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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermogrometers Model DMA 875 s/n 19050004

Certification No. 415/22

12 July, 2022

Page : 5 of 7

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.24	45.18	0.06
30.36	30.31	0.05
15.12	15.04	0.08

Calibrated by

Mr. Watchapol Subwat
Mechanical Engineer

Calibrated by
Meteorological Department

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19050004

Certification No. 415/22

12 July, 2022

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading	Correction
	% R.H.	% R.H.
84.25	82.2	2.05
62.14	61.1	1.06
41.32	40.9	0.42

Calibrated by

Mr. Watcharapol Subwat
Mechanical Engineer

Mete Bureau

เอกสารไม่ควบคุม



Date of Issue 12 July, 2022

Certification No.415/22

Page : 7 of 7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET
ขนาด 324 cm² Model DQA 230.1 Serial 19040030 ทำการสอบเทียบกับแก้วฝนแบบ
แก้วดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON
No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)



ลงชื่อ.

(นายวัชรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ

เอกสารไม่ควบคุม

Calibration Certificate

Page : 1 of 7

Mechanical Engineer

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Su



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Wind Speed And Wind Direction

Certification No. 429/22

20 July, 2022

Model DNA821 S/N 19020214

Page : 2 of 7

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacuum inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.9	0.12
11.02	-	-	-	10.7	0.32
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.7	0.31
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.7	0.32

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

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Meteorological Bureau

ไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 19040190

Certification No. 429/22

20 July, 2022

Page : 3 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.17	1008.5	1.72
1010.02	1008.3	1.70
1009.91	1008.2	1.73
1009.39	1007.7	1.74
1009.12	1007.4	1.74
1008.88	1007.0	1.90
1007.46	1005.8	1.68
1006.64	1004.9	1.79
1006.88	1005.0	1.90
1008.07	1006.5	1.62
1008.48	1006.7	1.76
1007.87	1006.2	1.69
1007.69	1005.9	1.77
1007.26	1005.5	1.74
1006.68	1004.9	1.83
1005.29	1003.5	1.77
1004.87	1003.0	1.89
1004.30	1002.6	1.72
1003.63	1002.2	1.45
1004.00	1002.3	1.68

Average

1.74

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Mete

gau

กรมอุตุนิยมวิทยา



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 19040190

Certification No. 429/22

20 July, 2022

Page : 4 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
757.69	756.4	1.29
757.58	756.3	1.28
757.49	756.2	1.29
757.10	755.8	1.30
756.90	755.6	1.30
756.72	755.3	1.42
755.66	754.4	1.26
755.04	753.7	1.34
755.22	753.8	1.42
756.11	754.9	1.21
756.42	755.1	1.32
755.96	754.7	1.26
755.83	754.5	1.33
755.51	754.2	1.31
755.07	753.7	1.37
754.03	752.7	1.33
753.71	752.3	1.41
753.29	752.0	1.29
752.78	751.7	1.08
753.06	751.8	1.26

Average

Calibrated by :

Mr. Watchapol Subwat

Mechanical Engineer

Calib

Meteorol

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19050007

Certification No. 429/22

20 July, 2022

Page : 5 of 7

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.16	45.22	-0.06
30.22	30.31	-0.09
15.46	15.59	-0.13

Calibrated by

Mr. Watcharaporn Subwat

Mechanical Engineer

Me

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19050007

Certification No. 429/22

20 July, 2022

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading	Correction
	% R.H.	% R.H.
85.42	89.2	-3.78
61.22	62.3	-1.08
43.51	42.1	1.41

Calibrated by

Mr. Watcharapol Subwat
Mechanical Engineer

Calibra
Meteorolog

เอกสารไม่ควบคุม



Date of Issue 20 July, 2022

Certification No.429/22

Page : 7 of 7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET
ขนาด 324 cm^2 Model DQA 230.1 Serial 19040036 ทำการสอบเทียบกับแก้วฝนแบบ
แก้วดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON
No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)



ลง

(นายวัชรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ

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 25 July, 2022

Certification No. 432/22

Page : 1 of 7

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : LSI

Type : Dato Logger E-LOG 305 wind speed and wind direction DNA 821
Thermoigrometers DMA875 Barometer DQA 801
Mfg Code : Dato Logger 20120283 wind speed and wind direction 20010222
Thermoigrometers 19100300 Barometer 20030053
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 1007.2 hPa

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

: HOOK GAGE NO 1425

: Wind Aloft Plotting Board

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

: Ultrasonic Anemometer

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER

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

: testo, testo 645 Serial No. 02848057

: Thermoschneider No.918802

STANDARD BAROMETER

: Digital Barometer Vaisala Type PTB220 No. V1220015

Calibrated by :

Mr. Watcharapol Suwat

Mechanical Engineer

Signature

Mr.

Barometer Vaisala



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Wind Speed And Wind Direction

Certification No. 432/22

25 July, 2022

Model DNA821 S/N 20010222

Page : 2 of 7

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacumm inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.5	0.52
11.02	-	-	-	10.8	0.22
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

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

Calibrated by :

Mr. Wat

Mechanical Engineer

Calibr

Meteorolo

ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 20030053

Certification No. 432/22

25 July, 2022

Page : 3 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1006.89	1006.1	0.79
1006.64	1005.8	0.84
1006.31	1005.5	0.81
1005.77	1005.0	0.77
1005.63	1004.8	0.83
1004.68	1003.8	0.88
1004.51	1003.7	0.81
1004.37	1003.5	0.87
1008.45	1007.7	0.75
1008.15	1007.1	1.05
1007.94	1007.0	0.94
1007.66	1006.8	0.86
1007.56	1006.6	0.96
1007.49	1006.5	0.99
1007.15	1006.2	0.95
1006.94	1006.0	0.94
1006.50	1005.6	0.90
1006.41	1005.5	0.91
1006.33	1005.4	0.93
1006.08	1005.2	0.88

Average

Mechanical Engineer

M

เอกสารแนบ



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Barometer Model DQA801 s/n 20030053

Certification No. 432/22

25 July, 2022

Page : 4 of 7

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
755.23	754.6	0.59
755.04	754.4	0.63
754.79	754.2	0.61
754.39	753.8	0.58
754.28	753.7	0.62
753.57	752.9	0.66
753.44	752.8	0.61
753.34	752.7	0.65
756.40	755.8	0.56
756.17	755.4	0.79
756.02	755.3	0.71
755.81	755.2	0.65
755.73	755.0	0.72
755.68	754.9	0.74
755.42	754.7	0.71
755.27	754.6	0.71
754.94	754.3	0.68
754.87	754.2	0.68
754.81	754.1	0.70
754.62	754.0	0.66

Average

0.66

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

M

tu

บคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19100300

Certification No. 432/22

25 July, 2022

Page : 5 of 7

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
46.12	46.24	-0.12
30.26	30.16	0.10
15.32	15.29	0.03

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

Calibrated by
Meteorological Department

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Thermoigrometers Model DMA 875 s/n 19100300

Certification No. 432/22

25 July, 2022

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading	Correction
	% R.H.	% R.H.
85.42	83.2	2.22
61.22	59.8	1.42
43.51	42.1	1.41

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

Calibra
Meteorolog

เอกสารไม่ควบคุม



Date of Issue 25 July,2022

Certification No.432/22

Page : 7 of 7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET ขนาด 324 cm² Model DQA 230.1 Serial 20030014 ทำการสอบเทียบกับแก้วฝนแบบ แก้วดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/ TIP)



ลงชื่อ

(นายอรรถพล หรรษ์วัฒน)

วิศวกรชำนาญการ

เอกสารไม่ควบคุม

Certificate of Calibration

Customer

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

Certificate No : 22-ACT-524

Request No : Req-2022-1546

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

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1
Manufacturer : SVANTEK Range : 94 , 114 dB / 1000 Hz
Model : SV 35 Instrument Status : Used
Serial Number : 44783
ID : UAE.EFM.019/2559

Calibration Environment and Details

Temperature : (23 \pm 2 $^{\circ}$ C)
Humidity : (50 \pm 20 %RH)
Barometric Pressure : (1013 \pm 10.0 hPa)
Received Date : 9 August 2022
Calibration Date : 19 August 2022
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


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

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


Note

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

Calibrated By :


Mr. Noppadon Luangart
Service Calibration Engineer

Approved By :



Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 19 August 2022

DAE
REMARKS SHEET (01.01.20)

☒ PASS
☐ NOT PASS

Remarks
Acceptance Limit ± 0.25 dB
Uncertainty ± 0.11 dB



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Certificate No : 22-ACT-524

Request No : Req-2022-1546

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	94.23	0.23	-	-	0.11	0.25
114 dB / 1000 Hz	114.23	0.23	-	-	0.11	0.25

Frequency of Sound pressure level

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

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

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)	Measured (%)		
94 dB / 1000 Hz	0.05	-	0.40	2.5
114 dB / 1000 Hz	0.02	-	0.40	2.5

Note :

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

End of Calibration



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 21E8625
REFERENCE No : 58409-5

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : 6236
SERIAL No : 172113
ID No : UAE.EFM.007/2561
SUBMITTED BY : UNITED ANALYST AND ENGINEERING
CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANONG, BANGKOK
10260

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 01-Sep-21

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 01-Sep-21

RECEIVED DATE : 26-Aug-21



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 21E8625

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO MODEL : 6236
S/N : 172113 ID No : UAE.EFM.007/2561
RECEIVED DATE : 26-Aug-21 CALIBRATION DATE : 01-Sep-21
AMBIENT TEMPERATURE : 23°C ± 3°C RELATIVE HUMIDITY : 50 % RH ± 20% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2 :2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.
THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR FROM CUSTOMER AT 94 Hz BEFORE CALIBRATION.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) MULTIFUNCTION SOUND CALIBRATOR	1986	01285	21E6450	06-Jul-22

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO :-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-16.10	-15.6	-0.5	0.50
250.00	-8.60	-8.4	-0.2	0.50
500.00	-3.20	-3.0	-0.2	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	1.20	1.0	0.2	0.50
4000.00	1.00	0.0	1.0	0.50

2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-0.20	0.0	-0.2	0.50
250.00	0.00	0.2	-0.2	0.50
500.00	0.00	0.2	-0.2	0.50
1000.00	0.00	0.1	-0.1	0.50
2000.00	-0.20	-0.3	0.1	0.50
4000.00	-0.80	-1.0	0.2	0.50

3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
74	74.0	0.0	0.50
84	83.9	0.1	0.50
94	94.0	0.0	0.50
104	104.0	0.0	0.50
114	114.1	-0.1	0.50

UUC* : UNIT UNDER CALIBRATION

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

1000
F

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22082

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : LARSON DAVIS
Model : LxT2/ Microphone 375B02 / Preamplifier PRML x T2B
Serial No.: 0005289 / 011732 / 056076
ID No.: -

Condition As Found : GOOD

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

Location : -

Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 18 JANUARY 2022
Calibration Date : 26 JANUARY 2022
Date of Issue : 28 JANUARY 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

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

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IAE
Checked Date: 05/12/19

☒ PASS
☐ NOT PASS

Remarks
of New Acceptance Limits
(1000Hz) = $\pm 1.0\text{dB}$

[Redacted]

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Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 2 of 8

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

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

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 3 of 8

Summary of Measurement Result :

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

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Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
29.6

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

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

3. Acoustical signal tests of frequency weightings

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 6 of 8

7. Level linearity on the reference level range

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

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Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22082

Job No. : VC65AC0044

Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

เอกสารไม่ควบคุม

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate Hydrogen Sulphide	Apex Instruments, USA.	XC-572-V 0803018	Envi Equipment Service Co., Ltd.	E22-08038	22 Aug 22	21 Aug 23	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 02376344	Entech Industrial Sulation Co., Ltd.	G 650522	15 Aug 22	14 Aug 23	-

Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No. : E22-08038

Page :1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : XC-572-V
Serial Number : 0803018
ID./Control No. : -
Environment Conditions : Temperature (25 ± 2) °C
: Humidity (50 ± 15) % RH
Cal. Date : 22/08/2022
Issue Date : 22/08/2022

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 Signature]

Approved by :



(Mr. Mana Fuekhud)

Technical Manger

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

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	22/08/2022	01:25 PM	Std Temp	293	K
Console Serial Number	0803018	Calibration Reference No.		E22-08038		Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure		755.24		K ₁	0.386	
DGM Serial Number	00002780	Calibration Meter Gamma		0.999		Console Leak Check		PASS

Calibration Data									
Run Time	Metering Console					Calibration Meter			
	DGM Orifice	Volume	Volume	Outlet Temp	Outlet Temp	Volume	Volume	Outlet Temp	Outlet Temp
Elapsed	DH	Initial	Final	Initial	Final	Initial	Final	Initial	Final
(Q)	(P _m)	(V _{mi})	(V _{mf})	(t _{mi})	(t _{mf})	(V _{wi})	(V _{wf})	(t _{wi})	(t _{wf})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
11.25	13.0	898.1510	898.2910	29	29	90.45264	90.58792	24	24
11.33	13.0	898.2910	898.4310	29	29	90.58792	90.72354	24	24
7.77	26.0	898.4420	898.5820	29	29	90.73418	90.86926	24	24
7.75	26.0	898.5820	898.7220	29	29	90.86926	91.00398	24	24
13.13	40.0	898.7330	899.0130	29	29	91.01454	91.28308	25	25
13.12	40.0	899.0130	899.2930	29	29	91.28308	91.55118	25	25
9.83	70.0	899.3120	899.5920	29	29	91.56906	91.83630	25	25
9.82	70.0	899.5920	899.8720	29	29	91.83630	92.10288	25	25
8.68	90.0	899.8850	900.1650	30	30	92.11486	92.37984	24	24
8.67	90.0	900.1650	900.4450	30	30	92.37984	92.64466	24	24



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	22/08/2022	01:25 PM	Std Temp	293	K
Console Serial Number	0803018	Calibration Reference No.		E22-08038		Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure		755.24		K ₁	0.386	
DGM Serial Number	00002780	Calibration Meter Gamma		0.999		Console Leak Check		PASS

Calibration Data								
Results								
Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	.0212 m ³ _{std} /min	Variation
				Value	Variation	Std & Corr		
(V _{m(std)})	(Q _{m(std)})	(V _{w(std)})	(Q _{w(std)})	(Y)	(ΔY)	(Q _{m(std)(corr)})	(ΔH _@)	(ΔH _@)
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O	
0.137	0.012	0.132	0.012	0.964	0.012	0.012	41.539	-1.642
0.137	0.012	0.133	0.012	0.967	0.014	0.012	41.946	-1.236
0.138	0.018	0.132	0.017	0.961	0.009	0.017	39.814	-3.367
0.138	0.018	0.132	0.017	0.959	0.007	0.017	39.855	-3.326
0.275	0.021	0.262	0.020	0.954	0.002	0.020	44.587	1.405
0.275	0.021	0.262	0.020	0.953	0.000	0.020	44.620	1.438
0.275	0.028	0.261	0.027	0.947	-0.005	0.027	44.426	1.244
0.275	0.028	0.260	0.027	0.945	-0.008	0.027	44.495	1.313
0.277	0.032	0.260	0.030	0.937	-0.015	0.030	45.326	2.144
0.277	0.032	0.259	0.030	0.937	-0.016	0.030	45.206	2.025
				0.952	Y Average		43.181	ΔH _@ 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 $\Delta H_{@}$, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Envi Equipment Service Co., Ltd.



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	0803018
DGM Model Number	SK25EX
DGM Serial Number	00002780

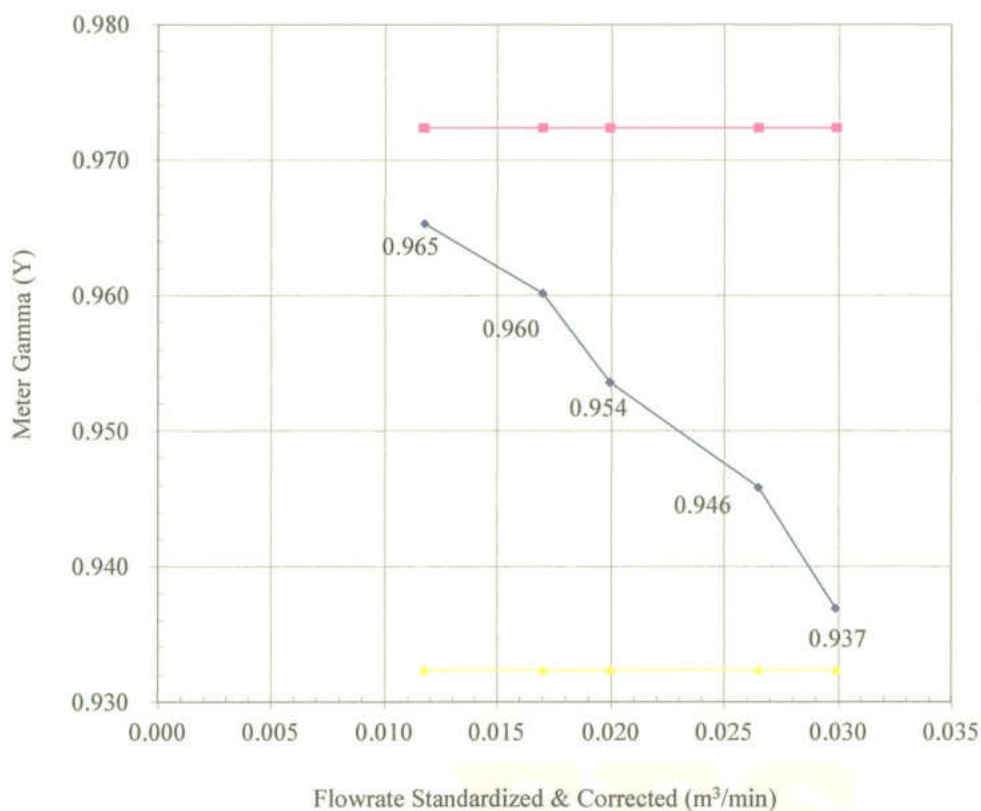
Calibration Conditions			
Date	Time	22/08/2022	01:25 PM
Calibration Reference No.		E22-08038	
Barometric Pressure		755.24	mmHg
Calibration Meter Gamma		0.999	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check		PASS

Calibration Date: 22-8-2022

Calibration Reference No: E22-08038

Meter Gamma vs Flowrate



Console Serial: 0803018

Console Model: XC-572-V



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	0803018
DGM Model Number	SK25EX
DGM Serial Number	00002780

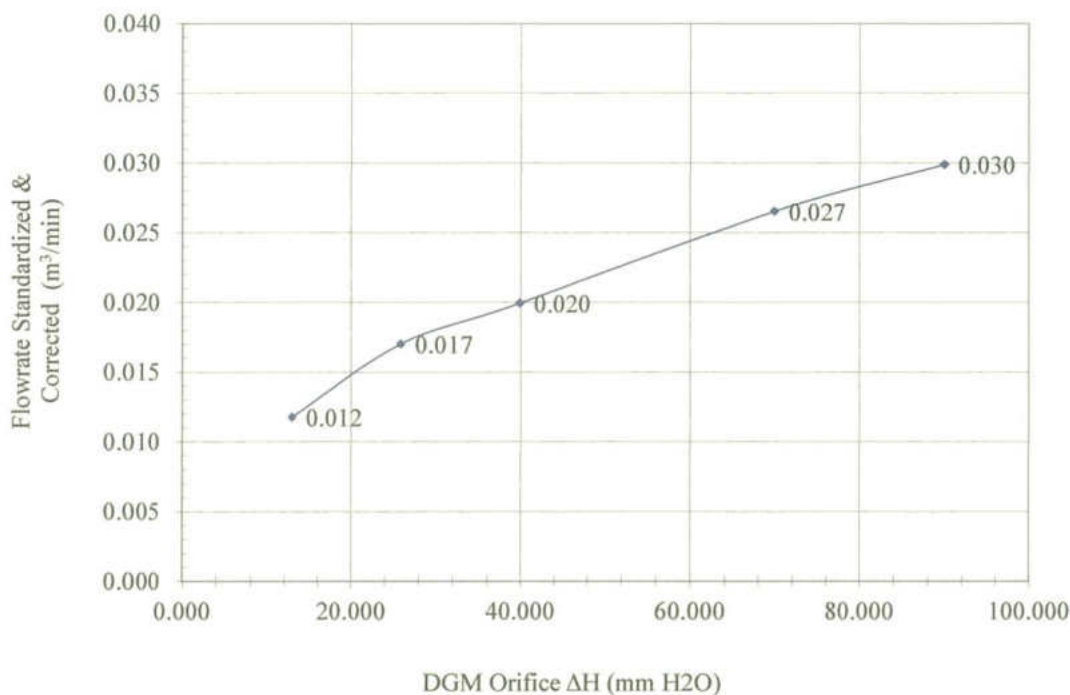
Calibration Conditions			
Date	Time	22/08/2022	01:25 PM
Calibration Reference No.	E22-08038		
Barometric Pressure	755.24	mmHg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 22-8-2022

Calibration Reference No: E22-08038

Meter Pressure vs Flowrate



Console Serial: 0803018

Console Model: XC-572-V



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	0803018
DGM Model Number	SK25EX
DGM Serial Number	00002780
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 16095

Calibration Conditions			
Date	Time	22/08/2022	03:15 PM
Calibration Reference No.	E22-08038		
Reference Thermometer	DIGICON		
Serial Number	183169105		

Results											
Console Thermocouple Simulator											
Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-16.0	25.0	38.0	93.0	150.0	259.0	371.0	482.0	593.0	815.0	1037.0
Aux	-16.0	25.0	38.0	93.0	150.0						
Probe	-16.0	25.0	38.0	93.0	150.0						
Filter	-16.0	25.0	38.0	93.0	150.0						
Exit	-16.0	25.0	38.0								

Tolerance Range

Stack ± 1.50% Absolute
 Probe ± 3.0 °C
 Filter ± 3.0 °C

Meter ± 3.0 °C
 Exit ± 2.0 °C

EES

Envi Equipment Service Co., Ltd.



เอกสารไม่ควบคุม

Certificate No: G 650522

Date of issue : 16-Aug-22

Instrument description : Flue gas Analyzer
Instrument model : Testo 350XL
Instrument serial no. : 02376344
ID no. or control no. : UAE.EMA2.113/2555
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-222833
Receiving date. : 10-Aug-22
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.00,21.00 %vol, Carbon Monoxide 80.97,309.9,1003 ppm, Nitrogen Dioxide 10.19,80.92,202.2 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 measurent Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

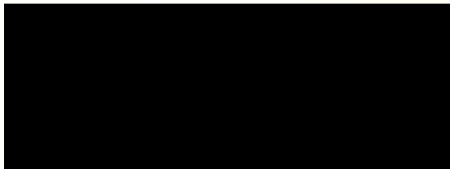
This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced 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 tracebility to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 15-Aug-22


Mr. Sedtawut Nueathong
Calibration Technician


Mrs. Nongluck Wongsettee
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O ₂) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide (CO) 80.97 ppm	2842/21	Linde	24-Jun-23
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2829/21	Linde	23-Apr-23
Nitrogen Dioxide (NO ₂) 10.19 ppm	3372/21	Linde	02-Aug-23
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 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 (SO ₂) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO ₂) 100.9 ppm	4942/20	Linde	20-Nov-22
Sulphur Dioxide (SO ₂) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 23.6 °C Humidity : 56.6 %RH Pressure : 1015.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.9 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.53	0.032	0.20
O ₂ (%Vol)	10.00	9.86	-0.14	0.40
O ₂ (%Vol)	21.00	21.08	0.08	0.80
CO (ppm)	80.97	80	-0.97	3.0
CO (ppm)	309.9	305	-4.9	6.0
CO (ppm)	1003	993	-10	12
*NO ₂ (ppm)	10.19	7.8	-2.39	1.5
NO ₂ (ppm)	80.96	74.4	-6.56	8.0
NO ₂ (ppm)	202.2	190.8	-11.4	12
NO (ppm)	30.08	25	-5.08	8.0
NO (ppm)	150.9	140	-10.9	8.0
NO (ppm)	320.6	298	-22.6	12
SO ₂ (ppm)	50.04	46	-4.04	6.0
SO ₂ (ppm)	100.9	95	-5.9	6.0
SO ₂ (ppm)	601.1	640	38.9	13

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.53	0.032	0.20
O2 (%Vol)	10.00	9.86	-0.14	0.40
O2 (%Vol)	21.00	21.08	0.08	0.80
CO (ppm)	80.97	80	-0.97	3.0
CO (ppm)	309.9	305	-4.9	6.0
CO (ppm)	1003	993	-10	12
*NO2 (ppm)	10.19	10.2	0.01	1.5
NO2 (ppm)	80.96	80.2	-0.76	8.0
NO2 (ppm)	202.2	204.5	2.3	12
NO (ppm)	30.08	31	0.92	8.0
NO (ppm)	150.9	152	1.1	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	601	-0.1	13

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

* Calibrations marked Not TISI Accredited "in this Certificate have been included for completeness."

End of Report

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0081	Technology Promotion Association (Thailand-Japan)	23CH6	5 Jan 23	4 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0G0017	Technology Promotion Association (Thailand-Japan)	23TW9	16 Jan 23	15 Jan 24	-
3	Conductivity Meter	Conductivity	Horiba	LAQUA-EC210 HCOJ0016	Technology Promotion Association (Thailand-Japan)	23CH7	5 Jan 23	4 Jan 24	-



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PAITANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 23CH6

Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HA0D0081
ID No. : UAE.EFM.074/2564(EFM.pH.07/64)
Condition As-Received: Used Item
Received Date : 04 January 2023
Calibration Date : 05 January 2023
Reference : 2301-0060WSC-2
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 : Saithip Meangmai

Approved by :

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lemgagtrakul

Issue Date : 10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 23CH6

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211306	27 Oct 2023

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: HA0D0081	4.00	177.48	177.4	4.01	0.058	2.00
	7.00	0.00	0.1	6.98	0.058	2.00
	7.00	0.00	0.1	6.98	0.058	2.00
	10.00	-177.48	-177.4	10.01	0.058	2.00

เอกสารไม่



Cert.No.: 23CH6

Page.: 3 of 3

Calibration Results**Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4,7)(7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 990C0039	4.008	4.01	138.5	0.0085	2.05
	6.987	6.98	-32.1	0.011	2.00
	6.987	7.00	-33.1	0.011	2.00
	10.008	10.03	-205.2	0.0096	2.00

Function : Temperature Measurement**(*) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : 9652

- Serial No. : 990C0039

Dimension of probe;

- Length : 102 mm.

- Diameter : 15.5 mm.

- Immersion Depth : 85 mm.

Calibration Point ($^{\circ}\text{C}$)	Standard Temperature ($^{\circ}\text{C}$)	UUC* Reading ($^{\circ}\text{C}$)	Error ($^{\circ}\text{C}$)	Uncertainty of measurement (\pm $^{\circ}\text{C}$)	Coverage factor k
25.0	25.004	25.0	-0.004	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.003	35.0	-0.003	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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เอกสารไม่ควา



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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Cert.No.: 23TW9

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	Horiba
Model :	LAQUA-DO210
Serial No. :	HE0G0017
ID No. :	UAE.EFM.082/2564(EFM.DO.01/64)
Received Date :	13 January 2023
Test Date :	16 January 2023
Reference :	2301-0434WSC-1
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean

Approved by :

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date :

18 January 2023

เอกสารไม่ควบคุม

B 0305696



Cert.No.: 23TW9

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).

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

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : **Dissolved Oxygen Meter Adjustment With Air 100 %**

Dissolved Oxygen Probe No.: 9K0E0163

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.14	8.15	0.012

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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a 1143664



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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23LM9

Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : Horiba

Model : LAQUA-DO210

Serial No. : HE0G0017

ID No. : UAE.EFM.082/2564(EFM.DO.01/64)

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

Location : TPA Onsite Calibration Laboratory

Received Order : 13 January 2023

Calibrated Date : 17 January 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Malee Butkruea

Approved by :

Approved Signature

() Pornthippa Tameyakul

(✓) Suwit Imjai

Issue Date : 19 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0050104



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2301-0434WSC-2

Cert. No.: 23LM9

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:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1523	2188080	2211285	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.: 9K0E0163

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
25.0	100	25.004	25.0	-0.004	0.16	2.00
30.0	100	29.996	30.0	0.004	0.16	2.00
35.0	100	34.995	35.0	0.005	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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เอกสารไม่คืน

a 1143785



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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Cert.No.: 23CH7

Page.: 1 of 3

Certificate of Calibration

Equipment : Conductivity Meter
Manufacturer : Horiba
Model : LAQUA-EC210
Serial No. : HC0J0016
ID No. : UAE.EFM.076/2564(EFM.SCT.02/64)
Condition As-Received: Used Item
Received Date : 04 January 2023
Calibration Date : 05 January 2023
Reference : 2301-0059WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In -house method :
- CP-CH6 by direct measurement
with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer
Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

(/) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagtrakul

Issue Date : 10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 23CH7

Page.: 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	221484	17 Apr 2023
2) Ref. Std. Thermometer	4982054	110RC044	2211306	27 Oct 2023

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

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

2. Certified Reference Materials :-

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

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
1413.0 μ S/cm	CPA Chem	823328	20 June 2023
12.880 mS/cm	CPA Chem	823329	20 June 2023

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

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413.0 μ S/cm

Conductivity Electrode Serial No.: 9B0K0160

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
1413.0 μ S/cm	1375 μ S/cm	1413 μ S/cm	9.2 μ S/cm	2.00
12.880 mS/cm	12.43 mS/cm	12.70 mS/cm	0.086 mS/cm	2.00

Remark - UUC* = Unit Under Calibration

เอกสารไม่คว



Cert.No.: 23CH7

Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9383
- Serial No. : 9B0K0160

Dimension of probe;

- Length : 104 mm.
- Diameter : 16 mm.
- Immersion Depth : 90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor <i>k</i>
25.0	25.000	25.0	0.000	0.13	2.00
30.0	29.999	30.1	0.101	0.13	2.00
35.0	34.999	35.1	0.101	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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เอกสารไม่ควม